
Resident Skeptic – SCIENCE
by
James R. Cowles

Resident Skeptic – SCIENCE

James R. Cowles

Artem Podrez from Pexels.com … Karolina Grabowska

Science

Chapter 1 – Silicon, Sentience, and Software

Every so often, I read something – a newspaper story, a journal article, an interview, a campaign speech … whatever – that elicits from me the following reaction: *Whiskey-Tango-Foxtrot? Ain't we been here before?* And that reaction is often followed by a supplementary reaction: *Whiskey-Tango-Foxtrot? Ain't we still here?* ("It's *déjà vu* all over again!" – Yogi Berra) The latest example of this species of *déjà vu* is an article about the potential of artificial intelligence (AI) to eventually evolve into a kind of silicon god with the capability of directing all human affairs, planet-wide. The claim is that this will happen, perhaps midway through the 21st century. The article then goes on to speculate on what choices would have to be made, should such an achievement be realized, and the problems that would be posed by such a machine intelligence. (Think of this as a real-world realization of the recent television series *Person of Interest*. Or perhaps more apropos would be to think of a real-life version of SkyNet from the *Terminator* movies.) What I find so drool-inducing, is that we – meaning the human race – have *already* done this. In fact, we have *already* done it, not just once, but several times over several millennia. We *already* know what choices have to be made. We *already* know the potential hazards. The *Venturebeat* author is no doubt awesomely competent at assessing the technical complexities of artificial intelligence, neural nets, heuristic systems, etc., etc. – but has evidently never so much as *touched* a book of world history. Certainly least of all European history.

o Creating gods … been there, done that, bought the pure-white t-shirt and tinfoil halo

It is quite possible to argue that human beings create gods out of whole cloth in essentially the same way they create sculpture, paintings, literature, ghost-pepper dipping sauce for chicken wings (... I'm still in recovery ...), "twerking" (izzat still a "thing"? …), and Sarah Huckabee Sanders' *haute couture* collection. This was apparently the position of Voltaire, who once waggishly observed that if triangles conceived of gods, the gods of triangles would have three sides. People undergoing near-death experiences usually have visions of the gods and holy people from their religion's hagiography. I know of no instance where a dying Christian envisioned, say, Sri Ramakrishna. I know several anecdotes about the death visions of various people prominent in the hyper-fundamentalist denomination of my youth, but have never heard tell of anyone in that company having a vision of anyone dancing or drinking alcohol. (Going to KKK meetings, maybe, but never doing any really Big Nasty!) Does this mean that people see what they expect to see, and that they create gods from the ground up, with no admixture of reality, that gods are entirely artificial, ontologically? Maybe, but not certainly. There may well be a Reality behind those particular appearances. Maybe God, understanding that people are dying, graciously vouchsafes to them religious visions comfortably congruent with the expectations of the dying person's religious tradition. Who knows for sure?

But two things we do know for sure are that, regardless of the gods' ontological character, (a) the attributes and actions of those gods are certainly modeled according to the history and culture of their worshippers, so that (b) those attributes and actions serve to validate the values, morality, and actions of the worshippers' culture. Or at least the way the gods' worshippers *wanted* their culture to be. The god(s) are basically the worshippers' culture writ large. So … e.g., did YHVH actually command the Israelites to slaughter the Amalekites, root and branch? Probably not, but Israel was a tiny nation in a

Levant of vast empires, and so, as a defense mechanism, styled itself as a martial culture possessed of a degree of military prowess that enabled such a tiny nation to punch above its weight. And the archaic Israelites modeled the character of YHVH accordingly, as a god of war (Ex. 15:2-4).

And even that is not the earliest example of nations depicting – creating? – their gods. We could consider the Mesopotamian civilizations that predated Israel. But the point would still be the same: contra *Venturebeat, we humans have been creating and / or modifying gods for literally thousands of years*. AI technology merely automates a process that was archaic when the cornerstone of the first Pyramid was laid. Now we can create gods at near light-speed.

o Creating texts that contain the teaching of the AI, the AI's rules of conduct, and interpretive / hermeneutical principles

The *Venturebeat* article cites an example of how the presumptive AI god could write its own equivalent of the Bible, perhaps variations on the theme of an existing sacred text like the Bible, but with strategic forensic variations.

If you type in multiple verses from the Christian Bible, you can have the AI write a new verse that seems eerily similar. Here's one an AI wrote: "And let thy companies deliver thee, but will with mine own arm save them: even unto this land from, the kingdom of heaven".

If this heuristic example seems possessed of ... shall we say? ... somewhat less than lapidary clarity, then whoever wrote the underlying AI program has already mastered the dubious art of making an AI that can write prose as slipperily ambiguous as traditional scriptural passages from traditional religious texts ... *something religious authors have been doing for -- again! -- thousands of years*. (Of course, to a large extent, this is excusable, given that religious writers are very often dealing with subjects that do not lend themselves to quantitative or lexical precision.) *There is very little, if anything, that humans can learn from AIs about writing texts whose meanings are vague enough to motivate humans to kill and maim one another* over who has the "correct" interpretation. It will be multiple millennia before AIs can hold humans a candle in this regard.

Furthermore, programming an AI to write a text of interpretive principles solves nothing. Again, humans have been doing that, time out of mind -- and always failing. Why? Because how-to-interpret texts are just that: texts. *I.e., texts that themselves are subject to a plethora of interpretations*. At that point, the only way to avoid an infinite regress of interpretations is to do what the Catholic Church did in the Middle Ages: at some point, turn from reasoned exegetical argumentation to naked force, and send in the soldiers with bonfires beneath stakes, to which heretics were attached. All of which raises a macabre possibility: once the AI has written its sacred text, would the next logical step be for the AI to launch an AI Inquisition to enforce the AI's official interpretation of the AI's normative text? *Again ... we have already done that!* So -- one more time -- the *Venturebeat* author is 'way behind the historical curve.

o The real spanner in the works: Fyodor Dostoyevsky's "underground man" and existentialist theoreticians of the Absurd generally

But theological issues aside, perhaps the paramount issue to be addressed is the exact-same issue that -- again, for multiple thousands of years -- has pertained to human relationships with traditional, non-

AI gods: how to maintain human freedom in the face of Divine sovereignty. And that issue remains unchanged, even if the Sovereign's intentions toward human beings are benevolent. (Which need not be true: see, e.g., David Blumenthal's *Facing the Abusing God* ... but that is another rant for another time.) *How would we go about preserving human freedom, even in the face of the* benevolence *of God?*

The answer, of course, is that not everyone would want such protection, given -- by hypothesis -- that an AI god would always be benevolent. We can assume benevolent intentions on the part of an AI god, but such intentions are purely suppositional on our part, and need not be true. *Venturebeat's* point is well taken: *... if an AI god is in total control, you have to wonder what it might do. The "bible" might contain a prescription for how to serve the AI god. We might not even know that the AI god we are serving is primarily trying to wipe us off the face of the planet.* (Cue the video clip about SkyNet from *Terminator* here. Also recall the *Twilight Zone* episode where the alien visitors brought with them a book entitled *To Serve Man* ... which, upon translation, turned out to be a **cookbook**.) But for now, let's stipulate benevolence on the part of the AI god. Existentialist philosophers / authors like Camus and Dostoyevsky counsel rebellion, even rebellion against unrelenting *benevolence*, for the sake of preserving human moral autonomy. The former counseled rebellion in the face of the Absurd, to the point of constructing our own purpose for existing. The latter advised preserving the freedom to act against one's own pragmatic self-interest by recognizing the Underground Man's primal freedom even to harm oneself:

I am a sick man. ... I am a spiteful man. I am an unattractive man. I believe my liver is diseased. I don't consult a doctor for it. ... But still, if I don't consult a doctor, it is from spite. My liver is bad, well -- let it get worse!

Actually, the Underground Man's advice is not so much advice as a statement of what actually is. It is not nearly so much a matter of telling humans what they *should* do -- rebel against their own self-interests -- as it is a matter of describing what humans *will in fact* do, if the alternative is to submit to even benevolent bondage: they will rebel.

That, I think, would constitute the fatal fly in the ointment of any AI god. And -- again -- this is hardly the first time this issue has been dealt with. According to orthodox Christian moral theology, sin did not originate with artificial intelligence technology. If anything -- this is my heterodox / revisionist gloss on Christian teaching -- sin originated with God's insistence that human beings should be *constrained* to act in a manner consistent with their own good: the Prescription caused the Disease. Compulsory self-interest turns even the Garden of Eden into Hell. Again, if *Venturebeat* is just now discovering this tragic truth, it is because *Venturebeat* has neglected the study of history. To say nothing of philosophy.

The above is not to prematurely judge whether AI technology will eventually develop to the point where an AI god is a practical reality. For all I know, it might actually happen. I am simply at pains to point out that, in essence, the entire subject has nothing whatsoever to do with artificial intelligence, neural nets, heuristic systems, etc. Rather, the whole issue pertains to the perennial issue of the relationship of human freedom to the Divine, which has been true since the abacus was invented.

Even an AI Eden would require an AI serpent.

Chapter 2 –Exploring Life in the "Big Empty"

I have written before about the likelihood of intelligent life in our Galaxy, and how the existence or non-existence of life in the Milky Way relates to human religious sensibilities. Now I want to take a more "global" perspective and approach that same question, not from the relatively parochial standpoint of intelligent life "merely" in our Galaxy, but from the standpoint of intelligent life in the entire Universe. But the questions I pose here are essentially the same in all respects as the questions I posed in the original "Skeptic's Collection" column. Given some realistic-seeming, in fact, most likely optimistic, assumptions about the probability that intelligent life will evolve on any given planet orbiting any given star, how widely separated – across the entire Universe – must intelligent races be, given our current understanding of physical law, and therefore how likely or unlikely is such life (a) to exist and (b) to be capable of contacting us? Fair warning: the answers are not encouraging, especially for *Star Trek* aficionados … like your faithful Resident Skeptic.

I should also say that I am skating over some issues that are still far from being settled by the current state of the art, and adopting a consciously naïve stance for want of better assumptions and also to simplify the math. For example, I assume that the topology of spacetime is basically that of a 4-dimensional hypersphere, whose metric – the formula for measuring distance – is the familiar Pythagorean formula $\sqrt{ (x_1^2 + x_2^2 + x_3^2 + x_4^2)}$, assuming a 4-dimensional spacetime. This is an important question, but it would seem that the exact topology of spacetime becomes less and less important as the effects of "dark energy" accumulate with time: eventually everything just … *evaporates*. I also freely admit that the proportion of planets with intelligent life – again, Universe-wide – are sheer seat-of-the-pants SWAGs (Scientific Wild-Ass Guesses). But, if anything, the estimates I use err on the side of optimism: in the entire history of SETI, there has been one and only one candidate event – the so-called "Wow Signal" – that perhaps ... maybe ... might ... just arguably be a manifestation of extraterrestrial intelligence. (Problem is, the "Wow Signal" was detected once but never repeated.) Finally, I assume that both galaxies and their constituent stars are more or less evenly distributed across the entire expanse of the Universe -- which is demonstrably, empirically false, but again, let's keep it simple. In any case, almost certainly, the Universe is not a Great Cosmic Tokyo Ginza District or Mall of America teeming with sentience, as depicted on all the *Star Trek* and *Star Wars* franchises – which leads us back to Enrico Fermi's nagging question "Where Is Everybody?" So the particular numbers I derive should only be taken seriously as, at best, order-of-magnitude estimates.

Moving right along – as one piece of Ex-Lax said to the other – we envision the Universe, at least the part of the Universe visible to us, and whose light has had time to catch up with us since the Big Bang, as a sphere 13.8×10^9 light-years (hereafter, ly) in *diameter*, i.e., 6.9×10^9 ly in *radius*. (Why 13.8×10^9? Because the best estimate we have for the age of the Universe, i.e., elapsed time since the Big Bang, is 13.8 billion years. So the light of the Big Bang has traveled 13.8 billion ly since then: 13.8 billion ly, i.e., 13.8×10^9 ly.) Remember the formula for the volume of a sphere: $4/3 \times \pi \times r^3$, where r is the radius of the sphere. Plugging in the above numbers to this formula, we derive: $4/3 \times \pi \times (6.9 \times 10^9)^3$, which reduces, in scientific notation, to 1.38×10^{30} ly^3. I.e., the total volume, in cubic ly, of the Universe is 1.38×10^{30} ly^3. Occupying that immense volume are galaxies, which are themselves composed of stars. How many individual stars altogether? It varies, of course, but the best estimate we have of the number of galaxies is that there are around one hundred billion galaxies, and that within each galaxy there are, typically, around 100 billion stars. So in total there are $10^{11} \times 10^{11}$ individual stars in the visible Universe, i.e., 10^{22} stars. Now, assuming that stars are distributed evenly throughout

the available 1.38×10^{30} ly^3 of space – again, which we know is **not** the case … keep reading and don't nit-pick – that means that each individual star occupies a volume of $1.38 \times 10^{30} / 10^{22} = 1.38 \times 10^8$ ly^3 per individual star, i.e., 1.38 hundred million cubic light-years per star, approximately the volume of Bill and Melinda Gates's **garage**.

Now … next question: what would the *radius* of a sphere be which encloses a volume of 1.38×10^8 ly^3? Turns out that is a softball question! Just put that exponential-notation expression on the **left** side of the above sphere-volume formula, then solve for r by taking the cube root! I.e.,

$1.38 \times 10^8 = 4/3\ \pi\ r^3$

So $r^3 = 3\ /4\pi \times 1.38 \times 10^8\ ly^3$ = So taking cube roots on both sides to end up with a linear distance, we end up with each star being at the center of a sphere of 320.3 light-years radius. We can call this value the "characteristic radius", and reference it with the symbol r_C. Its neighbor-star is likewise, on average, centered on a sphere with an r_C of 320.3 light-years. So the average separation between stars is 320.3 x 2 = 640.6 light-years. *Remember: this is the average across the entire Universe, not just our Milky Way Galaxy, and for all stars in the Universe, irrespective of chemical composition, mass, age, etc.*

But what about stars that have a retinue of planets, with at least one planet hosting intelligent life? No one knows. But let's suppose, strictly as a seat-of-the-pants SWAG, that one-billionth of one percent of the stars, *across the entire Universe*, have at least one planet with intelligent life. Now, given the foregoing, it is possible to ask the following highly relevant question: *What is the average value of r_C – the characteristic radius – of all stars hosting intelligent life?*

It turns out that it is possible, even easy, to derive a formula for the r_C value, as a function of the number of planets with intelligent life (or any other trait). Trust me: that formula, a mere generalization of the above steps, is

$r_C = [\ 3\ / 4\pi \times (1.38 \times 10^{33} / S)\ ]^{1/3}$, where S is the estimate of the number of stars in the entire Universe with the given characteristic (e.g., mass, chemistry, host of a planet with intelligent life, etc.)

Now, if there are, per the earlier estimate, 10^{22} stars in the Universe, and if one-billionth of one percent have planets with intelligent life, then the number of planets with intelligent life – again, across the Universe as a whole – is $10^{-9} \times 10^{-2} \times 10^{22} = 10^{11}$ stars. Per the above characteristic-radius formula, this yields a characteristic radius for stars hosting intelligent life of

$r_C = [\ 3\ / 4\pi \times (1.38 \times 10^{33} / 10^{11})\ ]^{1/3} = (\ 3.3 \times 10^{21}\ )^{1/3} = 1.5 \times 10^7$ ly $= 15 \times 10^6$ ly

In other words, and on the scale of the entire Universe, if one-billionth of one percent of stars host planets with intelligent life, those stars would be separated by an average of 30 million ($2 \times 15 \times 10^6$) ly. This distance is about 300 times the diameter of the Milky Way Galaxy.

When one pauses to consider the number of sheerly random, fortuitous things that had to go right to evolve intelligence, the more one thinks about it, the more optimistic one-*billionth* of one percent seems. So let's say only one-*trillionth* of one percent is nearer the proverbial ballpark. In that case,

$r_C = [\ 3\ / 4\pi \times (1.38 \times 10^{33} / 10^8)\ ]^{1/3} = (\ 3.3 \times 10^{25}\ )^{1/3} = (\ 33\ )^{1/3} \times 10^8$ ly $= 3.2 \times 10^8$ ly, which gives an average separation of $2 \times 3.2 \times 10^8$ ly, i.e., 6.4 *hundred million* light-years. "Phoning home" across this distance would probably eat even ET's lunch.

We can play these numbers games until Trump says something really nice about Hillary. But regardless of how the numbers fall out for any given iteration, the point will remain: it's really lonely 'way out there in the Big Empty.

Chapter 3 – Randomness and Chaos, an Important Difference

I have been reading for at least the second time, maybe the third, Richard Dawkins' magisterial book about evolution, The *Greatest Show on Earth* (hereafter *Show*). Like the other one or two times I have read Dawkins' book, it was an exhilarating ride. Until I read the appendix, which pertains to how the theory of evolution is, to this day, received in the US and non-Scandinavian Europe. That appendix to *Show* is a real downer. (I reacted similarly when I first read the book.) It turns out that, even in the supposedly enlightened First World – again, the Scandinavian countries are the blessed exception -- around 80% of respondents accept a theory of evolution that accommodates some kind of supernatural explanation, e.g., God did it all according to a literal reading of Genesis, chapter 1; or evolution was a mixture of natural law leavened with Divine intervention. (Dawkins is quoting statistics from the Pew Foundation's survey of religious beliefs / attitudes.) Only about 14% of respondents in the US, and a comparable percentage worldwide, outside of Scandinavia, subscribe to Dawkins' (and my) position of evolution as a purely naturalistic phenomenon.

The reasons for this incorrigible skepticism are dauntingly complex. But one conventional response justifying rejection of evolution that crops up time and again, both in my personal experience and in the literature, is that evolution purely through mutation and natural selection with no admixture of Divine teleology is, to use a recurring phrase, just too "random" to account for the awesome variety and complexity of life we find on earth. People who believe evolution is a random process see evolution as analogous to putting many handfuls of very sticky marbles, representing chemical elements and organic compounds, into an empty coffee can, snapping shut the lid on the can, and then shaking the can vigorously for perhaps 4 billion years. (The time issue is another sticking point: many of the more conservative respondents were "young earth" creationists or intelligent-design advocates. In that sense, and assuming such constricted time-frame, Divine creation or intelligent design would probably be a compelling alternative: 6,000 or 10,000 years would not allow nearly enough time for speciation by naturalistic mechanisms. Some Deity probably would indeed have to stacking the deck in favor of the appearance of intelligent life. But this is a rant for another time.) The problem with this view is that it equates *random* processes with *chaotic* processes (keep reading). This is one of those subtleties, one of those nuances, that most conservatives usually skate over, but that is the key to the entire question.

In fairness, we should concede up front that randomness does play an important role in evolution, and that it does so in two ways. First of all, yes, the *origin* of life is most likely accounted for by random occurrences. No one knows how life originated. There are lots of theories, but no one knows. E.g., there is the so-called "clay life hypothesis" of Graham Cairns-Smith that many find compelling. I am not enough of a paleontologist or evolutionary biologist to even venture an opinion on that. "Clay life" is one theory among many, and like all such theories of origins, it invokes randomness as a primary construct. Secondly, once life is "up and running," even at the sub-cellular level, randomness enters in from influences of the physical environment. Long-chain molecules of "proto-DNA" are bombarded by, e.g., cosmic rays, left-over radiation from the decay of radioactive material in the earth's deep interior, changes in ocean and air chemistry, etc., etc. (Again, this is after life is "up and running.") The material of life is altered at that deep level – hence mutations – and most of these mutations are maladaptive (i.e., diminishing the chances for survival) and so are selected out as evolution proceeds. (Considerably more than 95% of species have been forced to drop out of the march of evolution by such environmental pressures.) Note that, e.g., *which particular* base pair will be disrupted on *which particular* DNA molecule by, e.g., *which particular* cosmic ray s a purely random event, impossible

to predict, even in principle. So randomness does play an important role in what might be termed "micro-evolution". (Also in "macro-evolution," e.g., which asteroid will collide with earth at what time, when the "Siberian traps" will erupt when during the end-Permian era 250 million years ago, etc. But again, that is another rant for another time.) But conservative critics of evolution, while they have a valid point about the role of chance in evolution, then overreach by attempting to use randomness to discredit evolution *as a whole*, evolution *tout court*, evolution *as such*.

I say this is an "overreach" by conservatives because of the implicit assumption that any phenomenon that cannot be exhaustively characterized by a set of (perhaps quite complex) predictive equations is therefore random. I.e., they assume that there is nothing intermediate between true randomness, which is inherently unpredictable, and rigorous, mechanistic phenomena that are exhaustively predictable. Ever since the 1970s, perhaps before, the fallacy in this reasoning has been abundant. Some classes of phenomena are neither rigorously predictable nor purely random. These intermediate processes are usually called chaotic. (If you want to read an excellent non-technical book about chaos, you can do no better than James Gleick's *Chaos: The Making of a New Science*.) The difference between chaos and randomness is subtle but critically important. Chaotic phenomena are quite lawful, **i.e., anything but random**, but notwithstanding are not exhaustively predictable. Consider the following example of a chaotic phenomenon.

Think of the game of chess. Now, as a chess player, I am a wonderful garage mechanic. But even I know enough about the game of chess to realize that the number of possible chess games two people can play is, for all practical purposes, infinite. I.e., not *literally* infinite, but so large that even writing down, in fixed point notation, the number of possible chess games that could be played would be so large that *just writing down the number of possible chess games, move by move, in digits would probably require that all the trees that have ever lived on earth be converted to paper*, and probably all the alien quasi-trees that may exist on all earth-like planets in the Universe. Even using exponential notation like $N \times 10^M$ might not suffice, because there would be so many digits in the exponent on the 10. However, please note that **chess is a zero-sum game**, i.e., if we rule out ties, in any game of chess, **one player always wins and the other player always loses**. Since chess is a zero-sum game with definite, unambiguous winners and losers, one of the fundamental theorems of game theory says that, for any zero-sum game, **there is always an optimal (or min-max) strategy**, i.e., a strategy that will maximize – not guarantee, but maximize – the chances that you will win the game.

Now, note that the rules of chess are quite simple. I could write down the rules of chess – which chess pieces can move where, and how they can move – on a single sheet of 8.5 x 11 typing paper. Strategies in chess is something else. Entire encyclopedias of volumes have been written over the years by grand masters of chess. *But all those volumes on chess strategies, all the volumes that have ever been written or that ever will be written, all the strategies, all the gambits, are predicated on that one little 8.5 x 11 sheet of paper.* Chess is anything but lawless, anything but random. But predicting how any given game of chess will play out, whether the players are novices or grand masters, is ultimately impossible, and even attempting to do so taxes the intelligence and memory of even the grandest of the grand masters.

Furthermore, understand that the so-called "min-max theorem" -- for every zero-sum game, there is an optimal strategy -- is only *an **existence** theorem*, i.e., it asserts that an optimal strategy **exists**, but gives no algorithm for determining what that strategy is. With some risibly simplistic games, formulating the optimal strategy is laughably simple. (Tic-tac-toe is also a zero-sum game. Exercise for reader:

what is the optimal strategy for tic-tac-toe?) But as the complexity of a game increases, i.e., the number of moves, the number of entities (e.g., chess pieces) *than can **be** moved*, etc., etc., the difficulty of discovering the optimal strategy increases at a highly, *highly*, ***highly*** exponential rate. Network all the supercomputers that have ever been built, including quantum computers, and the resulting network would probably still not suffice to discover the optimal strategy for chess within the lifetime of the Universe. Furthermore, even if the optimal strategy were discovered sometime in, say, the 3525344362323332452445423rd century, *understanding and writing down this strategy* would be comparable in difficulty to discovering the strategy in the first place.

Yeah ... this is some real hard stuff! But the point is quite simple ... to wit ...

Despite being elegantly and pristinely rule-based, chess is inherently unpredictable. Or rather, it would be more strictly accurate to say that predictions about how a given game of chess will develop over time *are reliable only provisionally* – and that reliability becomes progressively less trustworthy as the game unfolds with time. It is like the weather: you can predict the weather a day or 2 in advance, but a week or 2 ... ? And a **month** or 2? Fug-gid-aboud-it! (Game theoreticians say that predictions about the progress of a chess match **diverge as a function of time**. Like weather forecasts.) Chess is chaotic. But chess is highly non-random. **Chess is orderly but chaotic**.

Same with evolution through natural selection. Once the random changes from cosmic radiation, asteroid strikes, volcanic eruptions, etc., have been factored in – and these are happening all the time – **evolution remains, like chess, a chaotic process**. But it is not random. It simply means that – again, like chess – everything that has happened and that is still happening gives rise to so stupendous a multitude of possibilities that prediction is a fool's errand, certainly prediction in the long term. So is evolution also bound by rules, like chess? Unequivocally yes. In the case of evolution, the equivalent of my 8.5 x 11 sheet of paper is the entire suite of natural laws of physics and chemistry. These would probably not fit on an 8.5 x 11 sheet of paper, but they are immeasurably more compact than the great, majestic "tree of life" evolution, in adherence to these laws, has produced in around 4.5 billion years. Several years ago, I was reading the late Stephen Jay Gould's remarkable book about the Burgess Shale deposits in Canada, and encountered a striking statement. I do not have the book at hand to quote *verbatim*, but Prof. Gould asserted that, if we were to rewind the process of evolution to the very beginning sometime in the Pre-Cambrian, then set the "tape" running again, it would not only be possible, but highly likely that re-running the "evolution tape" would result in an altogether different suite of organisms on earth, e.g., maybe an earth dominated by intelligent dinosaurs or by intelligent dolphins … or by no intelligent life at all. (The dinosaur and dolphin possibilities are my speculations, not those of Prof. Gould. Appropriately enough, Prof. Gould entitled his book *Wonderful Life*.

That, in general, is the problem with conservative creationist / intelligent design ideologies: they are so desperate to fit the breathtaking sweep of the Universe and the development of life therein into the Procrustean bed of their narrow, religiously motivated categories that they end up impoverishing the very Creation they claim to admire.

Chapter 4 – Rounded with a Sleep: The Two Climates of Climate Change

Our revels now are ended.

These our actors,
As I foretold you, were all spirits and
Are melted into air, into thin air:
And, like the baseless fabric of this vision,
The cloud-capp'd towers, the gorgeous palaces,
The solemn temples, the great globe itself,
Yea, all which it inherit, shall dissolve
And, like this insubstantial pageant faded,
Leave not a rack behind. We are such stuff
As dreams are made on, and our little life
Is rounded with a sleep.

William Shakespeare
From *The Tempest*, Act 4 Scene 1

In my more optimistic and mellow moments -- even I **do** have those, you know! -- I sometimes reflect that, really, there are **two** climates at issue in the climate change / global warming debate: the *physical* climate and the *rhetorical* climate that always accompanies the discussion thereof. In the former, it is imperative that human beings **mitigate**, hopefully prevent, change. In the latter, it is equally imperative that change be **encouraged** by our refusing to succumb -- as I confess I have from time to time -- to the temptation to engage in ideological bear-baiting of people whose political and religious conservatism renders them irrationally skeptical of climate change. As the earth *warms*, it is critically important to recognize that, because we inhabit a shared-in-common planet, the rhetoric must be kept *cool*.

Over the years, I have become convinced **initially against my will** that anthropogenic -- human-caused -- climate change is a significant threat. But I find that even those who accept the reality of anthropogenic climate change sometimes err on the side of optimism because our "default" habit of thinking and speaking in human-lifetime time-scales, the time-scales humans were evolved to deal with, powerfully influences the way we talk about climate change and how we perceive the associated transformations. How we habitually think and talk defines what we see: language determines perceptions. So ... please allow me to darken up the room!

Speaking of time, let's begin by considering some actual time-scales. How long has subspecies *homo sapiens sapiens* been around? At present, the only extant subspecies of homo **sapiens** is homo sapiens ***sapiens*** -- two *sapiens* -- i.e., us. The literature indicates that the best estimate of when this latest model of human being evolved -- with 'way cool original equipment / factory-installed options like a large brain, upright carriage, opposable thumbs, a voicebox supple enough to accommodate verbal communication, etc., etc. -- was 150,000 years ago. But to simplify subsequent calculations, let's use the roundest number possible that still keeps us within the taxonomic ballpark, and say (optimistically) 200,000 years ago.

