

Nature loves symmetry

Monday, September 09, 2013

I spend a significant part of my life driving. Driving can take my mind off one thing and put it on other things. This weekend I drove to Columbia for a football game and to Kansas City for a baseball game. Scott and Janet (my son and wife) were in the car with me. I had a good weekend. We met Eric, my other son, in Kansas City. I saw a crow. Crows have the largest brain to body mass ratio of any bird. Crows will try to eat anything that does not eat them first. Crows mate for life.

Ever wonder why anyone should care whether physicists discovered the Higgs boson? Maybe I should begin by mentioning that they did discover it. Some physicists have for years jokingly referred to it as the God particle. Do not be deceived by the playfulness of theoretical physicists. They are wild and crazy guys, but they did not mean to imply that discovering the Higgs particle had anything to do with proving the existence of God. What it really did was go a long way toward proving that the physicists' mathematical model of matter was an accurate metaphor. They needed the Higgs to add a simple thing to a perfectly symmetrical model of matter: mass. Unless they could find the Higgs, their model could not explain why matter had mass... how to give airy nothing more than a symmetrical shape, how to give it a local habitation and a name—in other words: weight... existence... reality.

The poet's eye, in a fine frenzy rolling,
Doth glance from heaven to earth, from earth to heaven;
And as imagination bodies forth
The forms of things unknown, the poet's pen
Turns them to shapes, and gives to airy nothing
A local habitation and a name.

-A Midsummer Night's Dream, Act V, Scene 1

Nature loves symmetry. Three of us were in the car. I was driving. Symmetry doesn't have to come two by two or in a circle with no beginning and no end. Three can exhibit symmetrical unity: the equilateral triangle; the Father, the Son and the Holy Ghost; Larry, Moe and Curly. Is it just me or does anyone else hear "American Pie" playing in the background every time someone invokes the trinity?

Okay... maybe it's just me.

Things were not unfolding symmetrically. My two passengers were being one with their cell phones, and I was resisting an urge to pick up mine to do some reading and writing while driving. I recently promised

myself and a bunch of other people I would stop doing that. I drive 60,000 miles a year—much of it alone. My Borg implant connecting me to the hive mind does keep me from talking to myself and from obsessing too much on a single interior monologue, but I admit I am a danger to myself and others when doing so. I claim no divine dispensation or privileged status. I defend the indulgence by saying fate will not let me off the OCH hook as easily as a fatal car wreck, but that would be no consolation to an innocent third party.

The thing that may finally keep me off the digital pacifier is the amount of life insurance now covering my life. Lenders have gotten wise to me. Every time I borrowed money for the hospital the last few years they made me get more life insurance. I hear the taunt from old man Potter: “You're worth more dead than alive.” I am willing to do almost anything for OCH but I will not willingly write my death as a cliché.

“Back to the burst bubble born...”

[In an effort to become more transparent and easier on the reader, let me say I am quoting myself. It is a line from a poem embedded in the middle of Grid; so, the reader is forgiven for not recognizing it. Those words pop into my head often as a way of announcing that I am returning to a topic I left abruptly some time earlier. Symmetry is the heart of the art of digression.]

Yearning for both symmetry and a digital interface, I saw a small hay field ahead on the right. It was freshly cut and sloped up to a house on a hill. If not for the presence of three round hay bales spread on the lawn, it would have seemed a front yard.

There were two large black birds perched on two of the hay bales. I was not merely hoping for a third, nor simply expecting a third—I knew there would be a third crow. I knew it with such certainty that I allowed myself time to search for something I could make out of the third crow and *The Third Man*, one of my favorite films. I found something, of course, but I was driving 80 miles an hour and had to get back to my crow trinity. I saw a flutter of wings, a smear of charcoal racing against time toward the third bale. Why was time part of the picture... equation? The third crow should have been perched on the third bale when I first looked. I knew it. The third crow knew it. I don't know who screwed up—whether the crow lingered too long in a tryst, a dalliance of desire, or something more fundamental was out of balance—but nature was straining to put things right. I wanted to turn my head... to look back... to give nature more time.

