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# Cosmic Fugue

What time is it? A glance to the clock on the wall next to me betrays a mechanical measurement of it. And I still do not know. My wrist watch buzzes along with a solar-powered processing unit showing an accuracy which still astonishes me. The call sign letters of WWV, an atomic-powered clock in Colorado is accurate to within a billionth of a second over the course of a thousand years. A referee shouts, "Time!" during some particular sport, and all play stops. Time does not. I cannot explain it any better than my fellow humans. In our limited layperson terms, let's try, shall we?

We spend it. Save it. Hold it. Compress it. It is wasted, run out of, calculated, balanced, chased, and run away from. We can have too much or too little of it in our hands. It is stamped, logged and placed on a piece of cardboard as evidence of work. There is not enough of it in a day, week, year or lifetime. Unfortunately for some, (especially to the middle school mathematics student gazing at the slowness of the classroom clock before lunch), there is too much of it.

We travel through it. There is no possible way to reach into the future or back into the past. There are simply too many arrows on that proverbial "signpost up ahead" pointing only one direction. It clearly warns potential time travelers against such physical chaos and contradictions. It is the very heart and soul of all our yesterdays. The present and future beckon, but only with the edge of the finest knife blade possible held between them. We call this a "moment", or an "instant." How long is it? We cannot know. Yet, we live through them. We are time travelers. We know of it, and its effects, both long and short term. We are at the helm of its grasp as we chart our courses on our individual pathways through the Challenge of the Passing Years. We do not own it. It owns us.

We cannot define it. Why?

The question is repeated, "What time is it?" The physicist would tell us it is a calculation of distance divided by the rate of an object moving in two dimensions. But isn't time its own dimension? (To a non-science person the definition of a dimension is that it represents a degree of freedom. Time is linked inextricably to our living, breathing and moving through these three degrees of freedom, isn't it? Perhaps time is dimensionless, it is definitely

the fabric woven into our comfortable movement through it and our daily lives.)

The microscopically-small rotifer munching on an even smaller bit of bacteria in several drops of pond water never measures time that we can begin to consider. But it must. Every living organism has an internal "tick". In the rotifer's case its organic clock is finite, limited, and is allotted only so much to beat during its lifetime. Its unique physical body will age, wither and eventually die. All completely dictated by internal and external forces. Trillions of cells in the bodies of living creatures, all using their powerhouses - the mitochondria - have a time of established existence built into them. There is an upper limit for them as well, and their precious operations.

Yet, do not the ants, squirrels, birds and numerous trees and plants respond to the changes that seasons bring? With a great degree of mystery, they are able to make uncannily accurate predictions for the immediate future and for their use only. (If only we humans had that ability to be such prognosticators with our own lives!) How is it possible they can see such changes in weather patterns long before the seasonal changes tug for us?

Are they aware of how they see themselves? There is no reflection for them to rely upon. We are assured they are not reflecting philosophically for that matter.

We cannot look into a mirror and see a reflection of ourselves in an instant. Light travels only so fast; we are seeing ourselves a fraction of a second in the past. Deep space is like that as well. Looking into the star-studded heavens, one looks back into time, the very distant Past.

Look beyond the tick of the clock on the mantle shelf. It is the beat of a heart, a cloud forming or evaporating. It is the transition of summer into autumn when the leaves receive a signal to begin their spectacular color spectrum. Or perhaps, it is the wakeup call from mother nature to rouse the sleeping and frozen ground from its deep winter slumber. Spring follows and there is a furiously-growing mixture of greens of every shade as they open and close according to their own chlorophyll-drenched clock.

It is an order of successive events. It is change. It is duration. It is epoch. A definition of it is never possible, or satisfactory; it also is equally difficult to conceive of in the mind. It defies any challenge to give it meaning. Often,

terms that are synonymous with time are used to attempt to define it. How careless of those dictionary writers! Poets and science fiction authors are more adept and adroit at commanding attention to their stories as they reminisce, pontificate, muse and soliloquize about time and lost loves, opportunities, sadness and happiness. Musicians and songwriters take advantage of its syncopated beats. A metronome sounds in their brilliant minds as the style of anapestic tetrameter is laced into their gentle words.