Now consider this 200-**thousand**-year time-scale in comparison to the time-scale of the impact of the Chixulub meteor or comet in today's Gulf of Mexico that occurred around 65 **million** years ago (the so-called Cretaceous-Tertiary, or "KT," event). This comparison means that humans -- i.e., homo sapiens **sapiens**, *us* -- have been around for only $2 \times 10^5 / 6.5 \times 10^7$ of that total elapsed time of 65 million years. The point? Only that, because the KT impact was the **last** mass-extinction event (MXE), the human species, since its appearance on the scene roughly 200,000 years ago, ***has never experienced a literal mass extinction event*** (which I define, as the literature tends to, as a catastrophe eventuating in the loss of almost all life-forms on the planet, though the percentage of mortality varies in the literature across MXEs). We have no "existential" experience of what an *actual* MXE "looks like" -- nowhere near -- only mathematical models.

This begs an important question: **even if we were in the middle of an MXE, would we even know it?**

Maybe, maybe not. It depends on the exact **cause** of the MXE. *In the case of an MXE caused by something like the Chixulub meteor strike, most likely,* ***yes***. A giant fireball screaming through the atmosphere, so bright it probably would blind anyone looking directly at it, hitting the planet, and causing fire to rain down planet-wide -- to say nothing of temperature changes, alterations in the chemistry of the atmosphere and oceans, tsunamis *hundreds* of feet high if it landed in the ocean (as the Chixulub meteor / comet did in the Gulf of Mexico), etc. -- would be difficult to miss, no matter how engrossed one was in *Game of Thrones* on any given Sunday evening. The long term consequences like changes in ocean and atmospheric chemistry probably would have to work themselves out over longer spans of time, but the *prompt* consequences would only require perhaps a generation or so, maybe even less. Even humans living on the far side of the planet -- ***if there had been such, which there weren't*** -- from the impact point would probably die in a matter of days or weeks. (For one thing, fragments of the comet raining down probably started a planet-wide forest fire that would suffice to melt, e.g., methane and CO2 clathrates in coastal areas, resulting in an enormous spike in greenhouse-gas emission and jump-starting a global warming cycle.) But other causes for an MXE, while no less lethal -- possibly even more so -- might well be more subtle, gradual, more incremental, and of longer duration -- and therefore more difficult to detect, especially over human-lifetime-scale time-spans by those living at the time. Have there been such?

Unequivocally, yes, at least one. I'm thinking in particular of the so-called "Late Permian (or end-Permian) Extinction" -- a.k.a. The Great Dying -- of 250 million years ago. During this period, all the Continents were still fused together into a mega-Continent usually called "Pangaea" -- archaic Greek for "all the Earth" -- and the end- / late-Permian MXE seems to have been triggered by stupendous volcanic activity in present-day Siberia (the "Siberian traps"), on a scale not seen since the initial formation of the planet, that "primed" the climate-catastrophe pump by ejecting massive quantities of greenhouse (and other) gases into the atmosphere. Once begun, the same vicious cycle ensued as in the KT event: the mean temperature of the planet rose initially, which resulted in the melting of methane and CO2 previously locked in ice, which perpetuated the process and caused it to become self-sustaining.

Now let's do the same calculation for the end-Permian MXE as for the Chicxulub event, just to put matters into perspective. Relative to the elapsed time for the end-Permian MXE, thehuman race has been around for $2 \times 10^5 / 2.5 \times 10^8$ of the 250 million years: **about 8/100 0f 1 percent** of that time. So if we compress the 250 million years since the end-Permian MXE to a 365-day year, where the end-

Permian MXE began on 1 January, it turns out that *homo sapiens sapiens* has been around for **about 7 hours** -- say from 5 in the afternoon til midnight on 31 December. Look at it still another way: from the time the volcanism on the plains of Siberia started until the Great Dying was finally consummated is usually estimated to be on the order of about 100,000 years, a very brief interval of time, geologically speaking. (I have read estimates in the literature of 40,000 to 50,000 years: 100,000 years, while arguable and credible, is in the high range.) However, if we use the real number of 150,000 years for the tenure of *homo sapiens sapiens* on planet Earth, ***the 100,000 years of the Great Dying comprises about 2/3 of the time required to establish our species***. It took less time for the end-Permian MXE to destroy 90% of **all** life than for evolution through natural selection to establish human beings as the apex species of earth. (And even less time than that, if we use the "mid-range" 40,000-50,000-year estimates.) We have little cause to indulge any taste for species jingoism: *homo sapiens sapiens* been around only a bit longer than it took to destroy virtually **all** life on earth 250 million years ago. Not to put too fine a point on it, but ... in terms of geological time-scales, human beings are an afterthought, an asterisked footnote on the final page of the great, continuously edited Book of Life. Lord of the Earth, indeed!

Problem is, especially if you are talking to a conservative individual or audience -- especially in cases where their conservatism extends to matters theological -- all the above is virtually guaranteed to make your audience *less* likely -- not more likely -- to take the issue of global warming / climate change seriously. No matter the degree of unanimity in the literature and among members of the scientific community -- the 97% number being bandied about is extensively backed up by climatological literature -- there is something about citing *actual science*, together with the relevant numbers, that makes one's pro-climate-change argument ***less*** credible, and that precisely among the people one is attempting to convince. I strongly suspect that this paradoxical-sounding effect is traceable to the fact that (a) conservatives are much more likely than liberals / progressives to be religiously observant, and to be much more observant *within theologically conservative traditions*, which has the effect of (b) rendering the time-scales of the foregoing MXEs much more problematical in the minds of conservatives than in the minds of liberals / progressives.

If I am religiously conservative, I am much more likely to believe in a young -- or at least much young**er** -- earth than someone to the left of me, ideologically. Consequently, when the latter cites climate-change precedents that rely on time-scales measured in several-dozen-million (as with the KT event) years or several-hundred-million years (as with the end-Permian event), a conservative with a religiously grounded chronology reacts with reflexive skepticism: the dinosaurs could not have been killed off 65 **million** years ago if the entire planet is only 6 **thousand** or 10 **thousand** years old. (The exquisite irony, of course, is that this argument is advanced by people who militantly insist that they believe in the Bible, whereas the 6-thousand-year number is found nowhere in the Bible, but was calculated by Anglican Bishop James Ussher, Archbishop of Armagh, in the 17th century. But pointing out this -- as it were -- "inconvenient truth" is guaranteed to end the conversation.) Add to that the conservative tendency to equate academic attainments with religious skepticism or even outright atheism -- which statistics actually tend to substantiate -- and an additional layer of skepticism is added. The issue is more a clash of ideologies than science: more a matter of climatolo*gists* than climatolo*gy*. At that point, the often thinly veiled disdain of secular progressives for religious people, especially conservative theists, kicks in, and the deal is sealed: dialogue degenerates into some cognate of Bill Maher's sneering reference to Christians as believers in "talking snakes" -- a stereotype that, if applied *mutatis mutandis* to, say, gay people and African Americans, would elicit outrage -- and the signal about climate change gets lost in the noise of *ad hominems* and ideological jingoism.

Bottom line: in enlisting public opinion in support of actions to mitigate ... dare we say even reverse? but, granted, baby steps first ... global warming, **what strategy is likely to have the best chance of avoiding the preemptively self-defeating effects of a premature appeal to scientific literature and scientific consensus**? This is not a question of intellectual integrity. Rather, it is a question of what works. It is a question of what works because of the brute fact that, at least in Western, European-derived, First World democracies, governments respond to people, and if the people *en masse* do not consider climate change a priority, then neither will their governments. Reversing climate change is inevitably going to cost money, great massifs of money, and if the heart of people is not in the issue, neither will the money be there (Matthew 6:21). Besides, even on the level of intellectual integrity, the prior questions are *"Whose intellect?" and "Whose integrity?"* I would venture two suggestions, one drawn from personal experience; the second just common sense:

(1) While thinking *globally in public*, speak and argue *locally in private*.

That means leaving the rigorously scientific "paleo" climatological substantiation for climate change in the background, at least initially. Omit references to 65 million or 250 million years ago, the 40 or 50 or 100 thousand years it took for the end-Permian event to extinguish 90% of all life on earth, the inferences to be drawn from the iridium layer laid down by the meteor / comet that marks the boundary between the Cretaceous and Tertiary epochs, etc., etc. Leave all that out. Yes, it's important. Yes, it's real. But if you are talking to and debating with people who are not conversant, even on the level of an interested and educated layperson, with the various esotericisms that support conclusions about climate change -- and certainly if you are talking to and debating with people with a pre-existing "hermeneutic of suspicion" vis a vis science -- bringing up data from remote geological epochs is virtually guaranteed to be counterproductive. Down-the-rabbit-hole paradoxical as it may sound, **the rigorous science detracts from the credibility of one's arguments**. But the paradox is not real, *only apparent*: you are doing politics now, not a research colloquium.

Instead, talk in terms that are local, both in terms of space and time. When my wife and I moved to Seattle from Boston 25 years ago, we were gratified to discover that, though very few houses had even window air conditioners, much less central air, there would only be a middle-single-digits-number of days in a typical Seattle summer when any kind of air conditioning would have been really nice. Most of the time, we could leave windows open on opposite sides of the house, and the prevailing breeze blowing between the two windows would be ample -- and there were only a few days during a typical summer when we needed to do that. But at about the 15- or 20-year mark, summers became so warm that we finally broke down, bit the financial bullet, and had central air installed. By that time, summers in Seattle had become warm enough that air conditioning was cost-effective. After roughly 20 years, my wife and I concluded that, yes, the climate was changing, becoming warmer, and these changes, even in our parochial neck of the woods, were gradually becoming perceptible. Keeping our house habitably cool requires no complex excursions into Christian, or any other, theology.

Which leads me to my second bit of advice:

(2) Under no circumstances whatsoever even come within photon-torpedo range of anything resembling, however remotely, a theological / religious / doctrinal perspective on climate change / global warming. Never. Absolutely never. Is any part of that counsel unclear?

The only context in which this rule may be relaxed somewhat is if one is speaking to or with a group of fairly liberal / progressive / left-of-center Christians who are already simpatico with the climate change issue. I have heard speakers on climate change / global warming address conservative – not necessarily fundamentalist – evangelical Christian groups who were foolhardy enough to frame their argument in terms of environmental stewardship, e.g., "We as Christians must address climate change because God has made us responsible for maintaining a healthy environment for all living things on the planet," etc., etc., etc. This invites the ensuing discussion to open out into a rehearsal of former Vice President Al Gore's – granted, excellent – video *An Inconvenient Truth* … and from thence into the imponderable mazes of the animus such an audience is virtually guaranteed to entertain against him and the Democratic Party. Or if not that, the discussion immediately *segues* into the scientific time-frames of climate change.

Instead of attempting to tap-dance in the middle of those partisan political mine fields, one would be better advised to … yes, by all means … discuss the precedents for climate change that are *well within the accepted chronology of a typical conservative-evangelical Christian audience.* Stay well away from time expressions that have to be expressed in floating-point scientific notation, e.g., 6.5×10^7, 2.5×10^8, 4×10^9, etc. **There is abundant short term data indicating the reality of global warming** on time intervals comparable to a human lifetime or a few human generations, and one interesting by-product of these so-called "dT" (variation in temperature, temperature-differential) studies is that **local cooling** is entirely consistent with the overall trend of **global warming**. And all of this is easily contained within the 6,000-to-10,000-year history of the planet demanded by conservative religious ideologies. So, e.g., Superstorm Sandy is entirely consistent, on a near-continental, short-term scale with global warming on a planet-wide, long-term scale. (Incidentally, this is a good reason to also use the term "climate change" in preference to "global warming": the former term carries no implicit bias as to the scale of the change in terms of space or time.) Finally, based on the data supporting such comparatively short-term studies of climate change, one can – while remaining strictly within the several-millennia range of conservative chronologies – reference model-based predictions of what is likely to happen to the earth's climate in the next, say, century or two. One need not reference time-frames measured in millennia or geological epochs to elicit concern, even alarm, about climate change.

Far too much discussion of climate change in progressive / left-of-center venues these days tends to begin with debates about science only to degenerate into ridicule festivals of others' (granted, atavistic) religious beliefs. Granted, this is great fun. *Mea culpa*: I've done my share. But this has two immediate effects: (1) it makes us on the left feel warm and fuzzy, because it makes fun of others' anti-scientific, flat-earth biases; but it does so at the cost of (2) in the long run making conservatives like Mike Pence and Ted Cruz – granted, lost causes to the climate-change issue – more credible to large swathes of the conservative population than people who believe in the urgency of the global-warming issue. I disagree with the Pences and the Cruzes and the other climate-change deniers as much as Prof. Richard Dawkins. But I disagree with Prof. Dawkins' reaction. He says, basically, "Ignore them."

The problem with that reaction may be stated in two words: **They Vote.**

Chapter 5 – Science Fiction Comics and the Frontiers of Science

Not quite 18 months ago, I published a column on “weird”, *X-Files*-ish phenomena, the kinds of events and (alleged) experiences that are regularly recorded in *Fate magazine*. My original intent in writing and publishing that column was, quite frankly, to break my addiction to Donald Trump, Trump-ism, Russia-gate, and what was, and often still is, my unhealthy incipient addiction to the raw sewage that has flooded the White House and the Executive Branch, by getting my mind onto a different track. But writing that column also had the unintended and unforeseen side-benefit of prompting some persistent reminiscences of the kinds of comic books I used to read just before and just after I entered puberty. During that time, in addition to *Fate*, I read three comics published by the American Comics Group (ACG): *Forbidden Worlds* (hereafter *FW*), *Adventures into the Unknown* (*AITU*), and *Unknown Worlds* (*UW*). I realize in retrospect that, just as the earlier column got me out of the rut of Trump and American para-fascism, the reading and remembrances of those four magazines got me out of what would have been the rut of unalloyed skepticism. Maybe the following will do the same for you. At the very least, maybe it will give us both a good laugh after having suffered through the passing of the fiscal kidney stone of the Republican tax "reform" bill, a.k.a. "No Multi-Billionaire Plutocrat Left Behind".

The writing in the three latter magazines was almost unrelieved *schlock*, and the art on the covers -- comprising buxom, scantily clad young women dressed in tight bodices and levitating hemlines, rather *risque* for that day -- was often worse. (*Fate* was the most blatant offender, though in a different way, as a glance at today's over-the-top-lurid *Fate* web site will attest.) But, at least as far as the writing is concerned, the operative word in the above is *almost*: " ... almost unrelieved *schlock*". Almost. But not always. Occasionally, i.e., often enough that I kept buying the "Big Three" ACG comics, the writing rose to the level of *The Twilight Zone*, *Alcoa Presents One Step Beyond*, *Science Fiction Theater* (which was appearing at about the same time), and *The Outer Limits*. That the writing attained even occasional brilliance is all the more remarkable when you reflect that all the stories -- *every last one* -- were written by one man, the managing editor of ACG, Richard E. Hughes, who wrote all the stories under a series of five pseudonyms: Lafcadio Lee, Zev Zimmer, Kurato Osaki (!), Shane O'Shea, and Pierre Alonzo, drawings of whose purely fictitious faces prefaced each story. To this day, I consider Richard E. Hughes to be a literary diamond in a cattle feed-lot. Consider ...

o Forbidden Worlds

Hughes wrote what I consider 3 classics in the "weird-comic" genre, the first of which is "The Train that Vanished" in a May-June (cannot recall the year) issue of *FW*. The story centered on a brilliant, *avant-garde* subway design engineer who, working on his own time, discovers a way to enable 2 subway trains to run on the same subway track at the same time. (Think of Albert Einstein working in the Swiss Patent Office.) As a proof-of-concept / "beta test," this genius engineer designs a black box and installs it on the track. When train 1 passes the black box, it is shifted to dimension A; when train 2 passes that black box, it is shifted to dimension B, and the 2 trains then alternate by trading dimensions, each time they pass the black box, so they never occupy the same track in the same dimension at the same time. Subway senior management discovers what he has done, and, perhaps because the engineer had not filled out the "goldenrod" copy of his time-sheet correctly in quadruplicate, fires him, whereup0n the engineer boards a subway train, waits for it to shift dimensions, and then leaps from the car into a community of dimension-B beings, who do value his creativity and genius.

When I first encountered this issue of *FW* and the subway story, I was coincidentally getting interested in the topology of what I later learned were called *non-orientable manifolds*, intuitively, surfaces like Mobius strips and Klein bottles in which concepts like "up-down", "in-out", "top-bottom", "inside-outside", etc., cannot be defined. (Hence the term "non-orientable".) Going into detail about the "weeds" of non-orientable surfaces would eat me alive. So suffice to say that, if a way could be found to alter the local topology of spacetime into a non-orientable manifold, then, with other, even more technical tweaks, what the subway engineer did with the subway trains would be possible. I am astounded that Richard E. Hughes understood such a recondite subject even well enough to write a -- rather brief! -- comic-book story around it.

o Adventures Into the Unknown

The second "Hughes classic" is "The Man Who Couldn't Sleep" in a November issue (again, I cannot recall the year) issue of *AITU*. Larry Keith -- I still remember the character's name after 50-plus years -- is a neurochemist who becomes fascinated with what human beings might achieve if they no longer needed to sleep ... and thereby waste roughly one-third of their lives unconscious. So he formulates a drug which, he thinks, will perform all the functions of sleep and yet leave the person fully awake, conscious, and alert. He violates the canons of science, however, and tests the drug on himself.

At first, he only notices that he is up, out, and about 'way past his normal bedtime. But as the night wears on, he notices that weird things begin to happen, the kinds of things that occur typically in nightmares: his neighborhood is invaded by dinosaurs, including a troupe of great apes; a raucous Mardi Gras, New Orleans-style jazz band, hundreds strong, camps outside his window and begins to howl for human sacrifice, etc. Of course, they settle on Larry Keith as their victim. (I still remember their blood-cry from having read the story so long ago: "Larry Keith! Let it be he!") Finally, the drug wears off, and he awakes in his own living room unharmed, but splashed with mud and filthy water from his headlong flight away from the dinosaurs and the jazz-band musicians. The last frame of the story shows Keith, dressed in pajamas, and now in bed and remarking "I guess sleep is more important than I believed. So I'm going to get some. Good night!"

Aside from broaching the old conundrum about how one knows that the world one sees round about is the real world, and that one's dream world is *just* a dream world, the story raises the unsettling possibility that, even if the waking world is the real world, perhaps the dream world would *become* real, were it not that it is just that: the *dream* world. Maybe our dreams would come true in the absence of sleep, thereby, in a Platonic nightmare, releasing the visions of the id from the constraints of the superego and allowing them to become ontologically realized in what we are pleased to consider the actual world. If you are inclined to just smile indulgently at such a possibility, remember that Dr. C. G. Jung speculated that UFOs -- phenomena with a demonstrably objective existence -- were projections from within the mind's collective unconscious. In any event, be careful what you wish for.

o Unknown Worlds

The third "Hughes classic" is a story that appeared in *UW* about an obscure, grey little man, much like Simon and Garfunkel sang about in "A Most Peculiar Man", who keeps to himself in his basement apartment, has no friends, and who remains unknown to everyone. All that makes him conspicuous is that he has a prodigious talent for fixing all kinds of machinery. But not only does he repair it, he ends up improving it ... without intending to or knowing how he does it. As the story unfolds, a young

couple brings him a black-and-white TV to repair. They leave it with him, pick it up when he calls to say it is fixed, but immediately return, breathless with amazement. Their black-and-white TV now displays vivid color. (Remember: this story was published back when color TV was a high-tech luxury, unaffordable to anyone but the one-percenters of the late 50s / early 60s.) But notwithstanding, people still persecute and ridicule the little man because of his harmless eccentricities.

Some time before, the grey little man noticed he has a large hole in his apartment wall. He has never bothered to fix it, and just hangs a curtain over it. But one day, especially depressed at being the pariah of his apartment building, he decides to explore. He climbs through the hole ... and to his astonishment discovers an entire world on the far side of the hole. In that through-the-hole world, there are people of great compassion and discernment who, recognizing his genius, not only accept him, but accord him an exalted place in their society. The last frame of the story shows the grey little man as viewed through the hole, surrounded by his new adoring friends on the far side, who, like the people in our world, bring their devices to him, not only because they value his skill, but even more so, because they value *him*. As a kid who was a nerd before such a word had ever been coined, this *UW* story, for obvious reasons, resonated profoundly with me. Twenty-five years or so later, I found my own refugs -- my own "hole in the wall," if you will -- in my wife and in my in-law family.

If there is a common motif in all three "Hughes classics", it is that physical technology, especially when developed carelessly, can bite the hand that creates it. But the "technology" of compassion and dignity never turns upon and rends the one who practices it. The former involves only confronting problems. The latter involves confronting Mystery. A mature skepticism always requires a recognition of one's cognitive limitations. As the old Scholastics expressed it *Omnia exeunt in mysterium*.

Chapter 6 – The *Dawning* of Personhood: Taking a Metaphor Seriously

I have recently written elsewhere about the ontological and epistemological problems surrounding the current debate about abortion. These problems – almost always unacknowledged and even unconscious – plague **both** sides of the abortion debate, **pro-choice no less than pro-life**. But, in the process of reflecting on that "Skeptic's" column and responding to reactions thereto, I have concluded that that earlier column did not really address the most fundamental problem with the current abortion debate: the difference – again, for the pro-choice position no less than its pro-life counterpart – goes even deeper than the disagreements I mentioned in that earlier column. In fact, so I would argue now, that most fundamental difference is not, at base, even religious or metaphysical or philosophical, though the disagreement has those implications and dimensions. Rather, the most basic disagreement that animates the current abortion debate is a failure to understand what one might call "digital" and "analog" phenomena.

A word of explanation … as everyone knows by now, digital computers are machines that perform calculations and manipulations of data based on sequences of zeros and ones. Hence the use of binary: 1 / 0 – based arithmetic. Even the provenance of hexadecimal codes is traceable back to binary mathematics. In binary arithmetic, a computer entity is either on (by convention, it has the value of 1) or off (by convention, it has the value of 0). Furthermore – and, for present purposes, most importantly – it has, because it can have, ***no value in between***. There is no such thing as any calculational component of a computer having a value like 0.23525232. That is a physical impossibility just because of the way digital chips are physically built. A physicist might well say that digital computers, and the components thereof, are all **quantized**, i.e., having certain discrete values but no values in between. A subatomic particle may be "spin-up" or "spin-down", but never "spin-sideways" or "spin-at-a-30-degree-angle". Quarks can have fractional spins and charges, but even those are always in discrete units with nothing in between. So also *digital computers*.

It was not always thus. In the pre-digital age, there were these things called *analog computers*. For technical reasons I cannot go into – I am very much a child of the digital age, at least in my professional life – components of analog computers, which are still in use for certain specialized purposes, can have values "in between" in a sense that digital computers and components cannot. Analog computers are useful for modeling and doing calculations about phenomena that are by nature *continuous*, with no sharp "quantized" jumps or breaks, e.g., pressure, temperature, voltage, speed, and weight, etc. (Digital computers can do this, too, but require much more "finesse". Again, most of this was before my time. Hence the hand-waving.) Analog computers and computer components are more like the coming of the dawn, i.e., continuous, **non**-discrete phenomena and processes, than the flipping on of a light switch from off (0) to on (1). The latter are essentially *digital* processes involving **non**-continuous discrete states.

What does all the above have to do with the abortion debate? I would argue: **everything**. In the distinction between digital and analog conceptions lies the essential fallacy of *both* positions on abortion – and, indeed, on most "life" questions generally, e.g., when to discontinue life support for someone in a "vegetative" state.

First, consider abortion. Pro-life proponents argue that human life begins at the moment of conception. The very locution "the *moment* of conception," so prevalent in pro-life literature and rhetoric, is a clue to the essential fallacy of pro-life arguments. I am no reproductive biologist or ob / gyn, but even I

know enough biology to know that **there is, in reality, no such thing as "the *moment* of conception"**. The use of this terminology implies that conception is a digital process, something that either happens instantaneously the instant the sperm hits the egg, or does not happen. One (conception) or zero (no conception). On or off. There is no process. There is no continuum. Only one or zero. Such is the pro-life model of conception, i.e., the *moment* of conception, when the biological light switch goes from 0 to 1.

In reality, however, *conception is a continuous analog **process** of several steps* and stages that meld seamlessly into one from the other. **It is a *continuum* that admits of no instantaneous "zorching" of a fertilized egg into human life.** *(By the way, please note that I have not yet so much as touched the issue of whether the fertilized egg is **human** life or not. Keep reading ...)* Conception, no less than the rest of the pregnancy, *unfolds with time along a continuum of development*. So asking the question "At what *moment* does fertilization *really* occur?" is like asking "When does dawn *really* come?" I.e., the question itself makes no sense because it evinces a fundamental misunderstanding of the whole issue. To extend the analogy, suppose you read in the *Farmer's Almanac* that dawn tomorrow will occur at 6:04 a.m. Does that mean that at 6:03:59.9 the outdoors are dark as pitch, and that the instant the clock ticks over that extra 0.1 second to 6:04, the environment is as brilliant as noon at Death Valley? Of course not. The coming of dawn is a *process*, a *continuum*, i.e., an analog, not a digital, process. So asking when dawn "really" occurs makes as much sense as asking "What is the *real* length of a piece of rope?" The answer is: "It all depends". That is the best answer we can give to the question "When does conception *really* occur?".

Analogous – so to speak – remarks apply to the pro-choice position. Again, as previously, **I should refer to abortion on demand and not pro-choice. The two are not the same.** The abortion on demand (AOD) position holds that a woman has complete sovereignty at all stages of her pregnancy because the fetus, being a physical part of a woman, is the woman's property. (As in the previous "Skeptic's" column, I reiterate that this is, in all essentials, the same argument that slave-holders in the antebellum South used to justify slaves as mere property: mere "meat machines" are property.) Consequently, so the argument goes, the fetus does not become a person until the moment of birth.

Again, observe the fallacy latent in that critical noun "moment", i.e., the implicit belief that **birth is a moment, a discrete instant**. No woman who has ever been pregnant and given birth would ever -- *could* ever, in a manner consistent with her experience -- subscribe to the notion that birth is a discrete, as it were, "digital", moment. There is no such thing as the "*moment* of birth" any more than there is any such thing as the "*moment* of conception". **Both are tricks of language.** This is true even if we forget the nine months of gestation. No woman who has ever experienced a several-hour labor can, in a manner consistent with that experience, affirm that there is such a thing as a "*moment* of birth". Birth -- that is, the coming-into-existence of an ontologically distinct human being -- is just as much of a continuum -- i.e., an "analog" experience, not a digital / binary / on-off datum -- as conception. In neither case does any magical "zorch" occur that confers such an ontological status on the fetus ... baby ... person ... pick your own word.

The same is true, not only of life, but of **human** life. Pro-life people always argue that "Of course, the fetus is life". **Agreed**, and again ***agreed***. The entity inside the woman's womb is indeed life. *Of some type or kind.* To assert that is to amplify the blindingly obvious. But that the fetus is life is beside the point. The salient question is "Is the fetus **human** life?" Or, alternatively, "Is the fetus a **person**?" The religious response is to argue that at the moment of conception -- but see above -- God infused the

fetus with a soul. Of course, such a principle, however religiously orthodox, would never pass constitutional muster because of the "establishment" clause of the First Amendment: no church's doctrine may be codified as civil law. Similarly, the AOD answer is to say "No, the fetus is not a person until birth, and until that point is a mere glorified hangnail with which the woman dispose howsoever she wishes". This response is equally unjustified and originates in the respondent's philosophical / metaphysical convictions, which are equally invalid, constitutionally. **I am not arguing that the fetus is a person.** As I said in the "Skeptic's" column, I have no idea what the fetus is. But hypothetically, if the fetus is a person, then one can argue -- and pro-life people habitually argue -- that there is no difference between aborting a fetus and sticking a living child's hand on a red-hot stove burner. One's presuppositions and first principles make all the difference in the world. All I am sure of, based on the science of the matter, is that the entire issue is a matter of conceiving of the relevant issues in terms of a continuum, and that trying to force the discussion into the Procrustean bed of digital / 1-or-0 / on-off thinking only poisons the well of the entire debate.

I am, for that very reason, also certain of one other thing. Practicality often requires issues to be resolved "digitally," even in "analog" situations. Airlines could not function if the flight schedule said "The flight departs at sorta-kinda / more-or-less / approximately dawn, and dawn is at 6:04 a.m. ... well ... plus or minus." For reasons of practicality and convenience something like the *Farmer's Almanac* definition of "dawn" as 6:04 a.m. is adopted for the sake of coherency. The law says that I ran the red light, and the cop gave me a ticket, because the traffic light was red. My counter-argument that "Gawrsh, officer, the light was not precisely **red**-red, but rather somewhere in the vicinity of orange or yellowish-orange or a Donald Trump shade of burnt persimmon" will probably not gain much traction, either with the officer or in traffic court. *So there will always -- **always** -- inevitably be a significant element of arbitrariness in appealing to the law to decide issues pertaining to the beginning -- and the end -- of life*, and insisting on *digital* answers to questions that are intrinsically *analog* gains nothing. Except more confusion. That is just the nature of the law: the precision of the law will inevitably be at variance with the ambiguity of experience.