But that would have been cheating and you can't cheat Mother Nature. You can't cheat Time.

So, I kept my head screwed on straight (but stole a backward glance) and I wondered if Lot's wife would have been turned to a pillar of salt if she had only turned her eyes instead of her head. Could I get off on a technicality? I am a lawyer. Why did I feel it as my failure? I did not make the crow late. I did not have to turn my head to know for a fact that the third crow was perched on the third bale a nano-second after the hay field fled past my peripheral field of vision.

I almost said “I'm sorry” out loud but it would have been difficult to explain—just as it is now.

“Back to the burst bubble born...”

Back when I said “Symmetry doesn’t have to come two by two or in a circle with no beginning and no end” I thought of “Ode on a Grecian Urn” by Keats—but I just couldn’t throw another digression at you. Now that you have had a chance to catch your breath... The poem by Keats has both kinds of symmetry. There is the mirror image symmetry that comes “two by two” in the last two lines of the poem: “*Beauty is truth, truth beauty, – that is all / Ye know on earth, and all ye need to know.*” There is also the symmetry of the circle that has no beginning and no end. A Grecian urn is decorated with pictures arranged in a circle narrating a story that never begins and never ends.

The truth is those words are a cheat. Symmetry is a cheat. Nature loves symmetry but it abhors a vacuum. There is a beginning. Time is asymmetrical. That is the lesson for today. Time is asymmetrical and perfect symmetry exists only outside of time.

My favorite description of time comes from an episode of *Magnum, P.I.*: “time has little to do with infinity and jelly doughnuts.” Time has little to do with infinity. That is a true statement. I am a little fuzzy on time and jelly donuts... we may get to that later... but I am clear on time and infinity. Infinity is a precisely defined mathematical term. In mathematics, time is best understood as a measurement of the duration of an event. One way to illustrate the difference between infinity and time is by reference to Zeno’s paradox about lovers who cross half the distance between them each time they take a step but they never kiss—an infinity of longing and yearning and reaching and loving.

It is, of course, a false paradox. *Time is space. Space is time.* That is all ye know on earth and all ye need to know. The measurement of time—like the measurement of space—does not separate time or space into discrete units. We only imagine it does. Mathematics has invented a numbering system that allows us to count (or, at least, to imagine we can count) an infinite number of points on a finite geometrical line connecting point A to point B or the passage of time from one moment to the next. Substitute a different kind of figure to represent space or time and the illusion is exposed. Instead of the space between the lovers, use one lover’s body as the defined “space” between two points. Now, imagine dividing the lover’s body into half. You will need a sharp knife and a bone saw.

Ever hear of a zero sum game? If the game is set up such that one player can only win when the other player loses, it is a zero sum game. Games with a fixed number of chances are zero sum games because the number of chances won and lost by the winner will equal the number of chances lost and won by the loser. For example, in a game of 10 chances, 6 wins + 4 loses = 4 wins + 6 losses. Mathematical equations are a kind of zero sum game in that both sides of the equation have to cancel each other out. If $A = B$, then $A - B = 0$. Zero is the sum of the equation. Symmetry is a zero sum game.

There was a man raised from birth by a family of wolves. He was found by hunter who killed the family of wolves—but that is a different story. In this story, the man is handed over to a remote monastery inhabited exclusively by monks who have taken a lifelong vow of silence. The wolf man is extremely intelligent and intuitive. He is educated in the basics of human civilization by the monks. He learns to read and write. He is shown how to eat with fork, spoon and knife. A film crew shows up at the monastery intending to make a documentary about monastic life, but when they stumble into the wolf

man and learn something of his story from notes written by the monks, they decide to abandon their original intent and to make instead a documentary about the wolf man.