Let's start the story here. Conceive of the second of that three-handed clock at the beginning of this essay. That part is a tick of the clock we are intimately familiar with as we go about frenetically in our daily lives. Very few of us need something more accurate. Now, there is something even smaller than the second. Much smaller. Something so tiny, that it is nearly infinitesimal. It is the term "instant". A photograph is one such concrete example of the that "instant" snatched out of time, and carefully preserved by its camera-wielding artist. Even that small picture of a moment in time can be divided further. Into something even more minute. (There is certainly no pun intended here!)

No, the fraction I have in mind can be split even more. Is there a smallest unit of time? If there is, it is beyond being a bit, a fragment, a mote of dust, or a dot. It is the reciprocal of an extremely large number. Hence, it is nearly inconceivable. I cannot think of a way to define that smallest unit of time in my layman's terms (or my imagination, for that matter). But if it could be defined, measured, drawn and calculated, then time itself could be manipulated. Think about this for the moment. Perhaps, this might be the beginning of how our universe began. Before time. It was that instant of Time itself before this decimal point leading the parade of too many zeroes to count as its fraction that began it all.

*The Void*

It was there. Hanging in a space not made. Yet, at the moment of Creation, hovering milliseconds prior to the Big Bang, there existed that smallest possible interval of time known. In this case, it was the time taken by a ray of light to travel the distance across the smallest known particle, i.e., a quark. The fabric of our universe was no bigger than a simple particle, this heated quark. Moments earlier, All Things hovered about and pulsated. Expansion was nearly instantaneous and nearly the speed of light.

This pinpoint of light was merely there. It was perhaps, smaller than the head of a pin. Much smaller. This bit of "stuff" included everything we would know, not know, fiercely debate, hypothesize, study, test, retest and refine many times over during our study of it billions of years into the future. (Think of this: the quest to know the unknown cannot be hastened. Our minds must simply wait. Shoulders of brilliant explorers must be stood upon while holding our clumsy tools in our quest to pierce the unknown.)

The intensely hot ray of light quivered, trembled and shook from its vantage point. The time was negative two minutes. Before what? That is impossible to say. This tiny pinpoint of light knew not of time, cosmic strings, space or geometry. It was a crunched up bit of heat, ready to spring forth. And it did.

The quark-sized singularity burst into a foam, bearing a temperature many trillions of degrees Celsius and with a density millions of tons of matter per teaspoonful.

It was the Big Bang.

*The Foam*

The foam was dense. It glowed. It was bright, but not from the light that it generated. But from its own massive radiation. Alpha, Beta, Gamma, X rays, and cosmic rays made for a colorful and scintillating fountain of hard radiation pushing and shoving its way from the glow. The foam was matter and energy and time and dimension all at once. It shook. It quivered. It stretched and contracted. It rose and fell. It wavered, collapsed, expanded, exploded, disintegrated, dissolved, and reappeared. It was hot. Massively hot. Incomprehensibly hot.

If an observer sat in a chair (in a space that did not yet exist?), a safe distance from this cataclysm, observing this glowing pinpoint of foam, he or she would have seen blackness all around it. For the foam was going to explode. There was no "now", no past and no future. There was no Time. Not yet.

Then, chaos.

A sudden and unspeakable and incomprehensible disorder broke out.

*The Explosion*

The burst was indescribable. The foam spewed from its pinpoint every piece of dimension, light, matter, particle and quark. Pieces of quarks. Even smaller pieces of the matter in question. For it was no longer matter. It was dense, ripped, and non-corporeal fabric. It was shredded. Hot, torn plasma that bubbled into and out of different dimensions. Matter and energy shot every direction, filling the blackness with light. It manufactured the material of space with its very soul as it expanded. And tearing at it just as frantically, these superheated blocks of foam devoured one another. They regurgitated even more foam. It was even hotter, but only briefly. This was the first fraction of a second following the Big Bang. The foam was disappearing quickly.