Consequently, I confidently predict that **no law pertaining to limitations on abortion will ever satisfy *either* side of the abortion debate**. Laws and court decisions that make the slightest concession to conception-as-continuum / -process instead of conception-as-discrete-moment will ever satisfy pro-lifers, who think conception is an on / off phenomenon like flipping a light switch. (*Roe* and *Casey* are such "continuum-centric" / analog decisions.) By the same token, restrictions on abortion that see *birth as a process rather than as a discrete event* will ever satisfy AOD advocates. When the matter comes down to laws and court decisions, laws and court decisions will *always* be reviled by one side or the other for just this reason. Hence my pessimism in this regard: **consensus is not an option, simply because the "metaphysics" of both sides could not be more opposed.** Much of the art of law consists of making fine, subtle distinctions, an art the current abortion debate is, to say the least, not conspicuous for practicing.

Welcome to the real world, boys and girls, when even matters as fraught as conception, birth, death, and dying are incorrigibly ambiguous -- because *the world itself* is incorrigibly ambiguous. And nowhere is the world more incorrigibly ambiguous than in biological processes, which always occur along a continuum, not in discrete, one-quantum-at-a-time, distinct steps. So grow up and deal with it. Both sides in the abortion debate need to stop demonizing one another and preening themselves in the belief that they have identified the discrete steps in the development of any living organism ... simply because **discrete steps do not exist**.

Show at least a modicum of epistemological humility in the face of phenomena that are intrinsically mysterious, phenomena concerning which we know very little -- concerning which we **can** know very little. There is nothing at all dishonorable, in the face of such phenomena, in simply shrugging one's shoulders and saying "I just don't know".

"The Universe is not only stranger than we imagine, it is stranger than we **can** imagine." -- J. B. S. Haldane

Chapter 7 – The Intelligence of Earth

I've never been much good at being "right-brained". In fact, I'm not even sure how legitimate the "right-brain / left-brain" distinction is anymore, or if its scientific basis, assuming it ever had such, is still legitimate. What I mean to say, terminology aside, is that I have always approached questions, issues, and experiences analytically and logically and with attention to the "down-in-the-weeds" details, i.e., supposedly with my "left brain". Partly this is because of my native temperament; partly this is because of my academic training in math and physics. Oh, I fully recognize that people can have flashes of insight and intuitive apprehensions. I have had such myself. But my knee-jerk response is always to do *post facto* critiques based on the rational, "left-brained" criteria of logic and evidence. Well … **almost** always … there have been exceptions …

One such exception was my "visionary" experience at my father-in-law's funeral. Another was afforded by my exposure to the *Ten Ox-Herding Paintings* that was so instrumental in my recovery from "vocation fixation". Another – the latest and the most gradual – is my growing conviction that **the earth and its environment – climate, weather, oceans, plants, animals, the evolutionary process, the very geophysical dynamics of the deepest earth under our feet – all evince behavior one may reasonably describe as "intelligent"**. Maybe even "conscious". I am even more firmly convinced, once we broaden our definition of "intelligence" and "consciousness" to include "non-human-centric" modes of cognition, that, while neither rational nor conscious, the environment may reasonably termed "**para**-rational" or "**para**-conscious", i.e., rational and conscious according to principles other than the principles that govern human intelligence and human consciousness. Hamlet was right: "There are more things in heaven and earth than are dreamt of in [our] philosophy … ". So I guess you could call me somewhat oxymoronically a "naturalistic mystic": matter and spirit are no more sharply divided than matter and energy.

Diane and I have a small house on the beach on the easternmost point of the Big Island of Hawaii, Cape Kumukahi. The ocean is literally a couple dozen yards outside our front door in the form of a calm little inlet. That inlet is the habitat of a large colony of sea turtles. (In honor of the turtles, we have nicknamed the house *Hale Honu*: "turtle house" in Hawaiian.) When we visit, the turtles are always there, cavorting in the gentle surf of the inlet. So we always take some portable plastic chairs out to the edge of the inlet, put them in the shade of the sea-grape and palm trees, drink our beer or Cokes, and go "turtle watching". We have seen as many as 20 turtles in 2 hours. Maybe it's just my imagination, but I always have a strong sense that the turtles always know we are there, and pop to the surface to see us as much as we go to the sea's edge to see them. I always feel ... well ... **regarded** ... **attended to**. ***Known***. (The turtles are a protected species in Hawaii, and our neighbors around the rim of the inlet are always very careful to leave them undisturbed.) There, more than perhaps anywhere else, I always catch a sense of how seamlessly the web of life is woven, a sense that gets me out of my Cartesian consciousness that says *I'm here; the world is there; we are separate and apart*. That sense of separateness, of apart-ness is what allows us to believe that we can manipulate, and even abuse, the world, its resources, and its environment without consequence, damaging the world even as we ourselves escape damage. The turtles always remind me otherwise, not on a level that my left brain can access, but on a level both beneath and beyond my carefully crafted Kevlar layer of cynicism and skepticism, on the level of the glands and of life's most primal juices.

I also caught a sense of that wholeness the first time I visited the Grand Canyon. One of the most vivid memories I took away from that awesome place was of myself standing alone on the rim of the Canyon,

a few hundred yards away from the visitors' center. It was a sunny day, cloud shadows drifting over the Canyon, and there was a group of Native Americans back at the visitors' center giving an exhibition of religious chant and dancing. I stood on the edge looking out over the vast expanse of strata through which the Colorado River had carved a channel over the millennia, listening to the primal rhythms of the drums, the flutes, and the chants, and watching a hawk as it soared from north to south.

I remember having this eerie, even numinous, sense of having been transported back in time 500 years -- and yet, in another way, of time becoming irrelevant altogether, utterly suspended in the reality of the moment. I seemed to **belong** there, not as a visitor, least of all as an interloper, but as a part of the vista that was somehow, in a manner beyond all words, necessary, even **essential**.

But a characteristic of all entities that are conscious and intelligent in **any** sense of those terms, "para" or otherwise, is **the drive to defend themselves**. In this sense, also, the earth -- including its climate -- acts with (para-)intelligence to a degree we are only now beginning to dimly appreciate. Let's acknowledge up front that the full spectrum of consequences of human-driven climate change have yet to become evident. Certainly there is an important difference between "climate" and "weather". Isolated storms, even on the scale of hurricanes, are not necessarily attributable to global warming. But if current models of climate change are even approximately accurate, the conclusion is inescapable that the climate is showing signs that, if displayed by biological species, would be regarded as self-defensive, often even violent. In "The Dry Salvages," the third of his great *Four Quartets*, T. S. Eliot wrote

I do not know much about gods, but I think that the river
Is a strong, brown god -- sullen, untamed, and intractable,
Patient to some degree ...
Keeping his seasons and rages, destroyer, reminder of what men choose to forget.
... Unhonored, unpropitiated
By worshippers of the machine, but waiting, watching and waiting.

Even in a time that is in the process of becoming painfully aware of the consequences of large-scale climate change, our conceptions of the world and its climate tend to still be controlled by Wordsworthian Romantic paradigms of female gentleness and nurturing. But all conscious and intelligent beings, when backed into a corner, can and usually do resort to violence to defend themselves, and at most are only "waiting, watching and waiting".

Contemporary climate science is beginning to teach us in the early 21st century what quantum mechanics began to teach us in the early 20th: that **the observer is an integral part of what is being observed**, and that **the actions of the former influence, even to the point of determining, what is seen in the latter**. We need not go as far as to endorse a form of the Gaia theory that implies actual conscious or para-conscious purpose, any more than we need to infer purpose from the statistical formalism of quantum theory. But we certainly can agree that both climate science and quantum theory offer a way out of the dead-end dualism of Descartes. The salient difference is that, in quantum theory, if we divorce ourselves from the phenomena we observe, we will not be able to sustain a coherent view of physical phenomena, whereas if we divorce ourselves from the earth's climate, we will not be able to sustain life itself.

Chapter 8 – A *Data-Driven* Critique of the Pro-Life Position on Abortion

Back in February of 2014, I published a "Skeptic's Collection" column in which I cited biblical texts in both Testaments calling into serious question whether the Judaeo-Christian God may be fairly characterized as pro-life. As you will see if you follow the above URL, that column was Part 1 of what I originally envisioned as a two-part series. But for reasons I can no longer remember, I never wrote and published Part 2. Until now. Part 2 approaches the subject of the pro-life credentials of God from a somewhat different perspective: comparing the texts allegedly asserting God's pro-life stance, not with other biblical texts as in Part 1, but with actual, empirical data, worldwide, on infant mortality. *My purpose, now as in 2014, is not to ridicule Christianity or Christians.* Though I am pro-choice myself, and though I approach the subject of abortion from an explicitly secular, constitutional, "rights-centric" perspective, I believe that a quite respectable case can be made for a pro-life ethic. But I question the tendency among religiously motivated pro-life people to "cherry pick" by concentrating too exclusively on biblical texts without running those texts up against the "phenomenal" world outside the Bible and checking whether the two – world and text – are mutually consistent. In the following, **I argue that they are not**. Consequently, while *a case can be made for a pro-life ethic, **that case cannot be founded on the theology of the Bible***. In fact, the God of the Bible is **anything but** pro-life, not because one's textual exegesis is wrong, but because the texts do not jibe with the empirical "facts on the ground". Conclusion: a *religiously grounded* anti-abortion ideology is a dead letter.

It is worth noting that it is possible to build an argument for a pro-life ethic on a purely secular, non-religious (not to say *anti*-religious) basis. But since I am discussing theology, I will deal only with *religiously grounded* pro-life arguments, specifically Christian arguments, since that is the religious tradition with which I am most familiar. At least within the Christian pro-life community, one of the most salient "canonical" texts justifying such a pro-life stance is Psalm 139. I will not reprise Psalm 139 here, beyond calling attention to the sweeping claims made in that text for God's excruciatingly detailed and utterly comprehensive custodianship of the developing fetus. I would theorize in passing that the language of Psalm 139, even in English translation, is so overwhelmingly majestic that the sheer cadence of the language can tend to anaesthetize one's critical faculty: when one is contemplating the overwhelming sovereignty of God's love (Hebrew: *hesed*, "covenant-love") for the developing fetus in the mother's womb, it can seem in bad taste, arguably sacrilegious, to bandy about statistics – rather like debating whether this specific blob of green paint should go **here** rather than **there** in Renoir's *Luncheon of the Boating Party*. It just seems exasperatingly beside the point. Again, my purpose is not to ridicule Christianity or Christians, but, with all due respect, **such "caviling" is precisely what is called for**. It is anything but beside the point.

To see why, consider … The percentage of pregnancies ending in miscarriage / spontaneous abortion – for the purposes of this column, I consider the two synonymous – varies widely, depending on how one defines "miscarriage" and "spontaneous abortion". ("Spontaneous" in the sense that the pregnancy terminates with no human intervention.) Also, as even a hour or two or cursory research will show, the incidence of such terminations of pregnancy varies widely from country to country: as one might expect, the rate is significantly higher in "Third World" countries, relative to their "First World" counterparts. But, in order to bias my conclusions toward the optimistic, I am going to assume that spontaneous-abortion statistics for the latter are **typical worldwide**. So in the interest of maintaining an "optimistic" bias, I will adopt the 15%-to-20% number for the miscarriage / spontaneous-abortion incidence for pregnancies worldwide. (Again, the actual number would probably go up significantly if actual miscarriage statistics for the developing world were factored in.) In fact, I

will "low-ball" even that number and peg the worldwide incidence of miscarried / spontaneously aborted pregnancies at 15%: the low end of that range.

Now, the Guttmacher Institute estimates that in 2012 – the latest year for which I could find statistics – there were 213 million pregnancies **worldwide**. If, by hypothesis, we estimate that 15% of these pregnancies terminate prematurely by miscarriage / spontaneous abortion, this means that, of the 213 million pregnancies in 2012, in round-as-possible numbers, about 32 million pregnancies miscarried / spontaneously aborted in 2012. (Not to belabor the point, but this 32-million number is almost certainly significantly on the low side.) This means that, in 2012, about 2.6 million pregnancies miscarried worldwide per **month**. For a 4-week month, this translates to 666,000 pregnancies (again, worldwide) per **week**. So **every day**, worldwide, 95,000 pregnancies spontaneously aborted. That is 4,000 pregnancies per **hour**, 66 pregnancies per **minute**, almost exactly 1 miscarried pregnancy per **second** … again, worldwide, and under what are almost certainly unrealistically optimistic assumptions. (Of course, I am also assuming, no less unrealistically, that these pregnancies all miscarry **in the same calendar year in which they were conceived**. Timing makes a difference, and if pregnancies conceived in *2012 miscarry in 2013*, the foregoing numbers for 2012 would decrease accordingly. But I would expect that this would be more than offset by factoring in the *actual incidence* of miscarriages in the "Third World".) The bottom line: even under the most optimistic assumption that the 15-percent miscarriage rate holds worldwide, one fetus is spontaneously aborted every **second** of every **minute** of every **hour** of every **day** of every **week** of every **month** of every **year**.

Of course, one can argue that it is fallacious – to say nothing of bad hermeneutics – to take Psalm 139 and like texts at face value and literally. Even from a purely secular standpoint, I concur. It does as much interpretive violence to the text of Psalm 139 (and others) to see it as a treatise on reproductive biology as it does to the text of *MacBeth* to believe Shakespeare is instructing us in factual Scottish history. The important point, this response would argue, is that God is intimately involved in the conception, gestation, and birth of each human being, not that God "jimmies" the odd chromosome here, "tweaks" the odd gene there, and patches up the odd faulty nucleotide over yonder, least of all that God fine-tunes the laws of chemistry and genetics in pursuit of some ideal of genetic perfection, like the people led by Khan (Ricardo Montalban) in the old *Star Trek* episode. But this begs a disarmingly simple question: **Why Not?** That is, given all the "omnis," why does God **not** intervene? According to orthodox – lower-case "o" – Christian theology, God is possessed of all the "omnis": *omni*science, *omni*presence, *omni*potence, *omni*benevolence. So when we run the theology of Psalm 139 up against the foregoing statistics, even as rough and approximate (though remember: most likely artificially optimistic) as the latter are, we discover that we are confronted by a kind of molecular-genetic version of the Problem of Evil.

As the stinging little doggerel in Archibald MacLeish's play *JB* says "If God is God, He is not good; / If God is good, He is not God. / Take the even, take the odd". Both alternatives – the "even" and the "odd" -- have consequences that are about equally distasteful to people who seek to found a principled pro-life stance on the theology of the Bible. "If God is God, He is not good", because, though possessed of all the requisite "omnis," God nevertheless allows fetuses – i.e., *children* – to die, and to die *in utero*, in numbers too hideous to long contemplate. Such a God is *ex facie* **non**-pro-life. "If God is good, He is not God" because, while God's *intentions* may be pro-life, we are now confronted with the biblical texts I cited in Part 1 back in 2014. Even if we interpret those texts, as I do, as theological parables and not as "straight" history, we have to consider the possibility that (a) the God as conceived in those texts is not "good" in any humanly significant sense, unless we are willing to consider

xenophobia and genocide as in some sense good, or (b) God is indeed “good” notwithstanding, but lacks the power (the “omni”) to instantiate in the real world God’s reverence and *hesed* for life in the womb. In case (b), if you are pro-life, you are on your own. God’s bioethics *vis a vis* abortion is, at best, a kind of *coda* to purely human reflection on rights and ethics regarding abortion and life issues generally, i.e., God is a “bit player”. What makes the game worth it is, as MacLeish’s poem concludes, “the little green leaves in the wood, and the wind on the water”.

My counsel, which I fully and respectfully realize not everyone can in good conscience follow, is to (1) cut the Gordian knot by (2) refusing to get lost in one’s underwear by trying to square the circle of the abortion issue, and life issues generally, by recourse to religious doctrine – all the more so because considerations of constitutionality end up “filtering out” such considerations, anyway, as matters of public policy, which the “establishment” clause of the First Amendment mandates to be religion neutral. Maybe if the dominant religious idiom of the Nation were something other than theocentric monotheism, if that idiom were, say, Buddhist or Taoist, the Gordian knot would not be so entangling. But that is not reality.

A good start would be to renounce "cherry picking". Facts count. So does intellectual integrity. The dialogue on such a fraught issue as abortion is not aided by ignoring the implications of either.

Chapter 9 – The Return of the Repressed and Sexual Morality

Every so often, I read posts from progressive, non-fundamentalist, religiously devout people – usually Christian, but not always – on, e.g., Facebook expressing astonishment and mortification at the manner in which the conservative evangelical / Reformed Christian church (with certain conspicuous exceptions, to be sure) has slavishly rallied around the Presidency of Donald Trump. This surprise is understandable if you only pay attention to the surface rhetoric of the conservative Christian church. But focusing on the superficial, conscious, "prefrontal-cortex" part of conservative Christianity is like looking at the surface of the earth and concluding that, except for the odd volcano here and there, the earth's core is pretty much like the earth's surface, that is to say, pretty dull: 95% or so quiescent, cold, and dead. You would miss the stupendous energy, left over from the creation of the earth around 4.5 billion years ago, that to this day, seethes out of sight and usually out of mind at the earth's incandescent core. But just as the "odd volcano here and there" speaks volumes about what is going on in the earth's interior, the culture of conservative Christianity reveals the energies that likewise seethe beneath its conscious exterior. Freud called this "the return of the repressed", and in books like *The Psychopathology of Everyday Life*, wrote about it extensively.

What plays the part of "the odd volcano here and there" is, in large measure, the hymnody of the conservative Reformed church. This musical culture is the ecclesial analog of the "Freudian slips" Freud talks about in *Psychopathology*. I have written at length about this elsewhere. But I want to concentrate now on two areas in which "the return of the repressed" – *on an institutional / cultural level* – is especially evident, and which, I would argue, account for the enthusiasm for Trump among so many conservative Reformed individuals and churches. *We find such institutional / cultural "Freudian slips" in hymns dealing with two issues that are especially problematical for conservative Christians: violence and sex.*

The fact that so many conservative Reformed Christians can so breezily pass over the implications *vis a vis* violence and sex in their own musical culture is persuasive evidence that this culture is built on a foundation of unconscious *repression* of those qualities. We only see the explicit manifestations -- "the odd volcano here and there", if you will -- in conspicuous eruptions like those involving Jim Bakker, Jimmy Swaggart, Bill Gothard, et al. As with their geological counterparts, such occasions beg an important question: *what is going on beneath the surface that accounts for such eruptions?*

Friedrich Nietzsche gives us a useful way of approaching this problem -- together with some of the most astute religious psychology ever written -- in his *Genealogy of Morals*. *Genealogy* is Nietzsche's description of the clash between the ethic of "primitive" Christianity within the Roman Empire and the ethic of the Empire itself. The details are far too complex to even fairly summarize here. Suffice to say that, whereas the ethic of pre-Constantinian Rome ("pre-Constantinian" turns out to be a critical adjective) valorized excellence, strength, and honor, all in the service of both individual and social nobility, Nietzsche asserted that Christianity, both then and now, emphasized the diametrically opposite values of humility, subservience, and self-abnegation.

But the important point to note is that the ethic of late Rome and the ethic of Christianity (as Nietzsche understood it) both likewise emphasized *the maximization of sheer power*. Whereas St. Paul's Christian God said in II Cor. 12:9 "My strength is made perfect in weakness," any of Rome's gods would probably have said "My strength is made perfect in *more strength*". (If you want to investigate the roots of Nietzsche's beliefs about the dynamics of power, the place to start would be Arthur

Schopenhauer's *The World as Will and Representation*.) Whereas Rome conquered others while itself avoided being conquered, the Christian ethic demanded that subjugation be endured patiently, the better to conquer by sheer *endurance*. The usual term of art for Nietzsche's understanding of conquering-through-endurance is *ressentiment*: resentment and rage sublimated into a passion for suffering and self-sacrifice. In other words, Nietzsche's *Genealogy of Morals* is a late-nineteenth-century account of what we today would term "passive aggression". Thus understood, Christians in the late-Roman period wanted to strike out, wanted to bring down the Empire, but, lacking the power to do so, repressed their rage and sublimated it into passive aggression, in the process turning the vices of classical Rome -- humility, self-effacement, self-abnegation -- into actual virtues. Nietzsche termed this process of converting salient vices into no-less-salient virtues "the trans-valuation of all values".

Most likely, Nietzsche did not know Freud and Freud's work on the unconscious mind. If he had, he would have found a soul-mate, because Freud's writings about the return of the repressed constitute a near-perfect complement to Nietzsche's writings about *ressentiment* and the transvaluation of all values. *What Nietzsche missed, Freud found.* Freud's key insight in, e.g., *Psychopathology* is that, just because the contents of the psyche have been repressed beneath consciousness, that repression does not mean those contents have simply gone away. *Repression is not destruction, it is abdication.* Rage suppressed simply shows up in other ways, "the odd volcano here and there" I mentioned in the beginning, ways that emanate from the unconscious mind -- where the subject herself has repressed them -- and manifest themselves in ways over which the subject has no control.

Seething beneath the surface consciousness, like molten magma at the earth's core, is a mass of rage, lust, and feral affect that has, over multiple generations, been repressed so that human beings can live in ordered, coherent, civilized societies. So there is no necessary pejorative value judgment attaching to repression, quite the contrary. "Civilization is bought at the price of inhibitions" -- Sigmund Freud. I include "lust" in that list deliberately, because one of the impulses, one of the Freudian instincts, most often repressed is the sexual impulse. Contrary to popular belief, Freud never said "Everything is sex" any more than Einstein said "Everything is relative". Therefore sex is one of the impulses that most often manifests itself as the return of the repressed. Hence the Elektra and Oedipus complexes. Hence, also, the incest taboo. (Freud's account of the etiology of the incest taboo is wildly fanciful.) All such complexes are living laboratories for studying the return of the repressed.

So is the conservative Reformed Protestant church. If one could study the Reformed psyche somewhat as geologists, geophysicists, and volcanologists study the interior of, say, Mauna Loa in Hawaii or Mt. Pinatubo in the Philippines or the Yellowstone supervolcano, the similarities would be all the more striking because of the repressed rage of the Reformed church at being culturally marginalized and considered a mere atavism. That rage is often incandescent, as witness the recent comment about giving Donald Trump a "mulligan" (do-over) regarding adultery. But this is nothing new.

Reformed evangelical rage at being looked down upon, though cloaked behind a screen of *ressentiment* -- humility, patience, and long-suffering -- has returned from being repressed and manifests itself in the musical culture of that church tradition. I hardly need reference hymns like "Onward Christian Soldiers" as cases in point. Sometimes the words of the hymns, not just the titles, are equally revelatory, as in "Stand up, stand up for Jesus, ye soldiers of the Cross", "The strife is o'er, the battle done", more or less implicitly in "A Mighty Fortress is our God". Even hymns that start out emphasizing humility and self-effacement -- like "Man of Sorrows" -- end up concluding on a note of hoped-for power ("When He comes, our glorious King, / To His kingdom us to bring, / Then anew this song we'll sing

/ Hallelujah! what a Savior!") Two of the few hymns that do not celebrate, or end up celebrating, raw power are "May the Mind of Christ, my Savior" ("Him exalting, self abasing, / This is victory!") and "Ah Holy Jesus" ("Ah, holy Jesus, how hast thou offended / That we to judge thee have in hate pretended?") As for sex, we need look no farther than "In the Garden", which is always erotic in its imagery and cadence, and in places at least approaches soft-core porn.

Given all that, and given all the pent-up rage and lust that the Reformed evangelical church has been repressing, it seems to me that *it is more appropriate to wonder why the Reformed tradition did not discover its affinity for Donald Trump before now*. (One more time in the interest of fairness: yes, there are exceptions in the Reformed evangelical church. But they are conspicuous *as exceptions* because of their contrast with the surrounding ecclesial culture, rather as a white buffalo stands out from the herd, the exception that proves the rule.) The "repressed" has been waiting to "return," in fine Freudian fashion, for many generations. Up until now, we have only had isolated inklings in the form of "the odd volcano here and there": the histrionic fulminations of, e.g., Jim Bakker, Jimmy Swaggart, Ted Haggard, and Bill Gothard. No wonder Reformed evangelicals are so facile at wink-wink'ing and nudge-nudge'ing at Donald Trump's adultery(ies): they have staged dozens of dress rehearsals with their own clergy over years past.

But perhaps the worst aspect of the discrete-volcanoes-here-and-there pattern is that its very gradualness breeds cynicism, and eventually even boredom. An honest, above-board orgy of recrimination and lust would at least have about it a certain refreshing quality of honesty. Such an untrammeled exhibition of honest lust the Reformed church in the US seems increasingly determined to give us.

Chapter 10 – More on The Return of the Repressed

Over the weekend, my wife and I watched – I for probably the dozenth time – the 1956 classic science fiction movie *Forbidden Planet*. Perhaps halfway through the movie, and largely because of the Freudian discussion of the power and place of the id in the human mind that was woven into the narrative, I had a lightning stroke of insight: *Forbidden Planet* (hereafter *FP*) is no longer, as it was in 1956, a vivid but purely theoretical cautionary tale about Freud's warnings concerning what he called "the return of the Repressed," but is also a chilling metaphor for the hazards of Trump as the first truly postmodern American President. Suddenly, I realized that we are not Dr. Morbius and his nubile daughter living on Altair IV perhaps 200 years in the future. Rather we are Americans living on planet Earth and besieged, like the crew of the rescue ship and the ill-fated colonization ship, the *Bellarophon*, by the id of a leader run amok and untethered to anything like even a reasonable approximation of reality. We must hope that the Nation escapes the fate that overtook the planet Altair IV.

In case you have been living under a rock in Death Valley since 1956, you will be familiar with the narrative arc of *FP*. A ship with hundreds of passengers embarked for Altair IV with the intent of colonizing the planet for the Earth government. After not hearing from the colonists for some time, Earth, presuming the colonists dead, dispatches a rescue ship on a year-plus-long voyage in hyperspace to find the survivors, rescue them, and return them to earth. Commanded by Capt. J. J. Adams (Leslie Nielsen), over the strenuous objections of the colonists' philologist, Dr. Morbius (Walter Pidgeon), the rescue ship lands on Altair IV, only to discover that but two people survived the destruction of the *Bellarophon*: Dr. Morbius (Walter Pidgeon), now a widower, and his daughter, Altairia (Anne Francis), who was born on Altair IV. Dr. Morbius continues issuing cryptic warnings of imminent destruction for the rescue ship and its crew if they (rescue ship and crew) do not depart immediately. Little by little, Dr. Morbius reveals that the *Bellarophon* and its passengers were all destroyed by an invisible monster of such malice and power, that even the venerable Robbie the Robot, who makes his first appearance in *FP*, cannot defend them.

Long story short, it turns out that the monster Morbius warns them of turns out to be Morbius' own id: the level of primitive, seething lust and unbridled power that lurks underneath the Freudian superego of every human being. (No moral evaluation should be inferred from this. Freud believed that the id should not be eradicated – which would be impossible, in any case – only that it must be restrained. It was Freud who insisted "Civilization is bought at the price of inhibitions".) Morbius is an intellectual, and in his zeal to exploit the technological and cultural riches of the long-extinct indigenous inhabitants of Altair IV – the Krell --- Morbius suppressed these lusts, thereby taking them off the leash of the moderating and disciplining superego. This is a classical case of what Freud called, "the return of the Repressed": **repress the id and, instead of getting rid of it, you merely abdicate control and set it free to run amok**. That is Morbius' fateful – and fatal – error: communicating with reality using only the rational, "Apollonian" side of his mind and allowing his "Dionysian" lusts free rein. Altairia escapes with the rescue ship and its crew, but Dr. Morbius pays with his life, and with the life of Altair IV itself, which he is forced to destroy, lest his own id, amplified by 200,000 years of Krell super-technology, wreak havoc across the Galaxy. In the closing scene, Capt. Adams remarks that, in perhaps a million years, human beings may be able to equal the technological and cultural achievements of the Krell, but hopes that, unlike the Krell, humans of that distant era will be able to discipline themselves so that humans do not share their fate. If the last two years is any indication, there is scant reason for optimism.