The film makers arrange a formal dinner to introduce the wolf man to a group of dignitaries, social scientists, and rich people as a kick-starter to garner as much publicity and funding for their project as possible. The dinner guests are asked to make allowances for the wolf man's lack of instruction in the finer aspects of life in high society. They are told he is easily embarrassed about his ignorance in such matters and, being highly intelligent and intuitive, will often sense when he has committed a faux pas even though no one intervenes to correct him.

The documentarians have a banquet hall set up with large circular tables. The event is being filmed as part of the documentary. The working "script" calls for the wolf man to enter the banquet hall first and alone. Though he has been educated about how to eat like a "civilized" human being, he has never been exposed to the kind of formal place setting arrangements and the fine dining code of behavior he will experience tonight. The intent is not to embarrass the wolf man but to observe him coping with the unfamiliar environment. The film makers want to see how he reacts to the empty room; so, he is told that, as the guest of honor, he must enter first and must choose his seat. He is told that he must signal the other guests to enter by taking a sip of water from his glass.

The place settings are crammed tightly together and, as any non-graduate from the Emily Post school of etiquette will attest, it is impossible to determine which water glass goes with which place setting. The wolf man circles a few tables, takes a seat and is obviously perplexed as to which water glass he should select but he knows that the other guests are waiting for him to give the signal. So, he selects the glass to the left of his plate and takes a sip. As the other guests are seated, they silently follow the wolf man's lead regarding the position of the proper water glass—not only at his table where they had little choice in the matter—but also at all the other tables—so as to not cause the intelligent intuitive wolf man any embarrassment.

Symmetry is the mere measurement of space. It is a universe of particles perfectly defined by a mathematical theory of everything... but without mass, no thing matters and there are no jelly donuts. Choosing the water glass on the right or the left is the equivalent of creating a nonzero "charge" in the symmetrical shape of matter without mass. Choosing—the charge—creates mass.

"Back to the burst bubble born as it cries 'poof' and remains in the air."

Little did I realize when I wrote those words almost forty years ago that I was describing the Higgs boson. The discovery of the Higgs boson filled the vacuum of space. Of course, the historian in me can't help but recall Einstein's heart felt desire to preserve symmetry which compelled him to create the most famous fudge factor in history—the cosmological constant representing the energy density of the vacuum of space. Einstein later called it his greatest blunder but it keeps coming back to life. Why?

Nature loves symmetry.

Nature abhors a vacuum.

There are invisible forces at work keeping the universe from flying apart. Put another way, but for these invisible forces, there could be infinity but there would be no jelly doughnuts. One of the invisible forces keeping the universe from flying apart is called the weak force. The weak force is connected to radioactive decay—weak because it leaks particles like a slowly dripping faucet. It is also connected to electromagnetism and so is also known as the electroweak force. The existence of the Higgs boson is not just another subatomic particle. The existence of the Higgs boson means that the electroweak force functions through the existence of a Higgs field, which is a quantity that permeates the vacuum and can have a nonzero value. A nonzero value for a field is indeed something special: the Higgs field can take a nonzero value when no particles are present—in the vacuum of space. In other words, or, more precisely, in the words of this particular rant, the Higgs field makes the vacuum of space asymmetrical. The blank canvas has an unseen smear of charcoal dust. Before the discovery of Higgs there was no evidence of a nonzero value for quantum fields. There were only quantum fields that create or destroy particles but take zero value in the absence of particles. Matter is neither created nor destroyed in the vacuum of space. That is a law. In fact, it is the first law of thermodynamics. It is a law of nature. The Higgs field has a nonzero value; so, it is not nothing, but it has the potential to create particles, to create matter out of nothing but the vacuum of space.

There is a painting in the museum of my mind: a freshly mown lawn beneath a house on a hill with three bales of hay hosting three oversized crows sitting perfectly still. I can't see the painting clearly because there is a flutter of wings and a desperate smear of charcoal obscuring my sight.