The parallel between Donald Trump and the Krell civilization is too obvious to need pointing out. Donald Trump is a one-man Krell. He is pure id with no intervening superego. Furthermore, the Republican Party, which could, if it so chose, act in lieu of that disciplining and constraining force by being, as it were, a "proxy superego," usually declines to do so. There is one critical difference, however, between Donald Trump and the Krell of *FP*: as their civilization was in the process of being destroyed, the Krell at least realized that their destruction was imminent. They did not have the self-awareness to *account for the origin* of their urge to destruction – evidently Krell versions of Jungian and Freudian analysts were in short supply, perhaps because the Krell psyche was as pathologically inflated toward the purely Apollonian as that of Dr. Morbius, plus the Krell had 200 millennia of experience in the practice of repression – but at the very least, *the Krell reacted with alarm and revulsion, even panic, and tried, however vainly, to stop the process*. **At least the Krell knew they – meaning their entire super-civilization – was deeply, deeply sick and tried to cure themselves. Donald Trump does not know he is sick, and in fact, *revels in his pathology*, cultivating the very antigens that infect both him and the body politic over which he presides.** Donald Trump is a connoisseur of violence and chaos. He is proleptically nostalgic for a Wagnerian *Goeterdammerung*. What the Krell sought to restrain, Trump intentionally cultivates.

German culture has historically been exceptionally susceptible to the allure of this urge-to-chaos. Without wishing to in any way engage in free-form stereotyping, it is worth reflecting on how much of this cultural tendency Trump inherited from his German father, Frederick Christ Trump. We could probably speculate endlessly on this question. So suffice to say that German culture – not individual Germans, who I regard as friends and family, but German culture historically – has been marked by an affinity – at times, one could even say a **fatal** affinity – for total destruction, a preference for destruction of itself and others over even honorable defeat. One can trace this motif back through history to the Battle of the Teutoburg Forest, and even into times preceding the Roman occupation. (It has even been argued that the Teutonic victory in the Forest effectively isolated Germany from the intellectual and cultural currents of the subsequent European Enlightenment. I would not go *that* far, but there is enough of a kernel of truth in that thesis to render it worthy of some serious consideration.) This Trump-like preference for chaos led to National Socialist book-burnings, but it did not start there: Martin Luther initiated the process of destroying, e.g., the works of St. Thomas Aquinas, and others merely copied him.

Also, e.g., one is at least entitled to wonder if Schopenhauer's *World as Will and Representation* (*Welt als Wille und Vorstellung*) could have been written by, among others, Hume or Voltaire – or, indeed, any of the Encyclopedists or Philosophes. (Ditto Nietzsche's Will to Power in, e.g., *Beyond Good and Evil*.) Granted, all this paragraph hangs on rather slender historical and cultural threads. German culture is not the only culture to be seduced from time to time by the meretricious blandishments of chaos, nor is Trump the only person to be thus enticed. One can also cite Mussolini and Franco as aficionados of laceration – even Oswald Moseley of the British Fascists. But the final word is significant: the ideology of fascism is the "vector" – the infected rat, if you will – that spread the contagion of fascism to the rest of the world. Germany was merely – arguably – the first victim.

The Krell were the victims of their own monomaniacal obsession with technology – in FP, Dr. Morbius even shows Capt. Adams and a few of his subordinates the machines the Krell designed to reinforce this obsession – and as it turns out, the disease that was purely fictitious in the case of the Krell in FP has turned out to be all too real in Western culture, and is instantiated in Donald Trump – the Krell who revels in, rather than restrains, his own id.

Our challenge in the near term is to assume the responsibility which the Republican Party has already abdicated: be to Trump the superego he needs but does not possess.

Chapter 11 – My Goedel is Killing Me!

Have you ever had the experience of noticing a certain pattern in a wild variety of contexts, a pattern that occurs so consistently that you feel it simply *has* to mean something … but you have no idea what? I say "in a wild variety of contexts" to rule out cases of patterns that occur *within the **same** context*, even though, at the time, you may have no idea of the cause. I remember back in the early 1960s, when I was in junior-high school, I went on a "geology jag". I spent several months reading books on geology, geophysics, and volcanology that noted with perplexity the mysterious – in the early '60s – pattern whereby volcanic activity tended to be concentrated around the circumference of, e.g., the Pacific Basin, what we today call the "Pacific Ring of Fire," and similar places. Given the context, it was very reasonable to suppose that the pattern had something or other to do with the physics of the deep earth. Several years later, along came tectonic-plate theory and suddenly the "Ring of Fire" pattern made all kinds of sense: the dots were connected. Well … those are *not* the kinds of patterns I mean, i.e. patterns that are so closely associated with a common context that inferring a common context-related *cause* is almost unavoidable.

Rather, what I *do* mean are patterns like the recurrence of the irrational, transcendental number pi in contexts that, at least on the surface, have nothing to do with the calculation of, e.g., the circumference of a circle, the area of a circle, the volume of a sphere, the period of a pendulum describing a circular arc as it swings, etc., etc. I still find this pattern mysterious, enticing, almost an invitation to some kind of Platonic or Pythagorean mysticism.

I recently had an "Aha!" moment about similar patterns that are … hmmm … well … rather than attempt an abstract definition whose generality would probably render it unintelligible anyway, I will start by citing a specific example: *the enigmatic drawings of M. C. Escher*. (The context in which I encountered Escher is also important, but more about that a little later.) Many of Escher's drawings are conventional enough, distinguished by an austere, draftsman-like precision of line, geometry, and perspective. Others, however, are anomalous, counterintuitive, antinomic. The antinomy is especially pronounced in e.g., drawings in which two hands sketch one another, a spiral staircase where the uppermost landing coincides with the ground floor, etc., etc. In all these drawings, there is a kind of pseudo-hierarchy, "pseudo" in the sense that ascending through the various echelons of the hierarchy ultimately leads back to the *lowest* level thereof. I show several examples in the images that accompany this column.

I had been familiar with Escher's work for some time, first encountering it in Douglas Hofstadter's fascinating and challenging book *Goedel, Escher, Bach – An Eternal Golden Braid*. Hofstadter termed "strange loops" Escher's work, much of Bach's music (e.g., *The Musical Offering*), and for technical reasons I will gloss over for now, Kurt Goedel's monumental *Incompleteness Theorem* of 1931.(Goedel fled European anti-Semitism, emigrated to the United States, and took up a research position at the Institute for Advanced Study in Princeton, NJ, where he became an intimate friend of Albert Einstein, who had fled Europe for the same reason. Fascists in the Europe of the 1920s and 30s were much like Republican conservatives today, believing that too many smart people, especially really smart Jews, constitute a liability, not an asset.) Strange loops -- I am pretty sure the term was coined by Hofstadter -- are structures that appear to be hierarchical, but that are structured such that following the hierarchy up ultimately -- after a perhaps large but finite number of steps -- *terminates in the lowest level*, the "ground floor", of the hierarchy, much as if one climbed the Washington Monument -- and exited back on the Mall.

I was so fascinated by strange loops that, shortly after reading Hofstadter's book (hereafter *GEB*), I talked to a professor-friend of mine -- I was a graduate student in math at Wichita State University at the time -- whose specialty was mathematical logic and Bob agreed to basically *teach* me Goedel's great Incompleteness Theorem. Bob has passed now, but his legacy for me was a continuing fascination with the foundations of math and systems of inference -- so much so that the semester after the independent study I read *Goedel's Proof*, a semi-technical treatment of the proof by Ernest Nagel and James R. Newman. Anyway ... *the whole point of this paragraph is to give you some idea of how monumentally dense and dumb I was: I understood almost all of what I read, but, lacking an appreciation of the "wild variety of contexts" I mentioned in the beginning, I saw only the individual trees and never the Forest.*

The reason Goedel's Incompleteness Theorem -- the biggest Tree in The Forest -- qualifies as a strange loop is because, in the process of proving his eponymous Theorem, Kurt Goedel managed to mirror in the *proof* of the Theorem *the Theorem itself*. In fact, more than that, the *proof* of Goedel's Theorem ends up being *isomorphic, i.e., structurally identical, to the numbers and to the very statements about numbers that constitute the very subject of the Theorem*. Goedel's Incompleteness Theorem is actually about itself. Now, for very deep reasons I simply haven't the space to go into -- hence the "hand-waving" tone of this column -- strange loops, however different they are in other respects, all have in common this property of *self-referentiality*: in different senses, all strange loops are "about" themselves and lead back to themselves ... except that there is no "back" because *there is no movement*. That is a common feature of the various species of contextual trees in the strange-loop Forest.

But I saw the Forest, in fact, I realized there *was* a Forest, only gradually as I began to reflect on other contexts -- *contexts radically "other" than mathematical logic and the foundations of math*. I remember the chill that ran up my spine -- gradually and over time -- as more and more of the Forest became visible, as strange loops manifest themselves in an increasingly "wild variety of contexts". Herewith a few:

o Goedel's Theorem itself

Without getting lost in the technical "weeds," suffice to say that Goedel's Theorem asserts that, under certain very weak conditions (basically, you only have to be able to do elementary arithmetic in your system of mathematics), there are certain statements in any system of mathematics / inference / logic that are *true but not provable*. (Here "provable" means, essentially, producible by a "Turing machine" or "Turing algorithm," i.e., an algorithm / recipe that just mechanically grinds out theorems for your system of inference with no admixture of creativity on the part of the mathematician / logician who is turning the Turing machine's wheels.) That is to say, if your only way of proving theorems is *via* recourse to a mechanical, "paint-by-numbers," recipe-like, follow-the-bread-crumbs prescriptive procedure, then Goedel's Theorem says that *there will always be certain statements that are true, but which cannot be proven*.

If you want these **un**provable theorems to be provable, you can always alter the axioms of your system -- but then *other* statements, including statements previously provable, will end up being **un**provable in the revised system. *In any system of logic, there will never be a one-to-one, exhaustive relationship between statements that are true and statements that are provable.* (Goedel proved his Theorem in response to *Principia Mathematica*, the monumental attempt by Bertrand Russell and Alfred North Whitehead to derive all of mathematics from logic alone. Goedel's Theorem is a technically rigorous

way of saying "Sorry, gentlemen! Y'can't get there from here!") A good visual metaphor for this is trying to trap a droplet of mercury under your thumb: you cannot, because the mercury droplet will always find a way to squirt out. The "thumb" of any axioms and rules of inference will always allow certain true statements to escape.

Goedel's Theorem is a "strange loop" because, even though the Theorem is a theorem about *meta*-mathematics, i.e., a theorem about all systems of mathematics as such, the proof of Goedel's Theorem -- you will just have to trust me here (though I do recommend Nagel's and Newman's book, as well as *GEB*) -- relies on replicating the structure of ordinary, *non-meta*-mathematics. That is, you think you have climbed one round higher on the logical staircase from mathematics to *meta*-mathematics, but in reality, you are still on the ground floor. You have not actually gone anywhere in any hierarchy. In fact, there *is* no hierarchy. You have always remained on the ground floor of Escher's mad castle.

o Christian theology

The ancient world conceived of the Universe as a vast hierarchy spanning unformed matter at the ontological bottom up to God at the top. According to St. Paul's great hymn in the second chapter of Philippians, Jesus, the Second Person of the Trinity, descended to earth, and even under the earth, and as a result God the Father -- who was also Jesus, by the way -- exalted Him to God's right hand. So, in a celestial sense, by following the Hierarchy of Creation, Jesus ended up back where He started. This is usually described in terms of *kenosis*, but it is also a grand, cosmic strange loop: Jesus, while remaining God, descends from God and returns to God without for all that ever ceasing to be God. Jesus' *kenotic* Journey is a Journey back to where He "came from", i.e., where He always "was".

o Literature, in particular, T. S. Eliot's "Four Quartets"

As I have said elsewhere, I have come, after 40-plus years, to believe that the key to understanding the "Quartets" is the celebrated passage from Heraclitus that is the preface to "Burnt Norton": *The way up and the way down are one and the same*. The "Quartets" comprise a literary embodiment of this maxim: Eliot's experiences during the London Blitz convinced him that the Journey into exaltation *just is* the Journey into pain: *the fire and the rose are one*. So ("Burnt Norton"): *At the still point of the turning world ... Neither from nor towards ... there the Dance is ... But neither arrest nor movement ... ,* so that ("Little Gidding") *the fire and the rose are one.* Thus we *arrive where we started and know the place for the first time*. Mystical spirituality is a strange loop: a non-ascent through a non-hierarchy.

I could cite other examples of strange loops until you seriously consider slitting your wrists in a tub of warm water, e.g, fractal phase spaces of chaotic / non-linear / "far-from-equilibrium" phenomena, many short stories of Jorge Luis Borges, many paintings by Jackson Pollock, holograms, *et al.* All these involve another characteristic of strange loops: *scale invariance, whereby a piece of the strange loop, no matter how small, looks just like the entire strange loop, e.g., magnifying a small area of a Pollock paint-dripping painting.*

But the most provocative, even uncanny, maybe even "spooky" aspect of strange loops is Hofstadter's compelling argument in *GEB* that strange loops constitute the essence of consciousness. Human consciousness has evolved as a strange loop: from organic molecules, to single cells, to multicellular life ... etc., etc. ... finally culminating in human consciousness -- which now "turns around" and

contemplates itself and its own origins. But beyond even this -- which is momentous enough in its own right -- is that the sheer ubiquity of strange loops, which are *every*where once you become sensitized to seeing them, invites the speculation that consciousness is not confined to the space in the skull between one's ears. Consciousness may be a kind of ontological "field," not unlike the old lumeniferous ether, that pervades all space and time like an ocean, and that individual consciousnesses are local waves in that vast expanse, Braham to the individual Atman.

Maybe strange loops suggest that Hindu mystics are right: *Tat tvam asi* ... "That art Thou".

Chapter 12 – Gamma Ray Bursts and Answering Dr. Fermi's Question

I have written before about the lack of evidence of intelligent life elsewhere in our Galaxy. But recently I watched a potentially game-changing science documentary on Netflix that seems to be critically relevant to the issue of the existence of life, intelligent or otherwise, in our or any other galaxy. The Netflix documentary, which is quite accessible to people with little or no technical knowledge of astronomy or astrophysics, is entitled, somewhat melodramatically, *The Real Death Star* (hereafter *Death Star*). I watched *Death Star*, and began to formulate my own speculations about the possible effects of gamma ray bursts in any galaxy unfortunate enough to suffer one, in particular, the unfortunate consequences for life in general – and *intelligent* life in particular. In fact, my curiosity was piqued to such an extent by the material along toward the end that I began to do a Bing and Google search based on the five-word phrase "intelligent life gamma ray bursts". So imagine my astonishment when my Bing and Google searches returned several "hits": astrophysics papers, peer-reviewed and authored by credentialed professionals in the field, that basically repeated my previous naïve, non-professional speculations. Gamma-ray bursts (hereafter GRBs) may resolve the Fermi Paradox I referred to in my "Skeptic's Collection" columns that I linked to in the first sentence.

So what are GRBs? Back in … if I remember … the 60s, the US launched a constellation of satellites of the Vela series that were intended to monitor Soviet compliance with atmospheric nuclear-warhead testing. The detonation of a nuclear warhead produces an explosion that is very bright in the gamma-ray spectrum. So any test of a Soviet nuclear device in the earth's atmosphere would be detected in real time, and would constitute *prima facie* evidence that the USSR was violating warhead-testing agreements. But what the Vela constellation detected was not nuclear detonations in the earth's atmosphere, but nuclear detonations – tremendous gamma-ray fluxes – *in deep space*. How deep in space? Long story short, the gamma-ray sources, each lasting from a fraction of a second to a few seconds, were not even originating in our Milky Way Galaxy, because the explosions were not concentrated along the plane of our Galaxy. Instead, they were occurring at cosmological distances measured in millions, even billions, of light-years. Furthermore, the gamma-ray sources were pretty evenly distributed over the entire sky. Gradually, the awesome truth dawned on observational astronomers and theoreticians alike: to be as bright in the gamma-ray spectrum as these explosions were, and in order to be observed at such stupendous distances, whatever was causing the GRBs would have to be the most powerful explosions since the Big Bang. Eventually, it turned out that, once observational astronomers could detect the afterglow of a GRB, each GRB was associated with a very distant, cosmologically distant, galaxy. Each GRB was bright enough in gamma rays to be detected quite literally halfway across the observable Universe.

This begs the question of what causes GRBs. If you are interested in the details, I highly recommend you watch that Netflix science documentary, *The Real Death Star*. Again, long story short: it turns out that the only mechanism that can account for the output of that much gamma-ray energy is the collapse into a black hole of a super-massive star, perhaps a star of several-dozen, perhaps 20, solar masses. Such massive stars can collapse into black holes in a fraction of a second to a few seconds – the observed lifetime of GRBs – and in the process *convert the entire star's mass into energy*, according to Einstein's famous formula of $E=mc^2$. Because of the tremendous pressure of the collapse, the gamma-ray flux takes the form of two beams of energy emitted in opposite directions. Imagine a GRB as a lighthouse that emits gamma rays instead of visible light. So powerful are these two beams of gamma rays that any planet anywhere in the galaxy containing the GRB, and that lies in the path of the beam, will be fatally irradiated, basically sterilized of all life, **even if that planet is on the opposite**

side of the galaxy from the emitting GRB. (In fairness, I should say that not all GRBs are this powerful, but many are.) The radiation flux of GRBs is just that powerful. For any form of life, intelligent or otherwise, in that searing line of fire … well … it is point-game-set-and-match-hang-up-your-jock-strap-and-hit-the-showers. The show is over.

Now, you might think that if a planet were not in the line of fire, the radiation would have little or no effect. Instead of a lighthouse, imagine the GRB as a machine gun. If you stand beside the machine gun instead of directly in front of it, you would not be harmed. But GRBs are centered on black holes, and black holes are not machine guns. There is strong theoretical reason to believe that most black holes – and therefore most GRBs – not only rotate on their axis, but that **they also** *precess*. You can observe precession when a child's top begins to lose momentum and slow down: the axis of rotation begins to wobble. Something like this probably happens with black holes and GRBs: *the gamma-ray source begins to wobble*. Imagine that the soldier firing the machine gun is drunk and rotates the machine gun erratically as he fires it. In that case, standing beside the machine gun would probably afford no safety. So the GRB would not emit merely a *beam* of death, but a *cone* of death: the conical pattern described as the GRB precesses. *That would not affect the intensity of the gamma-ray flux, but* ***it would affect the area of the galaxy jeopardized by the GRB***. Furthermore, even if the angle of precession close to the black hole were only a fraction of an arc-second, far enough away from the black hole, the diameter of the cone of death would widen out to perhaps thousands of light-years – again, with no change in gamma-ray intensity. *Any form of life inside that cone would be exterminated* once the gamma-ray wave front reached it, even if the wave front, traveling at the speed of light, took thousands of years to arrive. It is quite conceivable that, depending on where the GRB was located, **the cone of death could sterilize the entire galaxy**.

Anyway, I think you probably see where I am heading in terms of relating this to Enrico Fermi's famous question vis a vis intelligent life elsewhere in the Universe: *Where* ***is*** *everybody?* Please understand: I am speculating now. But it may well be the case that numerous life-forms evolved intelligence, both in our Milky Way Galaxy and in other galaxies in the Universe, but that at some point, the galaxy hosting those intelligent beings was subjected to the gamma-ray flux from a GRB. In fact, one of the papers I discovered and cited in the first paragraph estimated that, over the last 500 million years, there is at least a 50-50 chance that our Milky Way Galaxy experienced a gamma-ray event and that this catastrophe may account for one of the five great extinction events in earth's history.

GRBs are rare. The only reason they seem abundant is because the Vela satellites, and subsequent generations of X-ray instruments, survey such an enormous volume of the sky. But as rare as they are, we should remember the following grim principle: **It Only Takes One**. (Actually, in the interest of not oversimplifying a complex issue, I should say that it is not this easy. How deadly a GRB can be depends on the type of GRB one is talking about -- astronomers have developed several categories of GRBs, some more energetic than others -- and *how the GRB's gamma-ray beam is oriented*. If the orientation of the cone of death is *out* of the galactic plane, relatively little damage could be done. If the cone of death is oriented *within* the galactic plane, it will be quite lethal. Think of my hypothetical drunken machine gunner pointing his machine gun *straight up* instead of more or less *parallel to the plane of the battlefield*. Also, to truly sterilize an *entire galaxy*, it would probably be necessary for the galaxy to suffer a few to several GRBs, appropriately situated, over a few-billion-year time frame -- just as it would be important to situate machine guns properly to provide fire cover for an entire battlefield. But a few billion years is a minuscule time-frame in a cosmos with **a history of around 13.8 billion years**. There is plenty of time for GRBs to extinguish life in *any* given unlucky galaxy.)

This is a rather dismal conclusion -- and, again, I am speculating -- given the vision evoked of potentially dozens (hundreds? thousands?) of extraterrestrial, even extragalactic, civilizations evolving and arising to greatness, only to be cut down in their prime by a single star, perhaps on the other side of the host galaxy, collapsing into a black hole and generating enough gamma radiation to sterilize the planet these magnificent beings inhabited. Should we someday achieve star travel, we may well find evidence of such civilizations in the form of ruined cities that were once inhabited multiple millennia, perhaps hundreds or even *thousands* of millennia, in the distant past. Once in a while, in such a distant future, we might even find and manage to decipher the records of those alien astronomers that recorded the GRB that was in the process of destroying their race and their civilization. For all we know, the Universe may consist of a vast array of cosmic graveyards holding the remains of entire civilizations. Perhaps a real-life *USS Enterprise* would be tasked, not with "discovering new life and new civilizations," but by writing the obituaries of dead civilizations -- and hoping that someone would be left to write our own, should the Milky Way Galaxy experience its own GRB whose beam was pointed at *us*.

(All of which begs a rather macabre question: *what would humans experience if the earth were in the path of the gamma-ray emissions from a GRB*? [The following is taken partly from *Death Star* and partly from my knowledge of radiation physics.] The answer depends partly on how powerful the GRB was and on its distance from us. For the most powerful GRBs, observations indicate that there is really no such thing as a "safe distance". First, we would see an apparent second sun in our skies: the GRB itself. At almost the same time, the very air around us would fluoresce a bright blue due to ionization. That would last a few to several minutes. Gamma ray ionization would promote the oxidation of nitrogen in the earth's atmosphere. It is also possible to speculate that the oxidation of nitrogen would "eat up" much of the oxygen in the atmosphere, by chemically binding the oxygen to nitrogen, so we might begin to suffocate for lack of free oxygen. [Some of the oxides of nitrogen would probably assume the form of nitrous oxide -- so called "laughing gas" -- which has a powerful sedative effect. So some of us would probably be very relaxed and "buzzed out" while we died. The Universe has a rather dark sense of humor. In addition, the intense gamma-ray flux might catalyze the formation of nitrogen **di**oxide, a precursor of nitric acid, which would turn the earth's atmosphere a kind of dirty reddish shit-brown. This just keeps getting better, right?] The ozone layer would almost certainly be stripped away, resulting in the loss of protection from solar radiation, especially in the UV spectrum -- which would, in turn, result in a fearful epidemic of carcinomas, especially skin cancers, due to DNA damage. There would be a similarly catastrophic epidemic of birth defects and outright sterilization of both men and women. Birth rates would plummet. Ditto apocalypse-scale damage to plants and animals and their reproductive capacities. All the above we could expect from a powerful GRB located within a light-year radius of, say, five digits, e.g., 10,000 or 15,000 light-years. Because of the finite speed of light, we would never see it coming, except for a few observational astronomers who might see it briefly before their eyes vaporized. We can only speculate how many intelligent species have had to deal with just such consequences over the billions of years of the Universe.)

However ... in all fairness, I should say that several papers have recently been published on the arXiv.org web site arguing that [a] intelligent technological species can, given highly advanced technical means, actually mitigate the effects of GRBs, or that [b] a "phase transition" model of the development of life in a galaxy can actually *benefit* from GRBs. Fear not! The math is only of freshman-calculus caliber.

Perhaps a perverse analogy would be to reminisce about Magic Slates. Are you old enough to remember playing with a Magic Slate? During my childhood and adolescence, I used them up and discarded them in numbers that would probably suffice to fill my car's passenger compartment and trunk. You sketched on the slate or wrote on it. Then, when you finished or got bored with what you had done, you erased your work by the simple expedient of lifting the films away from the slate underneath, eradicating all the pictures and text you had created on the Magic Slate. The existence of GRBs is theologically problematical: perhaps -- who knows for sure? -- God uses galaxies as a magic slate to create living beings, intelligent beings, eventually entire civilizations. Then, having become bored with Her creations, She lifts the film of the Slate by igniting a gamma-ray burst, clearing all life from the galaxy and wiping the Slate clean.

As the late Prof. Martin Reif, a history professor of mine at Wichita State University, was fond of saying when I was an undergraduate sometime in the Pre-Cambrian *Sic transit gloria mundi*.

Life is unfair.

Chapter 13 – Gamma Ray Bursts: A Second Bite of the Apple

Let's lighten up a little on the otherwise-unmitigated pessimism and gloom involved in considering the consequences of gamma-ray bursts (GRBs) for galaxies that experience them. The Universe is a big, **big** place, big enough that, even with GRBs irradiating galaxies, we might realistically anticipate that there would remain at least a few galaxies where GRBs did *not* occur, at least within the lifetime of an intelligent, technological species within such a galaxy. (I define "technological" as possessing means of communication capable of sending messages to other species in other star systems. By that criterion, the Earth is host to an intelligent, technological species of life.) So I propose we run the numbers and see what they look like.

We may consider the Universe as a sphere with a radius of, in round numbers, 14 billion light-years (ly). The formula for the volume of a sphere, which we all learned in junior-high school is:

$V_{sphere} = 4/3 \times pi \times r^3$

where r is the radius of the sphere. If we plug in the relevant numbers, we calculate that, for the entire Universe, the volume is

$V_{Universe} = 4/3 \times pi \times (1.4 \times 10^{10})^3 = 4/3 \times pi \times 2.74 \times 10^{30}$ cubic ly = **1.15×10^{31} cubic ly**

As I said, the Universe is a big, **big** place: that is *how* big in quantitative terms.

Now, let's suppose that there are, say, 100 intelligent, technological civilizations in the entire Universe. (Why 100? It is a round number, therefore easy to work with. In any case, the subsequent calculations are easy to modify if you like a different number. If so, feel free!)

This means that that volume of 1.15×10^{31} may be carved up into 100 sub-spheres, one for each of our intelligent, technological species. So each species is allotted a volume of

$V_{species} = 1.15 \times 10^{31} / 100$ cubic ly $= 1.15 \times 10^{29}$ cubic ly

What would be the radius of each such "species bubble"? Quite easy. Now that we know the volume of each "species bubble," we simply plug that volume into the above formula for calculating the volume of a sphere **and solve for r**, i.e. for the radius of the "species bubble". So we derive

$R_{species}=(3/4 \times 1/pi \times 1.15x10^{29})^{1/3} = (0.275 \times 10^{29})^{1/3} = (27.5 \times 10^{27})^{1/3} = (27.5)^{1/3} \times 10^9$ ly = 3.02 x 10**9 ly

(Note that, to derive the radius of the "species sphere," we have to take the **cube** root, because we are starting with a spherical **volume**, i.e. a three-dimensional quantity.

Note also that I am skating over issues pertaining to inflationary cosmology. If Prof. Alan Guth of MIT is right, as he almost certainly is, about inflation, then the above geometry is almost certainly too simplistic: if inflation is still occurring at remote places in the Universe, then this complicates the simplicity of the "species spheres" paradigm.

I am also skating over the issue of dark energy / the "cosmological constant". If the *entire Universe* is expanding, the "species spheres" as envisioned above are almost certainly too small: *everything everywhere is getting bigger and drawing away from everything else*. *My "species spheres" scenario is, at best, a snapshot of this moment in time.* Intelligent technological species will become progressively more remote from each other as the ages roll on, thanks to dark energy. But let's keep matters relatively simple for now, shall we?)

But now note that *that approximately 3 billion ly number only gets us as far as the outer surface of one "species sphere"*. To get to the center of the nearest "species sphere" from *there* -- i.e., to the location of the intelligent, technological species inhabiting it that occupies the center of that *neighbor* "species sphere" -- we have to travel an additional 3 billion ly, i.e., the radius of the nearest "species sphere". So the total distance to be traversed from one "species sphere" to its nearest neighbor is **approximately 6 *billion* light-years**.

So a signal, traveling at the speed of light in a vacuum, *would require 6 billion years to get from the sending to the receiving intelligent species*. **Six billion years is about half again as long as the entire Earth has been in existence** (about 4 billion years). Actually, even *that* is an optimistic estimate, because it tacitly assumes that each "species sphere" is *immediately adjacent to its neighbor*. In actuality, each "species sphere" would most likely be separated from its neighbors by who-knows-how-many billions of light years of empty space. It is almost certainly **not** the case that the "species spheres" would be packed, belly-to-butt and cheek-to-jowl, like morning commuters in a subway at rush hour or like eggs in a cardboard supermarket case.

So what is the bottom-line conclusion? There are 2, one optimistic, the other pessimistic. Let's consider the good news first.

- The **good** news is that, for reasons of blind chance if nothing else, it is unlikely that GRBs have eradicated literally *all* life, intelligent and otherwise, in the entire Universe
- However, the **bad** news is that it may well be the case that GRBs have "thinned the herd" to the point that the surviving intelligent, technological species are so widely separated that the speed of light renders communication between them impossible, both practically and in principle.

(It might be a fun exercise to re-calculate the above numbers under the assumption that there are, say, 1000 intelligent, technological species in the Universe; then, say, a million. I have done this, and the news is only marginally better, certainly not good enough to be realistically encouraging. In fact, here is a simple formula for calculating the radius of the "species spheres" for hypothetical numbers of intelligent, technological species:

$R_{species} = (3/4 \times 1/pi \times 1.15 \times (10^{31} / N_{species}))^{1/3}$

where $N_{species}$ is the number of intelligent technological species in the Universe you want to hypothesize, e.g., 1000, a million, etc., i.e., the number of "species spheres". $R_{species}$ will be the radius of each hypothetical species' "species sphere". But remember that whatever this radius turns out to be, you have to **double** it to get the true distance from one intelligent, technological species to its nearest neighbor. So, in the case of a *million* intelligent technological species in the Universe, the radius of the *million-species* "species spheres" will be a bit over 140 million light years. So the distance from one

intelligent technological species to its nearest neighbors will still be 2 x 140 million ly = 280 million ly. Anyway, have fun!)

Bottom line: there probably is no *Star Trek* or *Star Wars* galaxy teeming with intelligent life like students on mid-term college break in Fort Lauderdale.

Now, to be sure, all the above assumes that all the intelligent species, and therefore all the "species spheres" are *evenly distributed across the entire Universe*, as I said previously, like commuters at rush hour or like eggs in a supermarket carton. In reality, such an even distribution would most likely **not** be the case. For reasons of blind chance, if nothing else, there would most likely be some "clumping": intelligent, technological species comparatively close to one another. But, if that is the case, then Fermi's Paradox assumes an even sharper edge: *if there are indeed "clumps" of intelligent species sprinkled through the Cosmos, then the various "clump members" would surely at some point detect one another's electromagnetic emissions* – ***and it would be reasonable to conclude that we on Earth would detect at least a bare remnant of this "spillover,"*** rather like a dog picking up random scraps that fall from a banquet table. But, at least so far, that has not been the case. *We hear nothing. From **any**one. **Ever**.* "Oh," you say, "but perhaps the 'clump' is too far away!" Then we are back to the original even-distribution conclusion. You cannot have it both ways.

For all practical purposes, Enrico Fermi's famous question of "Where is everyone?" may have been answered by GRBs – plus, to be sure, more mundane catastrophes like cometary collisions, environmental catastrophe, and species-wide war. ***My conclusion: we are probably alone in the Universe***, in the sense that whoever else may be out there is separated from us by such a stupendous distance that communication is impossible. So even if someday we were to invent a workable warp drive, no passing Vulcan starship will help us celebrate.

Hence the Great Silence.

"The silence of these infinite spaces terrifies me." -- Blaise Pascal, *Pensees*

Chapter 14 – Do You Have the GUTs to Walk the Planck?

As a cosmologist, I am an educated but rank amateur. Consequently, I would be willing to bet money that the following remarks and questions will be so naive as to cause the toenails to ache of any actual professional cosmologist, and perhaps make them laugh so hard they will need to avail themselves of a good supply of Depends. I mean people the caliber of, e.g., Andrea Ghez, Alex Filippenko, Kip Thorne, Alan Guth, Vera Rubin, and others of like stature in the pantheon of theoretical cosmology, e.g. faculty of the Institute for Advanced Study. (In fairness, I have met and spoken with Profs. Ghez and Filippenko, and found them extraordinarily approachable, anything but condescending, and strongly predisposed to take lay people's questions with utmost seriousness. I suspect the same is true with the others. Cosmology is an incredibly humility-inducing discipline.) So I will ask my question, notwithstanding.

Posing my question requires some setup for the sake of context ... So please bear with the following … At the moment, the best that theories of the origin of the cosmos can do is to project backward up to – *but not including* – the Planck time, i.e., the time when what would become the four fundamental physical forces of the Universe – gravitation, electromagnetism, strong force, and weak force – were originally unified in a single "*Ur*-force". The Planck time is the time it would take a photon travelling at the speed of light to across a distance equal to the Planck length (approximately 1.6×10^{-35} m). This is the 'quantum of time', the smallest measurement of time that has any meaning: 10^{-43} seconds. At such scales, reality itself may look like a "quantum foam" with virtual particles forming and disappearing, virtual black holes opening up and closing, etc., etc. No less eminent a personage than John Archibald Wheeler has seriously engaged in this speculation. Only *after* the Planck time do concepts like *time itself*, the spacetime metric itself (the way we measure distance and account for the way gravity warps the spacetime manifold), causality, etc., have any meaning.

Before the Planck time, known physics – including Einstein's general theory of relativity and quantum mechanics – break down, producing proliferating infinities without any physical significance. (The technical term is to say that, when we try to conjoin relativity and quantum theory in an attempt to describe the Universe *before* the Planck time, we end up with a *"non-renormalizable theory,"* since no known physical quantity, not even gravity at the center of a black-hole singularity, has a *literally* infinite magnitude: *but we seem to live in an incorrigibly **finite** Universe*. Granted, this principle of finitude is more aesthetic and philosophical than empirical, but at the same time, *we have never encountered a physical quantity that is **literally** infinite*. So precedent is on the side of finitude.) The search for a renormalizable Grand Unified Theory (GUT), which will enable us to "walk the Planck," and thereby reconcile general relativity and quantum theory, thereby rendering all results finite is the current Holy Grail of theoretical cosmology. One might say that it takes real guts to tackle the problem of the GUT. Or one might not. Anyway … just to be supposing …

Now, finally, to state my question ... what I would invite you to consider is the possibility -- I do not claim it is more than that -- that there is, and can be, no single GUT. I.e., perhaps we do not -- no one has, because no one **can** have -- the GUTs to "walk the Planck". Rather, the possible -- *only possible* -- alternative I propose is, not a Grand Unified *Theory*, but a Grant Unified *Onion*. An onion has layers. If you peel back one skin of the onion, there are numerous other onion skins *underneath*. Perhaps Reality is like that. So far, we have peeled back one skin -- probably the outermost -- of the Great Cosmic Reality Onion (GCRO): *the part of the Onion **after** the Planck time*. (Actually, the outermost layer of the GCRO might be represented by Newtonian mechanics, but let's not quibble.) To peel back

another layer of the GCRO, we need to find a way to reconcile general relativity and quantum theory. I fully expect that, though perhaps not in my lifetime, cosmologists and quantum theoreticians will formulate a theory that gets us past the first layer of the GCRO, the part lying *before* the Planck time, and to a deeper, *pre*-Planck-time skin of the GCRO.

Now, at this point, no one knows what the mathematical formalism of such a theory would look like. Gifted physicists and mathematicians like Sir Roger Penrose have advanced elaborate and quite elegant theories. But what is lacking in all cases is empirical verification. Ditto string theory. (Indeed, quite serious professional cosmologists have questioned whether string theory is a *scientific* theory at all, given that there seems to be no way to derive predictions from the theory, and no way to falsify any such predictions even if such were made. In any case, string-theory math is notoriously intractable. Prof. Edward Witten has discovered a way to derive five separate string theories from the original string theory, and to synthesize them into a single theory called "M theory" -- which is about equally incomprehensible. One need not be a cosmologist of Witten-esque stature to fairly ask if replacing a single theory with five string theories that are equally irresolvable constitutes progress.) Given that we do not know what that formalism looks like, *is it not possible -- "likely" is no doubt too strong a word -- that once we have that pre-Planck-time formalism in hand, we will discover, lurking within the math, additional anomalies analogous to the non-renormalize-ability of current cosmologies?* **In other words, is it not at least possible that, instead of a single GUT, we will need to peel back yet another layer of the Great Cosmic Reality Onion?** And so we will need yet another GUT.

There may be a multitude of GUTs -- one for each skin of the Great Cosmic Reality Onion, each fitting into the other like those Russian *matryoshka* dolls -- and, in fact, we cannot rule out the possibility that a comprehensive theory of Reality may be something *we can only approach **asymptotically***, just as the function f(x)=1/x approaches zero asymptotically as positive x increases without bound. So I would speculate -- again, it is no more than that -- that, at the end of the day, the very Beginning of the Universe -- where time, t, is identically equal to zero -- *may be **in principle** inaccessible*, just as zero is inaccessible to f(x)=1/x, i.e., we can get arbitrarily close but never actually there. Or time t equals identically zero may be in principle inaccessible for the same reason the precise value of pi is inaccessible, no matter how many terms you include in the Taylor series approximation. That is just the nature of f(x)=1/x; that is just the nature of pi. You cannot get there from here. Close, but never *there*. So, even if it exists, what would a GUT look like that could take us back to time equals identically zero?

I do not know. I do not even know if such a theory, such a GUT, *could* exist. No one does.

"The only wisdom we can hope to acquire is the wisdom of humility. Humility is endless." -- T. S. Eliot, *Four Quartets*, "East Coker"

Chapter 15 – Mannequins, Meat-Dolls, and Mozart

I want to solicit the help of – as strange as this is going to sound, coming from me – conservative, pro-life / anti-abortion, evangelical Christians in understanding something that has happened to me multiple times in debates about abortion. By "multiple times," I mean so often that I have come to expect some cognate of this pattern to recur as a matter of course. As you might expect, the whole debate turns on the issue of the "ontological" status of the fetus in the mother's womb: *is the fetus a human person or not, and if the fetus is human, when in the pregnancy does the fetus attain this status of person-hood?* As I have said elsewhere, I have no idea what the answer to the above italicized question is, and my entire stance of being pro-choice is predicated on my **ignorance** as to that issue. I simply do not know, and even if I did know, I would not feel free, in light of what I insist is the ambiguity of the various philosophical and scientific issues involved, to impose that answer on anyone else as a matter of law. I only have an opinion, and opinions are like anuses: everyone has one. Anyway, this is the pattern. Judge for yourself …

Whenever I express any reservations about deeming the fetus unambiguously human, my pro-life discussion partner always – I can recall no exceptions – responds with a kind of check-list of criteria that any biological organism must satisfy in order for us to classify that organism as a human person. For example:

o The candidate organism must possess a fully articulated genome of DNA that marks it as a human person.

(I keep saying "human *person*" instead of "human *being*" in order to exclude from consideration those in a persistent vegetative state that evince no, e.g., consciousness of self, cognitive activity, etc., etc. Even in such "flat-line" cases, I am still not sure whether they qualify as human persons or not. I mean cases like the tragic case of Shelby [Julia Roberts] in the movie *Steel Magnolias*. I do not propose to resolve that issue here. I am talking now about **person**-hood, not mere and purely ontological "**being**-hood". Nor do I propose to address the issue of the ontological status of advanced primates like the great apes, chimpanzees, etc., etc., whose DNA matches that of human beings in excess of 95% -- other than to say I am increasingly uncomfortable with using such creatures, such close cousins of human beings, in potentially painful and lethal laboratory experiments.)

o The candidate organism must have the ability to engage with homeostasis with its environment.

It must be capable of modifying its environment, either internally inside its own body, and / or by intervening in the environment, in order to ensure conditions capable of sustaining its own life. This is not to say that such homeostatis must be *successful*. Someone cast adrift in, say, low-earth orbit or on the surface of the moon without a space-suit or similar artificial environment would probably attempt to achieve homeostatis -- but, under those conditions, they would be unsuccessful.

o The candidate organism must engage in cellular reproduction, mitosis, etc., etc., as is the case with all multi-cellular organisms.

It is often asserted that even cadavers, for a certain period of time, keep growing fingernails and hair. I do not know if these specific examples are the case, but one of the universal characteristics of human persons is that they, at some level and to some extent, *engage in physical growth and development.*

The problem I have with this entire way of addressing the issue of the person-hood of the fetus is that **it concentrates exclusively on the properties of mere meat**. According to this argument, a live cow or a great ape would have an equal claim to human-person-hood. (Basically, my conservative / pro-life Christian interlocutor is arguing that *purely and exclusively phenotypic and genotypic considerations* – see the first "Skeptic's" column linked to above for the definitions of these important terms – suffice to distinguish a biological organism as a human person.) Just meat. Just tissue. Granted, meat and tissue with some interesting properties, e.g., human DNA, the ability to maintain homeostasis with its environment, cell duplication / regeneration / mitosis, etc., etc. But still … **just meat**.

Now, at this point, I must be careful in my response not to overreach by claiming I know more than I do. Again: **I have no idea when in pregnancy a fetus assumes full person-hood**. My consciousness of that ignorance, of my "known unknowns," is why I am content to leave the abortion decision up to the pregnant woman, her partner, and her doctor, at least up to a certain stage in the pregnancy, i.e., until that stage of the pregnancy when the person-hood of the fetus is difficult to argue *against*. (For the *Roe* Court, this would be sometime during the third trimester.) All I claim to know is that, as I said in the second column I linked to in the first paragraph, my knowledge of biology – not that I claim competence as a professional biologist or geneticist: I do not – leads me to conclude that *the person-hood of the fetus must be assessed as a phenomenon that occurs **along a continuum***, not as a digital, on-off phenomenon like flipping a light switch. (Actually, even turning a light on is likewise a continuum: it just *seems* to occur instantaneously. A better example would be certain quantum phenomena. But let's not go there.) The becoming-human of a fetus is like the coming of the dawn. Dawn occurs along a continuum. The dawn … well … the dawn … **dawns**. (Not for nothing do we say that, when a person gradually arrives at some crucial realization or insight that "It dawned on them" or "It dawned on me". Not for nothing did Aeschylus say "Pain that we cannot forget falls drop by drop upon the heart until ... against our will, comes wisdom." Yes. Exactly.) I admittedly belabor this point only so that you will not read into the following more certitude than I claim to possess.

Even with all the above phenotypic and genotypic considerations in place, even with all the check-boxes ticked off in the purely physicalistic / phenotypic / genotypic inventory of fetus-as-meat, I would notwithstanding argue that **there is still something missing**, something critical, in fact, something *sine qua non* in terms of the definition of what constitutes a human person. Without that critical item – without that All-Important Great Cosmic Check Box, if you will – a human being would still be merely what I call a "meat doll": basically, a department-store mannequin made of flesh.

What is that missing *sine qua non*, that *je ne sais quoi*?

Different cultures, different philosophical traditions, different religions have different names for this Check Box. Some call it "spirit"; some, "soul"; some, *elan vital*; some, *nefesh*; some, *ruach*; some *neshamah Adonai* (those last three are intimately related in the Jewish understanding); some, sentience; etc., etc., etc., etc. Pick your own word. It is revealing that, in Mary Shelley's novel *Frankenstein*, Dr. Victor Frankenstein had to introduce *electricity* into his composite cadaver – i.e., something not accounted for in the meat of the corpses – in order to endow his creation with self-consciousness, sentience, or … call it what you will … **something else more than and in addition to mere meat was required**.

This is the conundrum faced by all pro-life people who yearn to encode the person-hood of the fetus into civil law: the person-hood of the fetus, that which makes the fetus a person endowed with rights,

is essentially and irreducibly religious. Therefore, being religious, this missing element may not be inscribed into the civil law. Why? Because the "establishment clause" of the First Amendment prohibits writing religion into the law. Various religious traditions are quite free -- under the co-equal "free exercise" clause -- to oppose abortion for religious reasons. **But writing those reasons into the law of the Nation is a Rubicon whose crossing is sternly forbidden by the US Constitution.**

All these expressions, as different as they are otherwise, have in common that that missing ingredient is whatever it is that distinguishes Handel from hamburger, Picasso from porterhouse, Mozart from meat. Whatever that missing element is enables what would otherwise be a mere meat doll to become Antonio Allegri and write the great *Miserere*; to become Stan Getz and play a foot-stomping, finger-snapping tenor-sax riff; to become Einstein and formulate General Relativity; to become Picasso and paint *Guernica*; to become Bach, instead of beef, and to write *The Brandenburg Concertos*; etc., etc., etc., etc. No meat doll will ever write Mozart's *Violin Concerto No. 3 in G*; will ever become Franz Josef Haydn and write *String Quartet in F-major*. No meat doll could ever sing the great Edith Piaf's *La Vie en Rose*.

And here is the crowning irony: whenever our debate / discussion reaches this point, I find myself in the anomalous position of being the on-again / off-again atheist (or maybe agnostic) and half-assed Buddhist who is arguing *in favor of* the existence of the soul / spirit / … pick your own word ... whatever ... *over the opposition of my conservative Christian debate partner*, who only wants to talk about meat. I always thought, and was brought up to believe, that Christians were supposed to be in the business of *saving* souls, not in the business of *needing souls' existence proven* to them by someone they would consider an apostate. **But I find myself, of all people, cast in the latter role.**

How did that reversal of positions occur?

That is what I would like to have explained to me.

Any takers?

Chapter 16 – Toward the Cultivation of an Intellectual Conscience

Sometimes I am driven, against my more charitable instincts, to wonder just what it takes for advocates of creationism and intelligent design (ID) to grow an intellectual conscience. I am referring, of course, to people who should know better, in fact, people who have no business **not** knowing better. The latest example is courtesy of Howard Smith, as cited in a recent issue of David Klinghoffer's creationist / ID blog EvolutionNews.org. In that blog, Smith – or perhaps Klinghoffer's citation of Smith's text – irresponsibly **mis**quotes Prof. Stephen Hawking and **mis**represents the Anthropic Principle so as to **mis**interpret both as lending support to Klinghoffer's blatantly creationist agenda.

Klinghoffer cites Smith as claiming that Hawking asserted on a TV documentary *Reality on the Rocks* that "The human race is just a chemical scum on a moderate-sized planet." Klinghoffer asserts that Carl Sagan paraphrased this sentiment in Sagan's celebrated series *Cosmos* by saying "We find that we live on an insignificant planet of a humdrum star." The YouTube video of Hawking's assertion has been taken down because of alleged copyright infringements. But if Klinghoffer is correct that Sagan's assertion is a paraphrase of Hawking's view, then either Klinghoffer is misusing Hawking's statement (or Smith is misusing it) or Klinghoffer is mischaracterizing Sagan's statement as a paraphrase of Hawking's. One of those has to be the case. Sagan did indeed make the attributed statement. In fact, Sagan states that sentiment over and over again, just in different words, throughout most of *Cosmos*. But if you take the trouble to consider the statement in full context – something Klinghoffer evidently is not required to do by his professional ethics – you find that the on-the-surface intent of Sagan is quite the opposite of Klinghoffer's interpretation. Sagan is concerned to emphasize, **not** the **in**significance of the human race, as Klinghoffer alleges, but to affirm, to emphasize, even to magnify that significance. *Human beings, Sagan argues, are significant **precisely because** we are so rare, so fragile – so weak, if you will* -- such shining examples of warmth and of life, individual and infinitesimal oases of meaning in an otherwise dark, hostile, and meaningless Cosmos. When considered in full context, the true spirit of Sagan's assertion – and if that is indeed a paraphrase, of Hawking's statement – is contained in that magnificent jumble of fragments, the *Pensees* of Blaise Pascal (boldface added):

Man is a reed, the weakest of nature, but he is a thinking reed. *It is not necessary that the entire universe arm itself to crush: a vapor, a drop of water suffices to kill him. But if the universe were to crush him, man would still be nobler than what kills him, because he knows that he dies and the advantage that the universe has over him, the universe does knows nothing.*

So … y'pays y'money and y'takes y'choice. If, as Klinghoffer argues, Sagan's statement is a true paraphrase, a mere restatement in other words, of Hawking's opinion, then Hawking's evaluation is actually just a recasting of Pascal's "thinking reed" humanism, i.e., the exact opposite of an assertion of humans' insignificance. On the other hand, if Hawking is indeed denigrating the significance of humans in the greater cosmic scheme of things, then *in no sense whatsoever* can Sagan's statement in *Cosmos* be interpreted as a paraphrase. But in either case, Klinghoffer has used those respective statements dishonestly to further his creationist / ID agenda.

A similar critique applies regarding the Anthropic Principle (AP). Re AP, Klinghoffer makes the same error of confusing cause with effect that many critics, especially ID-motivated critics, make when they talk about the AP.

The universe, far from being a collection of random accidents, appears to be stupendously perfect and fine-tuned for life. The strengths of the four forces that operate in the universe -- gravity, electromagnetism, and the strong and weak nuclear interactions (the latter two dominate only at the level of atoms) -- for example, have values critically suited for life ...

This is just true enough to be dangerous. For example, given what we know of the time-scales of evolution, it is a pretty safe bet that if Newton's gravitational constant were such that stars burned so hot they typically evolved from primitive gas cloud, through the mature stars, to neutron stars or black holes or red giants in, say, 100,000 years, or even a million years, there would simply and literally **not be enough time** for life, at least intelligent life, to evolve. What Richard Dawkins aptly calls the greatest show on earth would be over before it even began, at least *vis a vis* sentience.

However, in other respects, Klinghoffer does confuse cause with effect. For example, with regard to the alleged "fine-tuning" of physical parameters. It would be possible to argue, and I have even seen it actually argued, that the earth's oxygen-rich atmosphere is "fine-tuned" to support our kind of life. But it was not always thus. There was a time when the earth had a **reducing** atmosphere, i.e., an atmosphere that, among other characteristics, was oxygen poor, an atmosphere in which our oxygen-loving form of life – never mind anaerobic bacteria – would be **poisoned** by oxygen. But one can still play "anthropic games" with intelligent, oxygen-**averse** life: one intelligent oxygen-**averse** being says to another "How wise God was in creating a planet with no oxygen … just so we would not end up breathing such poison and die!" Or one can imagine intelligent denizens of, say, the moon Titan going out for a stroll to admire Saturn hanging majestically in the sky, get a breath of fresh methane, and to thank their God for creating a moon with**out** oxygen and with**out** nitrogen and other atmospheric poisons. In other words, the mere fact that intelligent species S(X, Y, Z) evolved under conditions X, Y, and Z does **not** warrant the inference that conditions X, Y, and Z were "pre-configured" as they were *in order to* result in species S(X, Y, Z). Swap out X, Y, and Z for an equally probable alternate set of conditions A, B, and C and – given our experience just on earth, never mind other planets – there is a substantial and non-negligible chance that we would end with a different, but equally sentient, species S(A, B, C). (I invite you to consider the late Stephen Jay Gould's fascinating argument, in his book about the Burgess Shale *Wonderful Life*, that even earth-like conditions could have produced a different form of life – or no life at all – if one were to hit a "Reset" button and run evolution all over again.) Conditions drive evolution, not the other way round – at least until sentient beings become intelligent and technically proficient enough to alter their own environment and direct their own evolution.

But there is a still-deeper problem with Klinghoffer's argument, especially vis a vis the AP: how can we distinguish a natural from an artificial – the latter meaning "sentiently created" – entity or event? I dealt with this issue at greater length back in January of 2015 with my thought-experiment of a New Guinea native finding a wristwatch in the jungle. How would my hypothetical New Guinea native, who, by hypothesis, had never encountered any artifact of a technological civilization beyond perhaps, say, a jet's occasional contrail high overhead, know that the wristwatch was not some exotic, never-before-encountered plant? (For all their faults otherwise, the arguments presented by ID author Michael Behe do evolutionary biology a service in that they do persist in raising just this issue. His answers are untenable, but the questions remain legitimate.) Or perhaps a gift from the god(s) a la 1984's *The Gods Must Be Crazy*? As I said in my 2015 column, this was an issue David Hume raised with far more sophistication than I in his argument against miracles. Paraphrasing Hume, we can say which things / entities / artifacts / events are artificial and which are natural because we have seen them

manufactured or occur naturally, or at least read accounts of such, multiple times. But we have never seen a universe come into existence, and so lack the competence to make such a "global", ID-friendly assessment. And be such an event ever-so-improbable, mere improbability alone is no warrant for justifying an inference of Divine intent. Klinghoffer's reasoning, and ID / creationist reasoning generally, about such "ultimately improbable" events as the origin of the Cosmos requires an act of hubris that would make that of Lucifer look positively modest by comparison. Rather than rehearse even my "Cliff's Notes" article on Hume's argument, I will invite you to read that "Skeptic's" column and then do a deep-dive into Hume's An Enquiry Concerning Human Understanding, especially Section X.

Growing an intellectual conscience requires allowing one's sources to speak for themselves, in full context, not just the parts that support your thesis, and also to consider even those nuances of the subject that weaken your position, not just the ones that strengthen it. I recommend both practices to those committed to ID and creationist ideology -- and caution their readers that there is still a long road to travel to that ideal.

Chapter 17 – Chaos, Convergence, and Consequences

Sometimes even smart and literate people are somewhat naïve when it comes to science. We had an example just recently when educated and sophisticated people compared prevalent conservative skepticism about climate change / global warming with almost non-existent skepticism about the causes of the recent solar eclipse. But this turns out to be a case of dueling misconceptions about differences in scientific methodology: the methodology used to substantiate climate change and the methodology used to account for solar eclipses. The differences are subtle, requiring a working knowledge of the history of science, but important in appreciating the extent to which the two cases – climate change and eclipses – are not *quite* comparable. Almost. But not *quite*.

I am riding this particular horse off a rhetorical cliff, rather like Butch Cassidy and the Sundance Kid, because, ever since the recent eclipse, I have heard people compare the popular reactions to the eclipse and to climate change along the following general lines. The following is one of the two dueling misconceptions. Everyone, even the most hard-core climate change deniers -- literally *every*one -- grants science unconditional trust when it comes to eclipses, accounting for when and why they occur, predicting them, etc. But those same skeptics, who so readily believe in scientific accounts of celestial events like eclipses, balk like a recalcitrant mule – this is the second dueling misconception -- when presented with equally massive evidence substantiating climate change / global warming. The conclusion is that such an attitude is an explicit contradiction: after all, so the argument goes, **the same** scientific method that accounts for, e.g., climate change is **the same** scientific method that accounts for solar eclipses. **Why grant the latter a level of credibility that is denied to the former?** Is that not like calculating the square root of 2 on my Android and believing it, while doubting the value of the square root of 2 if calculated on my iPhone?

Problem is, it really is not quite the same thing as Android v. iPhone. And here is why …

Think about how Johannes Kepler, very early in the 1600s, developed Kepler's Laws of planetary motion. Remember: *Kepler accomplished this feat well over 80 years before Newton developed his laws of motion* – and, by the by, the mathematical discipline of differential calculus – in the great *Principia*. All Kepler had to go on were the voluminous but **purely empirical naked-eye** observations of the great Dutch astronomer Tycho Brahe (rhymes with "fry"), who ranks as one of the two or three greatest observational astronomers who ever lived, not least because *Brahe made his observations well before the invention of the telescope*. (Galileo would not peer through a telescope until around 1610, maybe slightly later.) Brahe was also an unrepentant party animal – when Brahe gazed at the night sky, his eyes were probably not all that were naked! -- whereas Kepler was a driven, dour, straight-laced Reformed Protestant, who had to wait for Brahe to take time out from his (Brahe's) bibulous dissipations just long enough to dribble out a few more precious pages of astronomical observations.

Notwithstanding, this was a marriage made in heaven: Brahe was almost OCD-like in the meticulous precision of his (again: **naked-eye**) observations and in the organization and recording of same, but lacked mathematical imagination; Kepler was a virtuoso mathematician, in fact, a kind of mathematical mystic – he wasted time trying to account for the motion of the planets by using the Platonic solids – but lacked raw data until he met Tycho Brahe. *Kepler's seismic discovery was that, hidden within the apparent chaos of Brahe's mega-reams of individual observations, there was a sublime and elegant pattern:* ***Kepler's Laws of planetary motion***. Eighty-plus years later, Sir Isaac Newton – like Kepler, also a 17th-century mega-nerd and a radically **non**-party-animal – would formulate his laws of motion

that account for why Kepler's laws are as they are. In fact, if you take a decent course in celestial mechanics these days, you will probably derive Kepler's laws as *purely analytical theorems*: special cases of Newton's laws. If you start with Newton's laws, plus the values of some fundamental parameters like Newton's gravitational constant, you don't even need to go outside and look up at the sky to derive Kepler's laws. All you need is pencil and paper.

The reason I describe this as a "seismic" result is because, from Kepler and Newton on, all you needed to describe the entire Universe **in classical-physics terms** was the value of a few – maybe a dozen-plus – constants like pi, Newton's gravitational constant, something called the "fine-structure" constant, the value of the unit charge on various particles like the electron, etc., etc., and the rest was sheer pencil-and-paper calculation. Predicting eclipses, as Newton's friend Sir Edmund Halley demonstrated in the late 1600s when he predicted the return of what came to be known as Halley's Comet, became a simple (seriously! it really is!) exercise in spherical trigonometry, no gazing through a telescope needed. (Quantum mechanics is **non**-classical, so you have to learn to live with arrays – "vectors" – of probabilities instead of determinate values; hence the "classical-physics" qualifier above.) The point is that the entire zoo, the whole riot of individual, discrete empirical observations, the eye-crossing jumble of numbers, had been corralled into an all-encompassing set of mathematical rules. The most highly developed sciences – physics, cosmology, eventually relativity, and even quantum theory (with the above *caveat* about living with probabilities) -- became *exercises in pure mathematics*. At the most fundamental level, the Universe is elegantly, astoundingly **simple**.

This is where the analogy to the reasoning behind global warming and eclipse predictions breaks down. The latter is an instance, in fact, a classical instance, of the mathematically rigorous discipline of celestial mechanics – an extension of Newton's and Kepler's laws. With Newton and Kepler and comets, we have an excellent and exhaustive grasp of what the general laws / rules are, and can express these laws and rules *quantitatively* via the medium of mathematics, e.g., we know with excruciating precision when Halley's comet will return and when there will be another solar eclipse over the American mainland. *But we do not have anything even remotely approximating that kind of predictive, quantitative power in fields like climatology, paleo-climatology, etc*. If we did, we could have predicted the origin and path of, e.g., Hurricanes Katrina, Harvey, and Irma years … decades … ago, and would not have to settle for multiple model-based "spaghetti diagrams" of all their possible paths. Weather is different from climate, but the two do have this in common: *both weather and climate are inherently, intrinsically* chaotic systems. We can model both, but after a very limited period of time -- typically a few days for weather – the predictions based on those models "diverge", i.e., cease to accord with empirical reality.

Does this mean that the climate change skeptics may be right? **Absolutely not. Climate change is real. Period. Full stop.** But the *reason we know* climate change is real is not because we have anything analogous to Kepler's laws of planetary motion or Newton's laws. Unlike planets' orbits, climate and weather, and changes thereto, are chaotic systems. (Actually, in the very strictest technical sense, planetary motions are also chaotic, but over spans of time measured in multiple billions of years, not the eye-blink of a few millennia. So celestial mechanics affords us the *temporally grounded illusion* of permanence and stability.) With climate and weather, we have to do what Brahe and other astronomers did, pre-Newton and pre-Kepler: make the best we can of large samples comprising petabytes of climatological and paleo-climatological information. This is the 21st-century version of the 17th-century Big Data-mining that Kepler performed with Brahe's astronomical observations. Try

to imagine predicting solar eclipses using sheer masses of Brahe-like individual, empirical, naked-eye observations: that is why Kepler's accomplishment is so drool-inducingly awesome.

Will there come a day when, as with Brahe and Kepler, we can comprehend the complexity of climate exhaustively in a set of mathematical expressions that will have the same precision, the explanatory, and the predictive power *vis a vis* climate that Kepler's and Newton's laws possess *vis a vis* astronomy? Well … never say "never" … but given that, with climate, we are dealing with chaotic systems constrained by relatively short (on a cosmic scale) time-frames, I would make bold to say "No". Large-scale quantum computing might extend the time before the models' predictions diverge, but I expect there will always be a limit. Chaotic systems are **deterministic**, but that does not mean they are exhaustively **predictable**.

(Even within chaotic systems, however, there is a deep order. It turns out that if we take all the relevant parameters of any chaotic system, we can construct a multi-dimensional "phase space" of all the possible states that any chaotic system can occupy at any given time. The topology of a chaotic system's "phase space" is always an elegantly beautiful fractal which is invariant with respect to scale, i.e., the "phase space" looks the same, no matter how microscopically you examine it. Zoom in on the "phase space". Zoom out on the "phase space". *It always looks the same.* Chaos theoreticians talk about "scale-invariance" of phase spaces in chaotic phenomena. If you find this side-note confusing, just ignore everything between the parentheses.)

The point of all the foregoing is that, yes, **in the foregoing limited sense** eclipses and climate change studies do share a common generic methodology, but only in the sense that, as is always the case with science, observation always constrains theory. In that sense, again yes, both climatology and eclipse prediction are instances of the scientific method. Beyond that, the methodologies are different in that eclipse prediction and description have the luxury of being describable in terms of very terse mathematical algorithms, whereas fields like climatology are always working "down in the weeds" with pure data.

Asserting without qualification or nuance that the two methodologies are "the same" is just true enough to be misleading, and so only muddies the water.

Chapter 18 – The Clandestine Optimism of *Interstellar*

This "Skeptic's Collection" column is dedicated to the life, work, and memory of the late Prof. Stephen Hawking, Lucasian Professor of theoretical physics and cosmology, Cambridge University, United Kingdom. "To strive, to seek, to find, and not to yield." -- Alfred, Lord Tennyson, "Ulysses"

If you have not seen the movie *Interstellar*, with Matthew McConaughey, Anne Hathaway, Mackenzie Foy, and John Lithgow, you should walk – not run – to the nearest theater or streaming service and watch it. *Interstellar* is a not just a science-fiction (SF) movie, it is a **science**-fiction movie, i.e., it does not cut any corners in terms of depicting the *actual consequences* of near-light travel, e.g., time dilation, black-hole physics, etc. (In that respect, *Interstellar* is a cinematic fraternal twin to Dan Simmons's excellent **science**-fiction novels *Hyperion* and *The Fall of Hyperion*.) Many of our most admired science fiction sagas – *Star Trek*, *Farscape*, *Babylon 5*, *Star Wars*, etc. – skate over the *sociological and psychological* consequences of near-light travel by the simple expedient of *ignoring* relavitity, leaving entire universes of potential reflection and exploration unattended. We concentrate on the science and forget the people. Prof. Kip Thorne, a Cal Tech Nobel Prize winner, has recently written a virtuoso book, *The Science of "Interstellar,"* that tackles explaining the science of the movie to an educated lay audience. But, presumptuous as it sounds, I want to supplement Prof. Thorne's book by similarly tackling what I call "The *Sociology* of 'Interstellar'". To that end, I propose a radical thesis: **the most formidable problems standing in the way of interstellar exploration will eventually prove to be, not technological, but sociological**. The most formidable obstacles lie not in the stars or in our machines, but in ourselves.

In the world of *Interstellar*, the resources of near-future Earth are on the brink of exhaustion because of humans' irresponsible and short-sighted exploitation of their home planet. Water is scarce. Crops fail. (The only way humans can eke out a bare subsistence from our ravaged world is by developing increasingly hardy varieties of genetically engineered *corn*.) There is a planet-wide Dust Bowl. The New York Yankees are reduced to playing sand-lot, pick-up games of baseball with local teams for food and lodging. McConaughey's character, Cooper, a farmer, is a member of the penultimate generation for whom the planet will be marginally habitable. The next generation, that of his daughter, Murphy ("Murph" ... Mackenzie Foy as Murph at age 10, Ellen Burstyn as grown-up), is the generation that, in order for humanity to survive, **must** leave our exhausted earth and colonize other worlds.

At this point of crisis, a wormhole is discovered in orbit around Saturn. Because wormholes are inherently unstable, persisting only perhaps a fraction of a second, the permanence of the wormhole decisively indicates that it is an artifact of high intelligence. (Disclosing the builders of the wormhole would spoil the movie.) A project is undertaken by the sparse remnants of NASA to launch a spacecraft, the *Endurance*, to fly to Saturn, enter the wormhole, presumably emerge in some distant part of our, or another, galaxy, and begin prospecting for habitable worlds. There is real reason to hope: automated probes, sent through the wormhole in advance of human explorers, transmit back information about four potential candidate worlds, all orbiting a supermassive black hole the human astronauts, who will follow them in the *Endurance*, appropriately christen "Gargantua".

To travel to the vicinity of the wormhole, the four-person *Endurance* crew – plus what I think is the coolest humanly intelligent robot ever to appear in an SF movie – undertake a 3-year journey to Saturn. No surprises here. They are traveling fast but far less than the speed of light over great but far less than

cosmologically significant distances. It is when they traverse the wormhole and begin to orbit the worlds around the black hole Gargantua that relationships, as well as spacetime itself, begin to warp. It is then that questions arise about the limits and capabilities of human individuals and human societies.

The first such question, in fact, one of the milder questions -- by now actually rather cliche among the scientifically literate -- is the way the intense gravitational fields encountered near Gargantua, combined with the immense distances traversed by communication signals to Earth, result in the rapid aging, relative to the *Endurance*, of the loved ones Cooper, *et al.*, left behind *vs.* the essentially **non**-aging, relative to Earth, of people on board the *Endurance*, who are subject to the time dilation resulting from Gargantua's immense gravitational potential. Video-conferencing with Murph and her brother Tom (Timothee Chalamet) reveals that, during the astronauts' brief time of the *Endurance* reference frame, **decades** have passed on Earth: Tom now has grey hair, has gotten married, and is a father; Cooper's father has passed; Murph, now a young woman, has matured into a scientific prodigy; etc., etc. This begs questions of tectonic significance: *when traveling near the speed of light and experiencing radically different times in different relativistic reference frames, how are humans to maintain vital relationships* ... and even can those relationships, so constitutive of the human condition, *be maintained at all*? And what, anyway, does "maintain" even mean in such a context? Relativistically significant gravitational potentials will tear matter apart. Will the associated time dilation, relative to remote observers, do as much damage to human relationships, and therefore to the human spirit?

But the consequences of actually landing on the surface of one of the four candidate worlds orbiting Gargantua are, if anything, even more wrenching. The more intense a gravitational potential, the slower time passes *as observed from a reference frame arbitrarily remote from that potential*. In the case of that one candidate world, the difference is significant. (The dialogue among the *Endurance* astronauts at this point, if transcribed and read with care, would constitute the framework for an excellent first course in general relativity.) In the specific case of this one candidate world, the strength of Gargantua's gravitational field at that point -- dictated by the mass of Gargantua and the distance of the candidate world from Gargantua's event horizon -- means that, *for each* **hour** *the astronauts spend on the candidate world's surface, seven* **years** *pass on Earth*. Go to bed and get a good eight hours of sleep on the candidate world, and when you wake up, *it will be 7 years / hour x 8 hours* = **56 years later** *on Earth than when you went to bed.*

Given that the entirety of planet Earth is living on borrowed time, the counsel of Dr. Brand (Anne Hathaway), an *Endurance* astronaut and the daughter of Cooper's professor and mentor on Earth (Michael Caine), is especially urgent: time must be considered a scarce resource. Every hour spent on the planet's surface is seven years subtracted, not only from the physical life of our planet, but from the viability of its socio-political structures and the very psychology of its inhabitants. As the environment breaks down, so do the bonds holding together societies, political systems, and human relationships.

(In fact, the equations describing time near a black hole indicate that, as one approaches the event horizon, time passes more and more slowly [at least for a non-rotating black hole ... an important qualification ... but let's not get lost in the weeds], and in fact, precisely **at** the event horizon, time simply stops. An observer outside the event horizon would therefore see an in-falling object "get stuck" on the event horizon, like a fly on flypaper. What happens with respect to time *inside* the event horizon?

No one knows. Attempting to calculate that means attempting to calculate the square root of a negative number [i.e., $r_s > r$ in the above linked article]: general relativity breaks down.)

There are multitudes of other aspects of the sociology of *Interstellar* we could explore. One of the more enticing, in fact, is the potential relationship between humanly intelligent robots, like the robot on the *Endurance*, who is *de facto* the fifth member of the *Endurance* crew, and human beings. Could such robots serve as, essentially, human surrogates as the possibility of human-to-human relationships undergoes gradual attrition because of relativistic time dilation? Such robots could be programmed to provide emotional comfort to humans without, for all that, being subject to feelings of bereavement through humans' absence. "Comfort robots" could support without *needing to* **be** *supported* by their human companions. (This is, of course, just a form of the classic "Turing problem": if the responses of a robot are indistinguishable from those of a human being, then is there really a difference at all? Are phenotypic differences really all that decisive? This would probably be an even sharper question during a future age when technology enabled light-speed travel. Robots would incorporate cybernetic human parts -- basically, benevolent cyborgs as in the later *Terminator* movies -- and *vice versa*.) They might serve the same purpose as "comfort animals" for emotionally fragile humans. I find that possibility at once horrifying and intriguing. But I think a more compelling issue is what *Interstellar* implicitly says about the implications of human mortality for the exploration of "cosmological" space.

The human species evolved in an environment that neither rewarded nor encouraged long-term thinking. We needed fire to cook our food, warm our caves, and keep predators away **tonight and maybe tomorrow night**. Large-scale use of wood certainly would lead to gradual deforestation, along with the associated ecological and social dislocations. But the key word is "gradually". *Only with* **millennia** *of time did it become obvious that humans needed to develop long-term planning* to deal with the consequences of advancing technology and its impact on the environment. Quite candidly, we are still not very good at this. We still habitually choose fossil fuels for the next five years over renewable, non-polluting alternatives for the next five *hundred*, with the result that, sometime during the next century, e.g., San Diego itself will *become* Sea World. And the root of *that* problem, in turn, is dual.

First of all, humans are a very short-lived species. Consequently, we find long-term planning difficult because our very *lives* are not long-term. A 7-year delay occasioned by an hour on the candidate planet's surface is roughly 10 percent of a typical human lifetime in the First World of the 21st century. Perhaps somewhere in the Universe there are intelligent species with typical lifetimes measured in say 10,000-year increments and perhaps billion-year histories as civilizations (as distinct from *homo sapiens sapiens*, which has been around about 150,000 years). Think of the *ent*-trees in Tolkien's *Lord of the Rings* or the Vorlon of *Babylon 5*. Either that, or there are species that, though as short-lived as humans, have developed socio-political structures and practices, unimaginably more advanced and enlightened than their human counterparts, that permit planning cycles measured in multiple millennia, short individual lives notwithstanding ... whichever.

The second reason humans are not good at long-term planning is because we are, perhaps all species at some point are, incorrigibly **tribal**. We care more about "people like *us* over *here*" than about "people like *them* over *there*". I have written about human tribalism within the comparatively parochial context of interplanetary exploration. I strongly suspect that there is a causal relationship between limited lifetimes and limited spheres of care for others, though I will not speculate on which way the cause-effect arrow points. Regardless of which is cause and which is effect, however, it should be

clear that serious exploration over cosmologically significant distances, as in *Interstellar*, will require planning and coordination over scales we can scarcely imagine now, especially if the exploration is to be accomplished by beings within very limited life-spans. I hardly need say that such planning and cooperation will require correspondingly profound social and political -- even religious ... perhaps *especially* religious -- changes. We will have to learn to think of ourselves as human beings first and as Americans, Russians, gay, straight, Caucasian, black, etc., second, just as American colonists in the early Republic had to learn to think of themselves as Americans first and Virginians, Georgians, Pennsylvanians, etc.,, second -- except on a stupendously larger scale. We have to learn to think cosmologically -- politically and socially, not just astronomically.

I hope I am wrong, but I am not optimistic. (But then, as a "para-professional skeptic," I am never optimistic about much of anything!) Observing the current xenophobia and the lengths to which nations and their people are willing to go, and the distortions to their political values and systems they are willing to tolerate, to preserve their latent "Other-phobia" virginally intact, together with the self-inflicted myopia of the "There is no Planet B" (*of course* there isn't if we refuse to even look for it ... duh!) ideology, at the very least, we are not likely to apply for membership in any United Federation of Planets anytime soon. The Caretakers in Carl Sagan's *Contact* would laugh us out of the Galaxy! But then, I have to remember ... the Caretakers of *Contact* did *not* laugh us out of the Galaxy, and on the contrary treated the human species with meticulous respect. Furthermore, after the impact of the Chicxulub meteor 65 million years ago, and after the great end-Permian extinction 180 million years before that, the prospects for life-as-such, life-*per-se*, life-*tout-court* on Earth would hardly have been a draw on the smart money. Even if nothing else, we are an adaptable species, socio-politically as well as evolutionarily. So when I reflect too long on human folly and its potentially fatal consequences, I like to recur to William Faulkner's great Nobel Prize acceptance speech:

I believe that man will not merely endure: he will prevail. He is immortal, not because he alone among creatures has an inexhaustible voice, but because he has a soul, a spirit capable of compassion and sacrifice and endurance. The poet's, the writer's, duty is to write about these things. It is his privilege to help man endure by lifting his heart, by reminding him of the courage and honor and hope and pride and compassion and pity and sacrifice which have been the glory of his past. The poet's voice need not merely be the record of man, it can be one of the props, the pillars to help him endure and prevail.

So, though it may be in spite of ourselves, there is reason to be optimistic that the starship *Endurance* may well carry a more prophetic name than we perhaps dare believe.

Chapter 19 – Opposing Adolescent Fascism of the Gut

Over the last several years, there has been a lot of chatter in the media about the obesity epidemic afflicting the United States, especially young teenagers of junior-high age. I will not rehearse the linked statistics here: you probably know them better than I, since, unlike your faithful Skeptic-In-Residence, most of my "Skeptic's" readers are parents. (However, in fairness, I do have a PhD in being a kid ... a fat kid in particular. So I do have some modest competence to say what I say below.) I have even written humorously about my own struggles with weight, body image, and exercise. But this is really no laughing matter. Now, as far as the biological, somatic, and nutritional dimensions of the problem are concerned, basically no one is laughing. Michelle Obama, for example, worked tirelessly to address this issue with teens – and was brutally ridiculed by old, fat, middle-aged-male Republicans who presumably want to remake the Nation in the bloated image of their own ***lipophilia*** ("lover of fat"). But not even Michelle Obama nor, as far as I know, any other writer on the subject – with the conspicuous exception of the National Association to Advance Fat Acceptance (NAAFA) -- has addressed the issue of *the* ***socio-cultural bigotry*** *against obesity* and its origins, least of all from the standpoint of actual, lived experience. At least to some degree, speaking as someone who was a fat baby who grew into a fat adolescent, and finally into a fat adult, I can.

Every fat kid, especially every fat boy, who ever attended a junior-high school, even if he never read Shakespeare's *Richard III*, is all too well acquainted with the revulsion with which Richard, the Duke of Gloucester as the play opens, greets the sight of his own body (Act 1, sc. 1):

Why, I, in this weak piping time of peace,
Have no delight to pass away the time,
Unless to spy my shadow in the sun
And descant on mine own deformity:

So this will, of necessity, be a more or less personal reflection on what it is like to grow up fat as a child into a fat adolescent, and what it is like to be a fat adult. And why. For me – again, speaking for myself – the locus of the problem was going through puberty in the feral-teenager, *Lord of the Flies* culture of junior high school. (Side note to literature teachers: there is no point in assigning *Lord of the Flies* as required reading to fat students, least of all to fat students who are intellectually gifted / curious, at the junior-high and high-school levels. By the time fat students like that reach high school, they do not need to read the novel. They have most likely already *lived* it.) In that context, and even that early, I can identify two sources of the problem. *The first source is the generalized bigotry against fat people that gets imported into the junior-high school subculture from the surrounding culture*, i.e., what I refer to as ***lipophobia*** (the fear / hatred of fatness and fat people). Given the exaggerated value attached to physical fitness and athletic prowess characteristic of the junior-high culture, an emphasis magnified by the raging hormones and nascent sexuality of kids that age, importing societal prejudices against obesity and lack of athleticism into any secondary-school culture is like telling great white sharks that it is quite OK to eat any passing SCUBA diver: you are giving them *carte blanche* to do precisely what they were predisposed to do to begin with.

It might be possible – I am not optimistic, but it might be marginally practicable – to at least mitigate such lipophobic prejudice by undertaking school-wide re-education efforts to inculcate a competing culture of fat-*acceptance*, not by minimizing the health risks of obesity, which are quite real, but by somehow teaching kids that teens who struggle with body image and obesity are actually heroes for

undertaking the struggle in the first place. (From personal experience in gyms – of which I am no longer a member – I can tell you that the heart-attack victim whose recovery includes an exercise program is viewed as a hero, whereas the fat person trying to get into some kind of decent physical shape is often treated as a source of free slapstick-comedy entertainment. This double standard still exists.) But this cultural change must begin – and will never succeed unless it does begin – in boys' and girls' gym / PE classes at the junior-high level. And at that point, ***you will crash into the brick wall of actual, deliberate, premeditated, even institutionalized fat bigotry on the part of PE teachers and gym coaches***, whose professional training evidently included courses on how to make fat kids feel like chimpanzee shit ... five days a week throughout a nine-month school year.

So consistent and so strong is lipophobia on the part of junior-high-school gym / PE coaches that I must insist that, at some point in their professional training, perhaps in college, coaches-to-be are intentionally taught how to ridicule, humiliate, and denigrate un-athletic people in general, and fat people in particular. In fact, I will go farther than that: most junior-high and high-school PE coaches seem to be frustrated at having been born too late to be members of the *Hitlerjugend*. I base that judgment on personal experience with PE coaches in junior-high school and high school. Fortunately, I quizzed out of high school quite early and was fast-tracked to college at an age when I was, chronologically, a high-school sophomore, which may well have saved me from becoming just one more suicide statistic. I was gratified to discover that, in college, there was, yes, a place for jocks, but *there was also a co-equal place for nerds and intellectuals*. (I know a few high-school students here in the Greater Seattle area, and they and their parents tell me that, in their kids' senior- and junior-high schools, the school administrators have adopted the policy of allowing kids to letter, not only in athletics, but also in academics. So it would be possible in such schools to letter in math, physics, literature, music, etc. I do not know how widespread this innovation is, but I do have some modest hope that a few tentative green leaves of academic virtuosity are gradually breaking through the overlying layer of gym-class Nazification and jock-athleticism.) I have personal experience of only one sterling exception to gym-class fascism as an undergraduate in a PE class in college. (More about that later.) Ridding junior-high and high schools of that prejudice, and getting rid of the people who harbor and perpetuate it, is the educational equivalent of de-Nazification in post-World-War-2 Europe. For both Naziism and lipophobia are alike militantly opposed to respect for the dignity of others.

I am pretty typical of the consequences of long-term lipophobia. I am also pretty typical of what could have helped me, had such assistance been available much earlier in my life. And, though it is too late to help me now – I will be 70 in 2019 – I think my case is typical enough to serve as a prototype for what to do in junior-high school, high school, and later. I am a living example of lessons learned about what **not** to do, also, and of what to do before it is too late. I do not hate exercise so much as I hate the *ideology* of exercise. *The ideology of exercise insists that, inside of every fat person, there is a fit person absolutely clamoring for release* from her / his prison of low-density lipoproteins. (Interestingly, in a recent episode of *This Is Us*, Kate, the obese wife of Toby, screamed that she was tired of being "Trapped in this body".) The first step in addressing body bigotry is to recognize that this is flat-ass false: contrary to the ideology of fitness, **not every fat or skinny person is an athlete *in potentia***. The problem is that the fat person, who is usually the first person to discover this, often gives up because they encounter the ambient body bigotry of the surrounding culture that tries to shame them into being **what they *can*not be**: "If I can't be an athlete, then I freakin' give up!"

Instead of setting people this often-impossible task, I would strongly suggest instead that coaches / PE instructors be assigned to un-athletic people, fat or skinny, to teach them that, yes, you can learn to

swim, yes, you can learn to play tennis, yes, you can learn golf, yes, you can learn to ski – in general, yes, you can learn to do what other people more physically gifted can do, **but you must learn these skills in your own way and in your own time**, i.e., you will never be an athlete, but you *can* learn to have fun. I would also suggest that, as part of their professional training, PE instructors be given the option of *specializing in the teaching of athletic skills to the athletically un-gifted*. I do not mean people who are physically challenged, e.g., paraplegics or stroke victims, but people who, though physiologically normal in other respects, are, to speak frankly, like myself, incorrigible klutzes. I.e., this should be explicitly recognized as an area of professional specialization, no different from cardiology, otology, hematology, etc., in medical school.

My understanding is also that college students majoring in education can often specialize in the teaching of the intellectually un-gifted and learning impaired. The PE equivalent of the same specialization should exist in university PE departments for PE coaches-to-be. This is the approach taken with, e.g., kids who are dyslexic: teach them that they are quite intelligent, but because of the way their brains are wired, **they have to learn to read the way a dyslexic person learns to read**, not the way a non-dyslexic person learns to read. My wife and I personally know of dyslexic kids who stopped viewing themselves as "dumb" and who did exceptionally well academically … **once such a teacher was found who could teach them to read the way *they* learn**, not the way someone else learns. Of course, the problem with implementing a program like this at the junior-high- and high-school levels would be that the lipophobic adolescent culture would knee-jerkingly react by labeling such classes "fat-kid gym," etc., which would only succeed in socially ostracizing obese and un-athletic kids. That is why the culture *as a whole* must change, and, in particular, why gym-class de-Nazification is so critical. As a "somatically dyslexic" person, I did not have anything like that help as an adolescent, and so did what kids often do: I gave up, and to this day I see participation in almost any sport as merely a golden opportunity to publicly humiliate myself. So I avoid it at all cost -- the unique and sole exception being my old Boeing "stretch" class for seniors, where we were all about equally un-athletic (however, see next paragraph).

This aversion has grave consequences, has had grave consequences for me. People whose life experience, especially as early-puberty teenagers, causes them to view exercise as the equivalent of Queen Cersei Lannister's Walk of Shame on *Game of Thrones* will usually, it may be for most of their lives, go out of their way to *avoid exercise*. (I did discover the exercise program for older adults and retired Boeing employees and their spouses, which is taught by some magnificently fit, but very enlightened staff – but then Boeing demolished the exercise center and dispersed the teachers to other Boeing campuses. Evidently the gods of History do not like fat people any more than high-school coaches!) I hardly need specify these consequences: high-blood pressure, joint problems from carrying excessive weight, pulmonary issues when you combine lack of exercise with smoking (which I never did, fortunately), etc., etc., etc. Basically, when it comes to fat kids – un-athletic kids generally, but specifically and especially fat kids – when in junior-high and high school, you steal their bodies from them even as they are inhabiting them, you shave several years off their quality and longevity of later life. It is slow-motion genocide-by-body-mass-index.

And religion does not help, least of all Christianity. Christianity has never had, nor does it presently have, anything like a coherent theology of the body. Christians are told – Catholic, Protestant, fundamentalist, mainline ... you name it ... they only differ in the vocabulary of lipophobia – that the body is basically something to be subdued, to be viewed with at least some degree of reflexive and critical suspicion. I hardly need continue to say that this aversion applies to the Nth power to matters

sexual. I well remember in 2002 Attorney General John Ashcroft having the nude statue of the Spirit of Justice covered in preference to being photographed with a nude female breast hovering over his shoulder in the background. Instead of celebrating the actual human form, fat or skinny, the historic tendency in Christianity, all of Christianity, has been to either idealize the body to the point of unapproachable ethereality – e.g., St. Paul's depiction of the body as a "temple of the Holy Spirit" – or to treat the body with knee-jerk suspicion as merely "of the flesh". Not a hint of Greco-Roman exuberance in celebration of *actual* people with *actual* bodies -- and none at all of Hinduism's exuberant celebration of physical sexuality guaranteed to precipitate a paroxysm of hyperventilation and pearl-clutching from American conservatives. In more conservative streams of Christianity, in fact, a passionate concern with the body is often viewed as at least incipient homoeroticism. This is really bad news for junior-high adolescents who look to Jesus for help in dealing with their changing bodies and is an actual hindrance to kids who are struggling with peers' and their gym-class coaches' actual explicit bigotry against them for their obesity and lack of athletic competence. On the day of His Resurrection, when Mary at the Tomb reached out to touch Jesus, His reaction was *Noli me tengere*: "Touch me not". This attitude toward the body is hardly what a fat kid needs to hear.

The issue of adolescent obesity – yes, to be sure – does involve vital issues like diet, exercise, and nutrition. Only a fool would say otherwise. But I will continue to insist that **the main problems are, not somatic, not nutritional, not biological – but cultural**. Small wonder that people do not give a tinker's damn what they eat when their fundamental dignity as a human being is not respected, and they are used as foils for jokes at their expense and for the expression of ignorant prejudice about their physical appearance. Until this cultural dimension is dealt with, addressing the matter of childhood obesity by *only* talking about diet and exercise will amount to drilling holes in the bottom of a sinking boat to let the excess water run out.

Addendum: I do have one brilliant example of the kind of enlightened, anti-fascist attitude I would like to see inculcated in every teacher and administrator in junior high and high school who has anything to do with the physical conditioning of students. That example is the late Dr. Robert Holmer, head of the PE department at Wichita State University. Dr. Holmer taught "adapted PE," i.e., PE for students who were healthy enough to undertake some level of exercise, but who were not fit enough to regular PE. The first day of class, I, along with my lame, halt, and blind fellow adapted-PE students, gathered to listen to Dr. Holmer. He told us basically "Don't worry about grades. The only way you will get less than an A is if you don't show up to class and at least try. The main purpose of the class is to teach you to have fun playing badminton. That's all. Show up, suit up, whack away at the badminton bird, and you will get an A. Just have fun!" We did. And it was. Fun, that is. I regularly stayed over with some of my classmates and played extra games of badminton until I had to shower, get dressed, and leave for my next class. In fact, for that class that semester, I was a terror with a badminton racquet and became round-robin singles-badminton champion. (I fantasize that badminton birds would shriek and scatter in panic when they saw me coming, and that behind my back they whispered of me as "The Enforcer".) In the beginning, I was clumsy and tripped over my own feet. Dr. Holmer would lift me up, slap my butt, and just said "Try again!" Why can't junior-high and high-school gym classes be more like that, more like Bob Holmer, instead of junior-level Nuremberg 1938 / National Socialist torch marches? That is the way junior-high and high-school PE *should* be: don't get into pissing contexts about being a jock, just have fun.

Chapter 20 – You Will Get a Kick Out of Keck

I write this the morning (13 February) after Diane and I had a wonderful, long, and calorie-filled dinner with two very senior people associated with the Keck Telescopes and the other telescopes atop Mauna Kea on the Big Island of Hawaii. It was a memorable evening that still resonates with me. One reason that conversation sticks with me -- aside from having discussed dark energy, blue-sky (black-sky?) projects for exploring the Proxima Centauri system, gamma-ray bursts, gravity waves, black holes, etc., etc. – is that one of the subjects we touched on banged down pretty hard on one of my hot-button issues: scientific illiteracy in general in the US and the western world, and *the need for informed, literate teaching of science to non-scientists*. I mean science *per se*, not just astronomy. Given that scientific illiteracy is being actively *promoted*, not merely tolerated as in previous generations and in previous political regimes, please consider this "Skeptic's" column my modest effort to piss into the hurricane wind of right-wing scientific ignorance.

Without attempting to sketch a linear, step-1-step-2-step-3 description of the scientific method, I will instead describe some of the most salient ways in which a scientific attitude / approach differs from its politically and religiously conservative counterpart. I do not believe that religion, even conservative religion, and science are necessarily and always in conflict. But conflict is virtually guaranteed to arise when conservatives fail to take meticulous note of the following different orientations:

o Regardless of their virtues in conservative politics and religion, appeals to authority are always out of place in science

In fact, it is the rule rather than the exception that *lack* of deference to authority has usually been required for any radical progress in science. This is one way of understanding Thomas Kuhn's account of scientific progress in terms of "paradigm shifts" in his classic *The Structure of Scientific Revolutions*: the prevailing scientific paradigm is, however unconsciously, accorded a certain authority, and that authority only changes when observations that fail to conform to the paradigm are repeatedly discovered and repeatedly corroborated. Examples abound. Newton's emphasis on absolute space and time was decisively refuted by Einstein's theory of relativity. Einstein's "classical" conception of the lawful regularity of all natural phenomena was likewise decisively refuted by, e.g., Schroedinger, et al., and the incorrigibly statistical character of quantum theory. With both relativity and quantum theory, "refuted" is perhaps too strong a word. Rather, the physics of Newton and Einstein came to be seen as special cases of more general theories. Newtonian mechanics is fine for the macroscopic natural world, where events occur at much less than light-speed. Similar remarks hold for quantum mechanics: we do not need quantum theory to describe the flip of a coin.

But "refuted" is not too strong a word in other instances. The Divine special creation of human beings was refuted by Darwin's theory of evolution and speciation by natural selection. The orthodox conception of dinosaurs as, essentially, overgrown lizards is apparently now in the process of being refuted such that many species of dinosaurs are coming to be seen as, essentially, overgrown *birds*. Even in such supposedly indubitable fields as mathematics and logic, the once-regnant belief that mathematics and logic are, at bottom, completely interchangeable was refuted in 1931 by Kurt Goedel and his monumental Incompleteness Theorem. I could go on citing other examples, but the point would always be the same: the authority once ascribed to the prevailing paradigm was overthrown. None of these advances would have been possible if the previous system of belief were held to be sacrosanct. *Science is incorrigibly and essentially **anti**-authoritarian.*

o But this does not mean that science is uncritically democratic; on the contrary, science respects ability, aptitude, and credentials.

So, for example, Ken Hamm's views on evolution are not "just as good as" the views of, say, the late Stephen Jay Gould or Prof. Richard Dawkins. Ken Hamm is not an evolutionary biologist. The other gentlemen are. The point is not the people, but their credentials: Gould and Dawkins have done distinguished, doctoral-level, refereed-and-published work in the field. Ken Hamm has not. *Science does not respect authority, but it has profound respect for* ***professional competence***. That accounts for the tendency of many conservatives, especially religious conservatives, to reverse that order of priority and ascribe scientific competence to people with degrees, not only in theology, but in certain fairly well-defined types of theology. Science is much like a medieval guild, which enforces its professional boundaries by insisting that, while anyone is free to *learn* science – in fact, the more, the better! -- being free to *do* science and to *contribute* thereto presupposes demonstrated competence in the field. The emphasis is truth, not ideological purity.

o This "guild-ness" of science implies that science is an incorrigibly social phenomenon

Even if, in certain conspicuous cases, individual genius produces revolutionary scientific breakthroughs, scientific discoveries must always be verified and substantiated through the activities of other scientists. The voice of one person, even if she turns out to be right, is not in and of itself decisive. Two examples from Einstein's work vividly illustrate science as a social phenomenon. Prof. Arthur Eddington, on 29 May 1919, observed a solar eclipse and compared the position of a star on the edge of the solar disc before the eclipse with the position of the same star during the eclipse. The star's apparent position shifted, during the eclipse, by the miniscule amount predicted by Einstein's general theory of relativity. (This was the result of the influence of the sun's gravity warping the space through which light travels.) In fact, the shifting of the apparent position of stars during a solar eclipse became one of the "classical" tests of general relativity. It is also worth noting that other observers, over the years, have repeated Eddington's observations with the same result: phenomenal agreement of observation with theory. Only a few years ago at the European Center for Nuclear Research (CERN in French), there was a few-day period when CERN scientists believed they might have detected faster-than-light ("superluminal") neutrinos – an explicit contradiction of Einstein's special theory of relativity. They inspected their equipment, reviewed their results, and concluded that the observation was due to a faulty equipment configuration. But the point is that even Einstein's eminence as a physicist did not absolve his theory from review by the physics community: authority has no place in science.

o The result of the incorrigibly communal nature of science is that science is always in the process of revision, of critique, with the consequence that scientific theories are always undergoing revision – and this is a sign of the ***health*** *of science*

Science is always reliable *precisely because* it changes in response to continually revised understandings of Nature. On the Ionian coast in the 6th century, BCE, Heraclitus said *panta rhei* -- everything changes – so that, as he also said, "You cannot step into the same river twice … or even *once*". Conservative politics and spirituality seem, to the same extent, to be enamored of the Unchangeable. E.g., originalists' claims that the real meaning of the Constitution is to be discerned in the original -- by definition, unique, one, and only -- intent of the Framers, also, e.g., the original text of the Bible. (That latter meaning is no less problematic, given the variety of manuscripts, translations,

and glosses on the biblical text, together with the inevitable linguistic ambiguities, like the ones that fuel debates about the New Testament's attitude toward homosexuality.) Science enjoys a salient advantage, in that constant and ongoing change is not only expected, it is welcome as a sign of robust health. Things that never change are usually dead.

o Science changes in response to ***evidence***

Prior to the work of Edwin P. Hubble, the received wisdom of astronomy was that the entire Universe consisted of just the stars we see around us in the night sky and through telescopes. But in the process of observing "nebulae" -- literally from the Greek for "fuzzy clouds" -- it became evident that these "nebulae" were not comparatively nearby clouds of dust, but rather great clouds of *stars* at truly cosmological distances of millions of light-years. What was once believed to be the entire Universe was revealed as only a single galaxy -- the Milky Way -- among what turned out to be hundreds of billions of galaxies comprising hundreds of billions of stars. Note that this change was effected by immense volumes of evidence gathered by a community of hundreds of astronomers worldwide.

By contrast, the more conservative one is, politically and religiously, the less difference actual, empirical evidence seems to make in one's final conclusions. High-nineties of percents of climatologists have concluded that (a) the earth's climate is changing because of (b) anthropogenic (human-caused) climate activity resulting from increased greenhouse-gas emissions. If anything, evidence for biological evolution and speciation through mutation and natural selection is even more massive. But the present Secretary of Housing and Urban Development -- a Johns Hopkins-caliber brain surgeon, no less -- insists that evolution is a deception hatched in Hell. Ditto the Big Bang. In such cases, the scientific paradigm has obviously been overtaken by "fact-free" faith.

In summary, I think much, quite probably most, and arguably all, the hostility toward science displayed by politically and religiously conservative people originates in what may well be an unconscious and inchoate, and almost always unacknowledged, insight into the fundamental nature of science: it is the task of science to account for natural phenomena via naturalistic means. I.e., via means that do not involve the intervention of a Deity who works with a purpose toward some superordinate end. Divine purposes can best be descried in a static Universe: essentially the static Universe of pre-Newtonian science (though Newton himself was a devout Christian). So any hint of dynamism, any hint of the Random, any hint of the "Stochastic", any hint of change that can be accounted for in terms of purely natural causes is automatically suspect, *no matter how much data and evidence there is to substantiate such a view*. In that sense, I would affirm the more radical view of the relationship between conservatism (both political and religious) and science. As long as you insist on believing in a static Universe where anything other than empirical evidence is the ultimate Arbiter, you will never understand science.

In that sense and to that extent, yes, an either / or choice is required.

Chapter 21 – Surveying the Cosmic Landscape

My thanks to Rev. John Heagle for pointing out to me a *New York Times* link to cosmology, superstring theory, and "relative state" cosmology that led to this column. Fr. Heagle is a one-man instantiation of what the Catholic Church should be, in terms of integrity, spirituality, justice, inquisitiveness ... and just plain indomitable good humor. Being friends with him is like being friends with the late Thomas Merton.

I have been thinking a lot lately about *landscapes*. Now, by "landscapes" in this context, I do not mean physical landscapes like the ones painted by, e.g., Albert Bierstadt, members of the Hudson River School, or Monet's haystacks, etc. I mean landscapes that result from the possibility that other Universes, other *Kosmoi*, may exist other than the one we see around us. You can think of the Great Landscape as a collection of lower-case-l landscapes, immense in number and quite likely infinite, of hills and valleys, each hill representing a possible Universe whose laws and physical constants are different from ours. (The Great Landscape is also referred to in the literature as the "Multiverse".) I have been brooding about this during the couple days my wife and I were snowed in because of an early-February snowstorm. The snowstorm was quite mild by Pacific Northwest standards, but it did afford enough quiet to reflect on such things. (If the snowstorm had been part of the Polar Vortex, I might have been able to derive a fully renormalizable theory of quantum gravity!) Anyway, my musings led to a question I found fascinating. But to do justice to the question, some background is necessary. I ask your indulgence in what follows …

A good place to start would be with the provocative theory of "alternate universes" – popularly known as the "many-worlds interpretation of quantum mechanics". Or, more technically, the "relative state" interpretation of quantum theory. The "many-worlds" interpretation of quantum theory is one of the more radical attempts to arrive at an interpretation of what actually happens when the "state vector" collapses. **No one knows whether it is true or not. In fact, it is not clear what kind of experiment could falsify "many worlds" quantum theory. All we know is that the math is consistent with experiment. So the following is purely speculative.** The state vector is an array of probabilities for the position of a given subatomic particle, probabilities that are predicted by the time-dependent Schroedinger equation. Until an actual empirical observation of the particle is performed, this array of probabilities continues to evolve over time – hence "time-dependent". But when a physical observation of the particle is performed, the state vector collapses, and one and only one of the previously-only-potential positions is realized. Hence the term, "collapse of the state vector". (The above remarks apply to the momentum of the particle.) The question begged is "What is so magical about the intervention of human consciousness *via* the performance of a physical, empirical measurement?" Does human consciousness have some mystical property that causes previously unknown quantities like the position (or momentum) of a particle to suddenly become sharply defined? Furthermore, what if I do not communicate my measurement to my research colleagues for, say, a week? Presumably, as long as they are not conscious of the results of my measurement, *the potential values of the state vector continue to evolve* ***for them***, and their state vector only collapses when I notify them of the results of my measurement. Such a conclusion would seem to violate the principle of no privileged points of view in the Universe, i.e., that the Universe looks essentially the same to everyone in any location. That would not be true if I were privileged for a week to be the observer of the particle's position.

(So, yes, one could write the history of science in terms of humans moving farther and farther away from any position of privilege in the Universe. In biology, e.g., humans once thought that they were privileged by having been specially created by God to "have dominion," as Genesis says, over Creation ... until Darwin published *Origin of Species* in 1859. Then we realized -- though some of us still have not -- that humans occupy no privileged position in the Web of Life. Science fiction, e.g., Carl Sagan's epic novel *Contact*, extends this conclusion by populating entire galaxies with a veritable zoo of intelligent species, many highly advanced. Problem is, there is no evidence (so far?) that such a zoo really exists. But, as far as we know at present, there **is** one privileged position, notwithstanding: the position of sentient beings, i.e., **us**, Pascal's "thinking reed". There is no evidence so far for other sibling intelligent species … unless the recent furor over the sighting of a rather anomalous object whizzing past Jupiter – ʻOumuamua: "scout" in Hawaiian – should prove to be of intelligent origin. Should that turn out to be the case, we would lose even this final privileged position: once again, there would be nothing special about us. We would no longer be a "zoo" of one.)

The "many-worlds interpretation" / relative-state formulation of quantum theory cuts the Gordian knot by restoring the "no privileged position" principle. It does this by insisting, with jaw-dropping consistency, that ***all*** *possible values of* ***all*** *possible parameters represented by the state vector are realized* and that none drop out. In other words, relative-state quantum theory asserts that **all** possibilities latent in the mathematical formalism of quantum theory represent, **not only *possible* worlds, but *actual* worlds – *actual* universes**. Every nanosecond, the Universe is splitting into – pardon the technical terminology – mega-ba-jillions of Universes, i.e., one Universe for each discrete possibility allowed by the state vector **of all particles *every*where**. Everything that *can* happen *does* happen – each nanosecond, all the time. (I use "nanosecond" metaphorically to represent the shortest possible physically realizable interval of time. There is some theoretical justification for believing that to be true, but let's not go there now, shall we?) So, indeed, no one's position is privileged, because *everything that can happen is, not only equally* ***probable****, but equally* ***actual****, i.e., with a probability of unity, in some universe or other of the Multiverse*. It is like an election where, not only all candidates, but all *possible* candidates end up being elected. According to the US Constitution, I am a *possible* candidate for President of the United States, therefore there is a Universe in which I *am* President. Not only are all things **possible**, all things are **actual**. Somewhere or other. In some Universe or other.

If you want to read a more comprehensive, but still accessible – well … more or less … -- account of landscapes and the Landscape, you can do no better than to download a copy of Lee Smolin's *The Trouble with Physics*. This is Smolin's critique of string theory, which he regards as siphoning away physics talent from the overly rarefied and philosophically problematical enterprise of string theory, and leaving equally important but more empirically tractable areas of physics neglected. (I agree with his position here. I used to be enthusiastic about string theory, but the deeper I got into the math, what little of it I can understand, the more impelled I was to ask questions like "How the ***HAY-YULL*** are we to ever derive falsifiable conclusions?" But that is beside the point for now: another rant for another time, as I am fond of saying.) Anyway, Smolin really bangs away about landscapes and the Landscape. He allows that it is quite possible that, when one universe collides with another, that the result can be a Big Bang comparable to the one that occurred 13.8 billion years ago and kick-started our universe. (This conclusion is also an elegant consequence of inflationary models of the Big Bang, but -- again -- another rant for another time.) Furthermore, if such a collision happened once, there is nothing to say it has not happened before with other universes, that it is still happening, and that each time, somewhere or other, infant universes are being created out of the cosmically sexual congress of colliding universes. Cosmic eroticism. Furthermore, each time a new Big Bang occurs, the resulting universe emerges from

its own fiery Big-Bang womb with its own collection of physical constants, its own collection of natural laws, etc., etc., etc., etc., and in no such case is there any necessary reason for supposing that those laws and those constants are the same as ours. Why? Because – again – everything that *can* happen *does* happen.

This idea of new universes being birthed from other Big-Bang events has a kind of elegant consistency with the history of science on our own tiny planet. There was a time when we thought our own sun was the only star in the universe. Then we saw other suns and realized that we were really not so special, after all. Then we comforted ourselves with the belief that, granted there are other suns, but the Milky Way Galaxy was what we used to refer to as an "island universe", i.e., that the Milky Way Galaxy simply *was* the entire universe, and that those strange smudges of light we observed through our telescopes were just immense clouds of luminous gas no doubt fluorescing as they were illuminated by the energy of the ambient stars. But then, in the 1930s, thanks to Messrs. Lemaitre and Hubble, we discovered that those odd blurs of light were not light within our Galaxy at all, but instead *were themselves other galaxies* – "island universes" – in their own right, and that they were located, not within our Galaxy, but at distances measured in dozens to thousands of millions of light-years. So again, we turned out not to be so special. Now, today, we are still accustomed to use a definite article when referring to our universe, i.e., **the** universe. But "many-worlds" quantum theory, coupled with string theory, holds out the possibility – *so far, that is all it is* – that **our very universe may be one of a most-likely-infinite number of universes** populating the Landscape / Multiverse. There is also theoretical justification for the existence of alternate universes in the mathematical formalism of inflationary cosmology, about which you can learn from a recent issue of *Astronomy* magazine's discussion of the 50 greatest scientific mysteries, but which I have too little time, and even less understanding, to explore here.

So far, so good. Now to my question … Suppose that whole universes – technically, I should say "11- or 16-dimensional branes [shorthand for *mem*branes]" – collide and that such collisions result in stupendous explosions on a scale comparable to our own Big Bang. (You might think of this as "brane damage" … or not … OK … sorry.) The resulting universe emerges from that primeval fire with its own physical constants, its own physical laws, in other words, its own identity. My question, to which no one knows the answer, as far as I am aware, is the following:

*Are there laws – call them "meta-laws," i.e., higher-level laws – that constrain the values of the physical constants that **can** emerge from the fire of a new Big Bang? Ditto laws: are there meta-laws that constrain the way the laws emerging from a new Big Bang **can** operate?*

If so, how do values of constants and the operations of physical laws get defined? Is it simply random chance? Is it random chance that, e.g., the speed of light is 300,000 kilometers per second and not 400,000 km / sec? Could there be a universe where the speed of light is *300* ***miles per hour***? Could there be a universe where the baby-universe equivalent of Newton's inverse-square law was an inverse-*cube* law? Or an inverse-*fourth-power* law? Could there be a baby universe where Newton's gravitational constant was ten trillion times the value it has in our universe? (If the latter possibility were the case, stars would burn out a lot faster, and so life might not have time to evolve -- but even that conclusion presupposes that the laws of biology and chemistry were the same in that alternate universe.) Or one ten-*trillionth* the value? (In which case, stars might never condense from the cosmic medium, but even that assumes that, e.g., the strong nuclear force would work the same in the alternate case.) We just do not know.

Are some universes simply physically impossible because the regnant meta-laws would not permit them to exist? Remember: the rule is that everything that **can** happen **does** happen, not that everything **can** happen, **period**. The entire meta-law question amounts to asking if there are constraints on what can happen, i.e., can certain things simply **not** happen?

Note that this question also has deep implications for the scope of any possible future unification theory. Unifying the four forces of nature – gravitation, weak force, strong force, electromagnetic force -- is expected to entail that the constants that characterize our universe – the speed of light, Newton's constant, etc. – simply "fall out" of the theory *as a logical consequence*, and do not have to be, as presently, empirically / observationally discovered. (We do not have to discover empirically that the sum of the angles of a triangle is 180 degrees, that is an immediate consequence of geometry … at least geometry on a "flat" plane.) That may well be possible in our cosmos, but will it necessarily be true across the upper-case-L Landscape of the Multiverse? It may well turn out that we can only unify our own world, not others. Or alternatively, *other* universes may require *other* unification theories. Note that all these questions are questions that are pertinent to our Universe, regardless of whether sister Universes exist or not.

Anyway, it is dinner time. I am hungry. And my wife and I are having great landscapes of spaghetti and meatballs. *Bon appetit!*

Chapter 22 – Evolution and Foresight as Obstacles to Intelligence

The recent report on the findings of climatic research into the causes and probable evolution of climate change – a more accurate term than "global warming" – prompted me to consider a possible answer to Enrico Fermi's classic question *"Where is everybody?"* Multiple generations of science fiction writers have projected a future in which the Milky Way Galaxy fairly teems with life, rather like Times Square on New Year's Eve or the tavern in the first *Star Wars* movie – so much so that the late Prof. Stephen Hawking has publicly counseled SETI investigators to – not literally STFU – but certainly to exercise due caution in broadcasting the existence of intelligent life on earth to every corner of the Galaxy. (Not that we have a choice by now: earth's electromagnetic emissions by now comprise a bubble 200-plus light-years in diameter.) We do not know, says Prof. Hawking, what sharks may inhabit the interstellar waters. (My analogy, not his.) So far, we have been safe. Except for the never-reproduced "Wow Signal", for which a serious possible explanation has now been proposed, SETI researchers have so far not found any intelligent signal, using any kind electromagnetic energy, that so much as hints at an intelligent origin. The following is pure speculation on my part, albeit – so I would argue – intelligent and informed speculation, as to this eerie silence. Anyway, I submit the following for your consideration …

The evolution of an intelligent species – actually, any species – usually takes multiple millions, even billions, of years. I say "often" and not "always" because the speed with which a species evolves can be measured in days, perhaps even hours, if the evolving organism is simple enough. Consider a flu virus comprising only several dozen base pairs. Add the adjective "intelligent" to the noun "species" and then we really are talking hundreds of millions, most likely billions, of years. It took about 4 billion years for the intelligent species *homo sapiens sapiens* to make an appearance on Planet Earth.

However … in terms of "boots on the ground" real time, evolution proceeds by fractions of a millimeter, temporally speaking. The proto-hominid is concerned with finding enough wood to keep her / his family warm *tonight*, and perhaps for a couple nights in the future. S/He is likewise concerned with finding an area with abundant resources for hunting and gathering *for perhaps a week or so in the future*. Even when settled agricultural communities evolved, the primary emphasis was on this year's harvest, and perhaps … maybe … next year's. What is the point of all this? **Only that the fraction-of-a-millimeter-at-a-time nature of evolution militates against anything that could reasonably be considered long-term planning.** *From the standpoint of survival and the propagation of one's genes into the future, this is a good thing.* A hunter-gatherer of, say, 100,000 years ago who paused to consider the long-term ecological effects of rampant deforestation, the poisoning of the atmosphere by wood smoke, the depletion of the oceans, etc., would probably be devoured by animals – or other hunter-gatherers – before s/he had a chance to reproduce, in which case I would not be around to write this "Skeptic's" column and you would not be around to read it. At least in terms of earth-like intelligent life, *it would appear that individual human beings, and human communities, are not "hard-wired" to reflexively consider The Big Picture*. From a "boots on the ground" perspective, evolution has simply not equipped us to think in those terms. We can certainly learn to do so. But it does not come naturally. It is like learning to use your left hand if you are right-handed. Furthermore, this difficulty is reflected in our political institutions and our educational systems. Ditto economics. It is no accident that late capitalism does not encourage long-term planning – defined as time-frames measured in generations at least or centuries. As for millennia, i.e., the time-scale when climate change becomes glaringly, life-and-death critical … well … ***fugg-id-aboud-it***!

Granted, I am referring now to *terrestrial* life, and to cognates thereof, i.e., to life that evolved on temperate, water-abundant earth-like planets, perhaps on a "super-earth", orbiting a stable, main-sequence sun-like yellow-dwarf or red-dwarf star like our sun within that sun's habitable zone. If the evolution of intelligent life on such earth-cognates was anything like the evolution of intelligent life on earth, then the environmental challenges we face on earth today would – so I would speculate – have their equivalents on those extraterrestrial worlds. So, from the standpoint of SETI, there is good news, but there also may be – **remember, I am speculating here** – bad news. The good news is that it is reasonable to conclude that, in the Milky Way Galaxy, there are around 2 billion earth-like planets ("earth cognates" in my terminology), but perhaps as many as 17 billion or even 100 billion. The bad news is that, for the reasons I have outlined above, the challenges posed for the evolution of intelligent life may be as difficult for beings inhabiting those planets as they are for us. (And remember: *this is assuming the existence of intelligent life to begin with*, i.e., discounting the "rare-earth hypothesis", which is by no means a crackpot opinion.) Assuming that the laws of chemistry, physics, and celestial mechanics are the same everywhere, it is reasonable to conclude that our own environmental challenges on earth would have their equivalents on those alien worlds. So the key question in assessing the likelihood of the existence of intelligent life elsewhere in our Galaxy is: **are there evolutionary regimes that result in brains whose "hard-wiring" is more congenial to long-term – as defined above – planning?** I mean planning in time-frames commensurate with large-scale changes in the home planet's environment.

Forms of socio-political organization also enter the mix. **Serious question: to what extent, if any, is an emphasis on individuality, individual rights, individual liberty – basically, the presuppositions of an "Enlightenment-centric" socio-political culture – compatible with long-term planning for the survival of the species when challenged by incipient catastrophies like climate change?** Maybe dealing with these challenges requires that intelligent species develop, if they have not done so earlier, forms of social organization similar to, e.g., the "formics" in the *Ender's Game* / *Speaker for the Dead* cycle of novels, or the Borg Collective of *Star Trek*, or the Caretakers who used – but did not build – the wormhole subway in Carl Sagan's incomparable science-fiction novel *Contact*. Or, less benevolently, the Dark Ones of *Babylon 5* or the malignant alien collective that launched the planet-devouring self-replicating Von Neumann machines in Greg Bear's *The Forge of God* and *Anvil of Stars*. *Without in any way advocating for such a collectivist polity*, a lucidly honest historical assessment would certainly indicate that trying to induce human beings to unite for collective action to confront a common danger is pretty much like herding cats … and feral cats, at that … unless the end-in-view is the apocalyptic and uncompromising destruction of some human enemy. Think "Manhattan Project." That kind of cooperation we are damned good at! Climate change / global warming? Well ... maybe not so much.

Back in the '60s, the astronomer Frank Drake formulated the by-now-classical Drake equation, which attempts to quantify the number of intelligent species in the Milky Way Galaxy by factoring in quantitative estimates of the various coefficients that combine to produce intelligence in various planets' species. I like to think of the Drake equation as analogous to the design of a digital circuit, with various "gates" -- AND gates, OR gates, NAND gates, XOR gates, etc., etc., -- that determine whether a given species achieves intelligence and a technological civilization capable of communicating with other intelligent species inhabiting planets and evolving their own civilizations. Many of the factors in the classical Drake equation are obvious, e.g., the rate of planet formation in a star's habitable zone (however one might define that), the fraction of planets that actually evolve life, the fraction that evolve intelligent life, etc., etc. The historical trend strongly suggests that we have

greatly underestimated the number and type of relevant coefficients in the Drake equation. For example, I would suggest that one such overlooked coefficient -- one that I have never seen acknowledged in the literature -- is the fraction of planets whose axis of rotation is stabilized by the presence of a large moon and the influence of other, probably gas-giant, planets in the same star-system. (An example of where the absence of these factors is critical is Mars. Mars only has two little pebbles for moons, Deimos and Phobos, and so Mars' axis of rotation has, over the millennia, precessed perhaps 90 degrees, and the climatic variations would virtually preclude the evolution of intelligent life. By contrast, earth has a very large moon and is farther away from Jupiter, with the result that earth's axis of rotation is stable enough to ensure a stable climate congenial to the evolution of intelligence.) Bottom line: it is reasonable to conclude that the proportion of intelligent species capable of taking the long view, of planning for the future in terms, not of years or even of generations, but at least of **centuries** would have a critical bearing on whether a given "candidate" species achieved intelligence and survived long enough to develop space travel and a sophisticated communication technology. This is perhaps one missing coefficient in the classical Drake equation: the percentage of species that have evolved intelligence sufficient to engage in long-range planning.

But our response -- or lack thereof -- to climate change strongly suggests that we may in perhaps a century, maybe less, encounter a break point where our endemic inability to take future centuries, even future millennia, into proper account may render us a footnote in some hypothetical Sagan-esque Galactic survey. We have to overcome the short-sightedness selected into us by the imperatives of evolution. So far, there have been five mass extinction events in earth's history. We may well be in the middle of the sixth. Granted, some of these were unavoidable, e.g., the end-Permian catastrophe 250 million years ago. Others, if they occurred today, might be preventable, **given long-term planning**, e.g., the Chicxulub event 65 million years ago. But all would require a capacity for long-range planning for which we humans have thus far shown little aptitude or inclination.

So perhaps now we have the answer to Dr. Fermi's question of "Where is everyone?". Perhaps the eerie silence we detect with our radio telescopes is mute testimony to the scarcity of intelligent species that evolved an intelligence, and the accompanying social and political organizations, sufficient to deal with multiple-millennia-long threats to those species' existence. Maybe the Universe is silent because, thanks to the in-built limitations inherent in evolution, intelligent species' own short-sightedness caught up with them.

Chapter 23 – Alternative Scenarios for Catastrophe

I'm tired of ranting against Donald Trump, and you're probably tired – quite understandably – of reading about him. So let's talk about something much more pleasant: different scenarios, all possible but of varying degrees of probability, of how the world could end. Back in the early 70s and into the early 80s, I ran a kind of internal think-tank at Boeing that did highly classified work for the US Defense Department and for many of the defense ministries of the NATO countries. In the process, I got to know fairly well some people working in various disciplines who were employed by what those in "the Game" generically refer to as the "3-letter agencies," including some work for one known facetiously as "Christians In Action". Back then, there was an acronym in fashion: **TEOTWAWKI**, standing for **T**he **E**nd **O**f **T**he **W**orld **A**s **W**e **K**now **I**t and pronounced "tee-oh-TWACK-ee". (Acronyms come into and go out of fashion like long hair, wide ties, and short skirts. I doubt if this one is still current.) But given the nature of our work, it was useful shorthand. For example, we would ask questions like *If the Warsaw Pact invades NATO, and NATO has to resort to tactical nuclear weapons to stop them, would that be TEOTWAWCKI?* So how about a light-hearted diversion from Trump … like examining some speculative TEOTWAWCKI scenarios? Consider the following, all possible but in no particular order:

o Nearby gamma-ray burst

The discovery of gamma-ray bursts dates from around 1967 when the US Defense Department launched several satellites of the Vela series, intended to detect the telltale burst of gamma-rays from nuclear explosions that would originate from any Soviet violation of the 1963 Limited Test Ban Treaty that grew out of the near-catastrophe of the Cuban Missile Crisis. Surprisingly, in a very short time, the early Vela satellites detected several such gamma-ray bursts (GRBs). The problem, however, was that the gamma-ray emissions, typically lasting several seconds to a few minutes, originated in deep space, not anywhere near the earth. Furthermore, over a short period of time, it became clear that the frequency spectrum "fingerprints" of the emitted gamma-rays did not match those of any nuclear weapons in the inventories of the Soviets or any other nuclear power. Also, instead of being concentrated along the plane of the Milky Way galaxy, as one would expect if the bursts were of galactic origin, the GRBs were more or less evenly distributed over the entire sky. More sophisticated gamma-ray satellites soon measured red-shifts in the GRBs indicating distances of several billion light years, i.e., out toward the edge of the visible Universe. That the GRBs were visible at all, let alone that they were as bright as they were at such distances, indicated that, whatever their source, GRBs were emitted by the most powerful explosions in the Universe since the Big Bang. Universe-wide, there are a few hundred detected per year.

Long story short, it now appears that GRBs result when certain rather exotic classes of stars – Wolf-Rayet stars, blue super-giants, et al. – exhaust their nuclear fuel, undergo catastrophic gravitational collapse, implode into black holes, and thus end their lives – not as mere novas or even supernovas – but as **hyper**novas, or more technically "class 1bc" supernovas. Hypernovas' / GRBs' gravitationally driven core collapse results in two "jets" or "pencils" of ultra-intense gamma rays being emitted, at 99-plus percent of the speed of light, from opposite poles of the collapsing star. If one's line of sight happens to coincide with the jets' axis, the resulting GRB is so powerful that it is easily observed across, essentially, the diameter of the observable Universe.

As far as has been determined, there is no evidence that the Milky Way galaxy has ever experienced a GRB / hypernova event. But if it ever did, we might realistically expect that, depending on the energy of the GRB, any planet in any star system directly in the path of either gamma-ray beam, perhaps as far as 10 **thousand** light-years, would be effectively sterilized of all life, even life beneath the surface of the planet. This is problematical for earth beings, because there is one prime candidate for hypernova-hood only 7500 light-years distant: the binary system Eta Carinae ("Eta Car"). Both stars are blue supergiants, the larger with a mass approximately 100-200 times the mass of our sun; the other a comparatively tiny 50 solar masses. It is virtually certain that at the end of only 30 million or so years, one or both components of Eta Car will collapse into a hypernova / GRB. When that happens – "when," not "if" – we'd best hope that at least one of two circumstances prevails: (a) the gamma-ray jet from the explosion is aimed well away from earth and / or (b) a future earth civilization will have developed level-10-trillion sun-block.

Otherwise … well … does the term "Crispy Critter" ring a bell? **Result: TEOTWAWKI**

o Errant black hole

The Universe is a big place and black holes are probably quite rare, because black holes only form from stars so massive – about 5 times the mass of the sun -- that even gravity is not strong enough to stave off ultimate collapse. But black holes do exist, and there is certainly no *a priori* reason why one could someday not wander into our solar system and wreak apocalyptic havoc. In fact, this is just the scenario explored in a couple of "hard science" science-fiction novels by Matthew Mather: *Nomad* and *Nomad Sanctuary*.

But wouldn't we see it coming? Doubtful. Our sun is nowhere near massive enough to form a black hole naturally. But if the sun were somehow compressed into a black hole, its event horizon – the spherical bubble of space within which the gravitational effects of the black hole would be visible – would be less than 4 miles (technically, twice the Schwarzschild radius of 1.9 miles). But a 5-solar-mass dead star – now a black hole – with an event-horizon diameter of about 20 miles could invade the solar system, and we might not know it until we saw the planets, including the earth, being dragged out of their orbits and / or streams of solar mass pinwheeling off the surface of the sun and into an accretion disk centered on an object we could not see. Of course, we could see an asteroid or a comet 20 miles in diameter. **We know what to look for and how to look for those**, maybe even defend against them to some limited extent. **But when you are looking for a black hole, you are quite literally looking for nothing – i.e., for no-thing**, since the singularity itself is invisible – and have to search instead for the gravitational-lensing effects that would only be visible near the surface of the event horizon, which would typically be much more difficult to detect.

If it ever occurred – which it probably never will … but even so … -- a black hole entering our solar system would be the cosmic equivalent of a biker gang crashing high tea at Downton Abbey: there would probably be no way to save the good china. **Result: TEOTWAWKI**

o Climate change / global warming

Now we enter the realm of the all too possible ... even the all too imminent. I'm not going to waste time preaching to persuade people that climate change is real. At this point, anyone who remains unconvinced is in essentially the same situation as *Titanic* passengers who continued to insist that the

ship was "unsinkable," even as the seawater lapped around their knees. I used to be relatively optimistic, thinking -- and even writing with what at the time I saw as an admirable sense of alarm -- that ... golly-gee-gawrsh ... we had best start addressing this issue, because **in a hundred years**, our great-grandkids will see Florida underwater. Now, at this point, my attitude is "True enough but ... think about **us right now**". I'm 67 years old and believe it is quite possible that even I could live to see, probably not all of Florida, but Miami and Fort Lauderdale -- and certainly the lowlands of Holland -- and the Embankment in London submerged, and the Jefferson Memorial in Washington, DC, isolated on what might then be called something like "Jefferson Island" when today's high-school juniors graduate college and begin their careers.

All that is a done deal. So, to me at this point, the really interesting questions comprise long-term issues of biological evolution, and the lessons they have to teach us for the future. Evolution is a short-term phenomenon, tending to equip an organism to maximize its chances to survive, and thereby pass on its genome, *in the immediate future*. So organisms evolve to, e.g., learn how to make and use fire so they can stay warm tonight, without thought to what the burning of organic materials is going to do to the environment in 10,000 or 100,000 years. So there are sound evolutionary reasons why human beings have such a difficult time doing planning measured in generations, let alone centuries: we have to train ourselves to think in those time-scales, because such time-scales are so much longer than the typical human lifetime, in terms of which evolution has equipped us to think. I have written about these and related issues here and here. I would also speculate that perhaps one of the reasons for the "Fermi paradox" -- if there are thousands of intelligent species elsewhere in the Galaxy, why don't we hear from them? -- is that one of the most difficult challenges for any intelligent species anywhere is transcending their evolution so as to learn to think in time-frames measured in at least multiple generations -- and that such may remain true, even for species with very long lifetimes, because the time-frames all expand proportionately. (An intelligent species with an average lifetime of 1,000 years may find it as difficult to think in terms of millennia as humans do to think in terms of centuries.) But one lesson, I would argue, is decidedly not speculative: our future survival on this planet absolutely requires that we learn to think and to plan, at the very least, in terms of multiple generations, preferably in terms of a few centuries. Unfortunately, our political systems and governments seem designed, like biological evolution itself, to run on short time-scales: 2 years, 4 years, 6 years ... the next election, the next Great Economic Plan, the generalissimo's lifetime, who will run the junta when el jefe expires, etc.

The clock is ticking closer and closer to **"TEOTWAWKI o'clock"**.

I will pass mercifully over possibilities like nuclear war, global pandemics (both natural and those resulting from biological-warfare experiments *a la* Stephen King's The Stand), alien invasion, economic collapse, and the Zombie Apocalypse. I will only close with one more ...

o Electing Donald J. Trump President of the United States

No! No! Quick! Somebody get my hands off the keyboard!

Chapter 24 – An Anti-Alien Wall – a.k.a. "Dice-In Sphere" – for the Earth

Over the five years or so I have been writing these "Skeptic's Collection" columns, there have been several occasions when I have received information, often anonymous and always via clandestine back channels, regarding extremely sensitive subjects that have been cloaked in secrecy, but which have been critical to national security. The latest example is my recent acquisition, through similarly confidential sources, of the complete back-story of the sighting by US Air Force pilots and radar operators of unidentified flying objects west of San Diego in 2004. What all such occasions have in common is an ethical question: to publicize or to maintain secrecy. Usually I do the latter. But since the *New York Times* has already surfaced the story, at least the part that is now public knowledge, I now feel free to disclose the rest of the story and the Trump Administration's reaction. Just remember: you heard it first from your faithful Resident Skeptic. I am hastily writing this account in case an unmarked black helicopter lands on my lawn, shoots me with a tranquilizer dart, and carries me away to … well … the fabled and iconic "undisclosed location". In that event, and if I meet him, I will tell Elvis everyone says "Hi".

In the actual event, the headquarters of the US Aerospace Defense Command – SPACECOM – in Colorado Springs accessed recordings of the video from the F-16 that detected the objects. President Trump, several of his senior advisers, and members of his Cabinet – including, Secretary of Defense James Mattis, and, for some unknown reason, Secretary of Education Betsy DeVos – were immediately summoned to the Situation Room in the White House to view the video recordings from 2004. Following is a *verbatim* transcript of that conversation.

TRUMP (leaning his golf club against the "sit room" wall): OK. What're we here for? Anybody know?

MATTIS: An F-16 flying just west of San Diego detected what seems to be a whole *fleet* of UFOs engaging in high-velocity maneuvers. What you are seeing on the screen, Mr. President, is that video from 2004.

TRUMP: A fleet of … UF … what?

MATTIS: UFOs, sir.

TRUMP: What the hell is a UFO? Izzat something launched by Li'l Rocket Man? Whazzis name? Little Richard? Kim Jong Hoo-zis? If so, I'll blow his tiny testicles to the moon. Somebody, quick, [snapping his fingers] gimme the "football" …

MATTIS (hastily): No, sir … no, sir … a UFO is … [there follows a rapid-fire description, comprising words of one and two syllables, of what a UFO is, punctuated by Trump's semi-comprehending grunts] … so no nuclear response is called for … in fact, at this time, no *military* response at all …

TRUMP (in a peevish and disappointed voice): *Shit!Then why am I here?* I was eating dinner and watching reruns of "Fox and Friends". And speaking of eating, where's the damn ketchup for my cheeseburgers and fries … fa'Chrissakes, who can eat 2 double quarter-pounders with cheese and fries with*out* ketchup? And mustard. (Snapping his fingers imperiously) Gimme mustard, too!

A VOICE ON THE SPEAKERPHONE: Mr. President, this is Gen. Lori Robinson. I am Commander in Chief, North American Aerospace Defense Command. Sir, I want to apprise you of our current estimate of the – "

TRUMP: Wait a minute … you're a *woman*? Are you telling me a *woman* is in charge of NORAD?

GEN. ROBINSON: Yes sir, I am the CinC. Actually, it's now known as the North American Aerospace Defense Command, sir, or just SPACECOM. Now, Mr. President, if I may proceed … "

TRUMP (slapping the conference table): Well … Gawwwwwwd-*DAMN*! A *woman* in charge of NORAD – WOW! Hey Kelly, remind me never to grab …

GEN. ROBINSON: Again, it's actually SPACECOM now, sir. Anyway, if I may …

TRUMP (bellowing and pounding the conference table): Where the HAY-YULL are my mustard and fries! [The golf club falls over with a harsh clatter.]

[A man in an Air Force uniform – a full colonel – enters the Situation Room, salutes Trump, places a bottle of mustard and a sack of fries before Trump on the conference table, salutes again, does a crisp right-face, and leaves.]

GEN. ROBINSON (continuing): Sir, since at least 1947, the skies of the Nation have been host to thousands of UFOs – Unidentified Flying Objects – the vast majority of which are either misinterpretations of natural phenomena or ordinary objects seen under extraordinary conditions. But ever since 1947, there has been a persistent "hard core" of perhaps 5 percent of the sightings that were, and remain, unexplained, and this 5 percent of UFO sightings, the objects, whatever they are, manifest, not only intelligent behavior, but seem capable of feats of aerodynamics – 100-G acceleration, instantaneous right-angle turns, etc. -- that are far beyond current or projected human technology. This is evidently the case with the objects you just now observed in the 2004 video recorded by the F-16 off the San Diego coast. For a variety of reasons too time-consuming to detail at the moment, but which are summarized in documents contained in the red-striped folder on the conference table before you marked CLASSIFIED – CODE WORD, we at SPACECOM and our brethren the Joint Chiefs of Staff have concluded that the objects recorded by the F-16, and many similar craft whose images have been captured over the years since 1947, are indeed spacecraft flown by aliens from a highly advanced extraterrestrial alien civilization.

[Conferees open the classified folders on the conference table before them, and spend several minutes scanning the documents therein. Trump is holding his copy of the classified document upside down while scanning it, turning it right and left, trying to make sense of it. Frowning. Growling. Finally, Trump closes the folder with a snap and slams it down on the conference table.]

TRUMP (his voice sinking to a low, threatening grumble): So, General, you are telling me, your Commander-in-Chief, that the United States, for the ... let's see ... [ticking off the arithmetic on his fingers] ... yeah! ... 71 years ... for the 71 years since 1947, has been invaded by illegal aliens. Izzat right? No passports. No visas. No work permits. No green cards. Just as calmly as you please picking our produce and cleaning our swimming pools as if they belonged here. So the teen-age girl polishing the cleats on the soles of my golf shoes at Mar-A-Lago could be an *alien*?! You are also telling me

that, if these aliens happened to have kids while in this country, even if only in the Nation's airspace *over* the country, *the kids would automatically be American citizens*. And even if the aliens had kids *outside* this country and brought them within our borders, they would be … what? … DACA aliens? Izzat right, General?

GEN. ROBINSON: Well, I am not an immigration lawyer, Mr. President, but as a layperson, yes, that would be my understanding, as well. But, sir, these are not "aliens" in the usual sense of that term. The beings piloting these UFOs are not even from this *solar system*, much less this *planet*. They are from … well … we don't know where … but certainly somewhere millions of light-years from –

TRUMP (shooting from his chair, pounding the conference table, and spilling the French fries): I don't give a shit, General! They are aliens, undocumented *aliens* – you used the term, I didn't – and they are certainly here illegally. And we have to by-Gawd stop them.

SECRETARY DEVOS: If I may ask Gen. Robinson a question, Mr. President –

TRUMP (under the table picking up the mustard bottle and errant french fries): Sure, Betsy, go ahead –

SECRETARY DEVOS: General Robinson, you said that you and your sources have concluded that the aliens piloting the craft observed off the San Diego coast are evidently from – quote – somewhere millions of light years – unquote away. What is a light-year, and how great a distance is, say, a million light-years?

GEN. ROBINSON: Well, Madame Secretary, a light-year is a very common unit of distance in astronomy, and is defined as the distance light travels in one year, going at a speed of 186,264 miles per second in a vacuum. So one light-year is about 6 trillion miles. So a million light years is the distance light travels in a time-period of a million years, or 6 million trillion miles ... that is, 6 followed by 18 zeros miles.

SECRETARY DEVOS (chuckling): That's obviously not possible, Gen. Robinson. The Universe is only 6 thousand years old. So *nothing* can be more than 6 thousand light-years away from anything else. Or I suppose 12 thousand light years, if you count both directions.

TRUMP (resuming his seat): This is all very interesting, but we have to decide on a course of action. And there is only one course of action available: *build a wall*.

MATTIS: A wall, Mr. President?

TRUMP: Hell yes! I mean a wall around the whole planet!

MATTIS: So you're thinking of a sphere enclosing the entire planet to keep out the aliens.

STEPHEN MILLER (Trump adviser): Basically, a Dyson sphere, except for the earth!

TRUMP: I dunno ... what the hell is a "dice-in" sphere, something to hold the things you roll at the craps table in Vegas?

MILLER: No, sir. It's a giant sphere that advanced civilizations build around their parent star in order to capture all the energy of their star, instead of the less-than-1-percent primitive civilizations like earth capture. But, of course, designing such a sphere, even just for the earth, would be an unprecedented engineering problem. So I don't know ...

TRUMP (waving his hand breezily): Never mind that. I can do it. I can design the "dice-in" sphere myself so it will keep the aliens out. It will be the biggest, most beautiful "dice-in" sphere any being has ever designed --

MILLER and MATTIS in unison: But Mr. President --

TRUMP: -- because, you see, I'm really, like, smart. Real smart. And real stable. [Pounds table] Now forget the aliens for a minute. Somebody bring me some more damn french fries!

Chapter 25 – Words as a Medium for the Propagation of Ignorance

A little learning is a dangerous thing;
Drink deep, or taste not the Pierian spring :
There shallow draughts intoxicate the brain,
And drinking largely sobers us again.
-- Alexander Pope

I cannot remember when I first fell in love with the English language, but subjectively, it seems like I could have fallen in love with it *in utero*. (My parents tell me I talked at an exceptionally young age, and both times I took the GRE, I blew the top of the scale off the language-skills section.) So it always irritates me to no end to look at the way people **mis**use and **ab**use the English language. (It also irritates me when people misuse foreign words that are *imported* into English, like the German *Weltanschauung* and *Angst*, but these are rants for another time.) Sometimes the frustration crosses a certain threshold, and I feel impelled to describe these malapropisms and to admonish the people who indulge in them to … dammit all! … become more literate regarding whatever subject they are addressing. Sometimes I wonder how and why people were allowed to graduate from high school, never mind college, with such slovenly habits of writing and speaking … and therefore of thinking. Anyway, thanking you in advance for indulging my urge to vent, herewith some salient examples.

o Quantum

"Quantum" is a perfectly good, in fact, by now indispensable, word. But there should be some kind of law, some enforceable principle, that forbids people from using the word "quantum," even in a metaphorical sense, unless and until they have undertaken the gonad-busting effort requisite to understanding and using it correctly. (In practice, this will mean at least a master's degree in some relevant field: physics, quantum chemistry, philosophy of science, etc.) In physics, "quantum" refers to the smallest possible physically observable / detectable unit of radiation. (And by the way, the plural of "quant**um**" is "quant**a**," not some lexical monstrosity like "quant**ums**," the very writing of which makes my stomach queasy.) E.g., the quantum of electromagnetic energy is the photon. One photon is one quant**um** of electromagnetic radiation. Two photons comprise two quant**a** of such. Anyway, moving right alone …

Now, it is … yes, to be sure … possible to use terms like "quantum transition" correctly, i.e., there are such things as "quantum transitions". But understanding how to use this term correctly, like using "quantum" itself, requires decaliters of midnight oil, together with blood, toil, sweat, and even tears. *(General principle -- if you declare a major in physics but fail to declare a second, co-equal major in mathematics, steer clear of both: you are too dumb to major in either.)* The term "quantum transition," when used correctly, refers to the phenomenon whereby a subatomic particle transitions from one quantum state to another *without occupying any state in between*, e.g., when an electron in an atom transitions from one "orbital state" – a purely metaphorical term: electrons are "standing waves," not micro-planets orbiting a micro-sun --- to another *without being anywhere in between*. I have lost count of the times when I have heard a religious conversion described as a "quantum transition" – as if the convert simply went from being an unbeliever to a believer, or *vice versa*, without experiencing, e.g., anything like a "dark night of the soul" in between. I am sure even St. John of the Cross would have been impressed with such a prodigious feat.

Anyway, in the “downstairs” world of the Cosmic Downton Abbey Mr. Carson, Mrs. Hughes, Daisy, Mrs. Patmore, *et al.*, occupy, the world is indeed a quantum world. But upstairs where Lord and Lady Grantham and their feuding daughters live, the quantum effects smooth / average out to an *apparent* -- **but only apparent** -- continuity. Humanists and theologians fail to appreciate the difference, and so, in order to appear scientifically literate and metaphysically *au courant*, consistently misuse such terminology. A good example of this syndrome is Diamuid O’Murchu’s *Quantum Theology*, the very title of which is like fingernails scraping a blackboard, which is a good argument in favor of not using such terms at all unless and until you can use them correctly. Otherwise, you *diminish* your credibility, you do not augment it. If you cannot use the term literately, stay away from "quantum" altogether. Otherwise, you will merely succeed in playing the naked emperor modeling his new wardrobe.

o Entanglement / Synchronicity

These two words actually go together, especially in the area of “New Age” – is that terminology still a thing? – philosophy and theological puffery. This pair of words is actually a double irritant, because it distorts two legitimate and fascinating concepts from two different fields, and manages in the process to pervert both at the same time. To wit:

"Entanglement" refers to the quantum state of two quantum systems which, for whatever reason, interact with each other. For example, two photons are emitted in opposite directions *from a common source*. Conservation of spin says that the two photons have opposite spin: +1 ("spin up", again purely metaphorically) and -1 ("spin down"). But wait … it gets better. We know that if one photon is passed through a device that flips the spin to the opposite – say, it flips the +1 photon to -1 – then conservation of spin says that the other photon of the pair flips from -1 to +1 and that **the flip occurs instantaneously, i.e., with identically zero elapsed time**. The two photons are said to be *entangled* because **their quantum numbers influence each other instantaneously over unlimited distances**. The two photons could be separated by the width of the Milky Way galaxy, and flipping one would still instantly flip the other, distance notwithstanding. Albert Einstein referred to this phenomenon – which is quite real, though Einstein had his doubts – as *spukhafte Fernwirkung* (“spooky action at a distance”). Today, physicists talk in terms of something called “non-locality”. So far, so good: this is good empirical science.

But then along come the people who know just enough to be dangerous, the same type of people who habitually use the words “quantum” and “theology” in the same sentence. Their contribution to the discourse is a word coined by Dr. Carl Gustav Jung: **synchronicity**. Jung believed that certain coincidences in the lives of his psychoanalysis clients could be accounted for by the meaning *ascribed by the client* -- important italics! -- to the juxtaposition of the two coincidental events. The example he gives is of his experience in the therapeutic treatment of a client who was having a whole series of dreams set in dynastic Egypt. As the client was recounting one such dream, into the open window of the consulting room flew a scarab beetle, one of the gods of ancient Egypt. The New Age interpreters of "quantum" metaphysics argue that the flipping of the photon is an example of Jungian synchronicity. The problem is that *synchronicity is a matter of subjective, idiosyncratic meaning* to a specific individual, i.e., the meaning attributed to the event by the analysand. Multitudes of coincidences are occurring all the time, but not all are meaningful. For all I know, thousands of scarab beetles are flitting into thousands of psychoanalysts' consulting rooms. But absent an *ascription of meaning by the client*, the aggregate portent of these events adds up to zero. So the question "What does the flipping of the photon spin mean?" begs the unanswered question "Meaningful *to whom*?"

Alternatively, others in the same marginal New Age tradition argue that ... golly-gee-gawrsh ... if we could only get everyone in the world, all 7 billion of us, to sit down in a quiet room at the same time and send out "positive thoughts" and "positive energy" that the socio-politico-spiritual state of the entire human race and the inanimate universe would be synchronistically revolutionized and a hundred million flowers would bloom ... **just by thinking about it**. Honest t'Gawd, I have had good friends actually send me literature about such exercises in conceptual masturbation. For one thing, I have my doubts about just plain-vanilla synchronicity. I seriously doubt that, even if it exists, synchronicity is susceptible to empirical science, even in principle, because Jung said synchronicity **does not operate by cause-and-effect**, whereas empirical science does. So saying that simultaneous exercises in synchronicity can **cause** anything, let alone eventuate world peace and harmony, is diametrically opposite Jung's own conception of the alleged phenomenon. He even wrote a book entitled *Synchronicity: An* **Acausal** *Connecting Principle* (boldface added). So ... sorry gang, you cannot do something with nothing. In general, and except perhaps within the skull of the occasional individual sitting by an open window, *synchronicity does not* **do** *anything*.

o Deconstruction (and its adjectival variants, e.g., "deconstructionist," "deconstructive," etc.

As usual, "deconstruction" has a legitimate meaning. I became acquainted with the meaning -- actually, meaning**s**, plural -- of "deconstruction" as a result of having taught courses as adjunct faculty in deconstructionist "lit crit", deconstructionist philosophy, and deconstructionist interpretation theory. The way the term is used in the popular press, often even undergraduate papers, makes me want to bang my head on my desk. But I can descry a common thread of meaning in virtually all the misusages, to wit ...

As popularly conceived, "deconstruction" is usually equated with some kind of "reverse engineering". For example, if a flying saucer really had crashed and been recovered at Roswell, NM, in 1947 -- which I do not for a moment believe -- you can bet that the best engineering talent in the Nation would be intensively occupied dismantling the craft and attempting to reverse engineer its exotic propulsion systems. In the popular press, this reverse engineering process would probably be described as an attempt to "deconstruct" the alien spacecraft. So in this popular understanding, to "deconstruct" something -- a machine, software code, a literary text, etc. -- means to peel back the various layers of development, redaction, and revision until one arrives at the original, e.g., the fundamental physics that made a gravity-drive possible, the source code for Stuxnet, the original meaning of a constitutional or Gospel text, etc. This, of course, presupposes that there ever **was** an "original": an Original with a capital "O". This first principle is what almost all forms of deconstruction, of which there is a whole zoo, denies. Or as deconstructionists are often wont to express it, there is no "transcendent Signified". There are only ba-zillions -- sorry for the technical "lit-crit" language -- of individual signifiers that *merely point to one another*. (A "signifier" is merely what you have when your "signi-" is burning.) **In deconstructionism there is no Original.** So reverse engineering is the *diametric opposite* of deconstruction.

The following is the *gedanken* experiment I used to use to explain all the above to my students in my deconstruction classes, especially *vis a vis* "lit crit". Everyone at one time or another has made hundreds, maybe thousands, of photo- / Xerox copies of documents. Suppose all those copies were for public dissemination from the public domain, like accounts of Donald Trump's extramarital assignations. Intuition says that, at some point, however long ago, there was an original document of which all subsequent documents are copies. Let's call this the "Ur-Document" ("ur" is a German prefix

meaning "ultimate" or "primordial"). Deconstruction denies this. Deconstruction says that there is "always already" no Ur-Document. **There is no Original.** There are only copies. And copies of copies. And copies of copies of copies. And copies of copies of copies of copies. Etc. The **non-**existence of an Original, an Ur-Document, in any context whatsoever, is one of the cardinal tenets of the currently fashionable attitude of postmodernist nihilism, which, as I have argued elsewhere at length, bids fair to demolish all 500 years of the European Enlightenment project, including liberal, constitutional democracy. But that is another rant for another time. For now, if you are interested in learning about postmodernism and deconstruction from someone who actually *knows* something, while avoiding the sacrifice of scholarly rigor for the sake of popular accessibility, nothing has been written better than Prof. Stanley Grenz's *A Primer of Postmodernism*.

For now, please accept my thanks for reading my ventings above. I don't know about you, but I feel much better!