It was time for Time to begin.

*Winking Out*

Dust, superheated beyond comprehension, but cooler than the foam, instantly transported itself from place to place. Three dimensions (in fact, many dimensions) did exist, yes, but there was no up or down, no left or right. Just space, dark, empty, yawning, cavernous, lonely, limitless space

filling up with dust and gravity. The dimensions collided with each other, overlapping and tearing at each other with vast rips, tears and rends. The very fabric of space itself was torn, shorn, cut, eviscerated and clumsily shredded over and over. Layers of dimensions mirrored these impacts. Known, and very much unknown, vast physical properties were created; they cancelled one another out, and destroyed each other with their innumerable contradictions. It was bedlam on a universal scale!

Our observer (again, in that hypothetical chair) would have seen great cascading galaxies, whipping and spiraling quasars, and massive dust balls of superheated plasma winking out. They all were faster than the speed of light. All of the Past, Present and Future were wrapped into this warping of dust. Some of this dust "drained" away from one universe. It tumbled and fell; no, it was sucked away and it instantly disappeared. It was slammed and shredded. It was a vicious, and infinitely-fast vortex that engulfed, distorted and then consumed its energy and dust-filled "meal." It drained out of one layer of space, dimension and Time and into another with an inaudible scream of rending fabric. It was gone forever. Hence, Time did not exist for this matter.

Only space was being filled by these galactic cores of dense white light. They glittered furiously at great distances. The ones close by were brilliantly white and sparkling. One moment they were in one spot. In the next one, they vanished and reappeared in another spot many light years away. They performed an instantaneous space transfer as well as time displacement. So many contradictions of Euclid's Geometry! Remember, even that did not exist yet. The violations of every Newtonian and Einsteinian Law happened over and over. Sadly, those brilliant minds of the most learned of men were more than one hundred fifty million centuries into the future. They could not possibly know at this moment in Time how correct their perspicacious observations were.

Every law of physics was broken and reinvented at the same time. The foam was also gone. At the center of the great explosion, was a massive black hole. This was the greatest of cores. The Center of Everything. The Beginning of All Things Known. The Unknown. The End of Everything.

A massive rotating gravitational pool with a mix of matter and energy that would one day, billions of years hence, pull all of everything back into a pinpoint. The process would start over well into the future. But this

universe, at this moment, indeed, for many countless eons, was nearly secure in its formation. It was far beyond stabilization, however. But it was encouraging, nonetheless.

It was also two minutes old.

*Building Blocks of Dust*

As the building blocks of hydrogen and helium were formed from the dust, they were themselves ripped to shreds. As dust clouds lingered, shimmered and dissipated, they stretched into nothingness. As matter and antimatter faded together after violently cancelling each other out, they separated from each other safely into different universes. Corridors separated the explosive and contradictory entities. Black, white, gray; on, off, neutral; plus, minus, zero; the universes were matter and antimatter and a distorted no man's land netherworld between the two. These corridors were the "safety" valves put in place to prevent even a shred of invasive particles of either universe from destroying one another in a mind-numbing cataclysm. (The warning sign is clear to all of them: stay out. The universes are safe: theirs and mine. If one particle of matter of either one should meet outside of the confines of its

nearly-invulnerable region, it would be complete and total and utter annihilation. Of both universes. Everywhere. Instantly.)

But, somewhere out in the cosmic turbulence, whirling, spinning, twisting, spiraling and bending were the most basic of all the constituents of the Superstition Mountain Range of Arizona. It was not even part of a cooled-planet with a molten iron core. Not yet.

The formation of our Earth and the Sun had to wait a little more than nine billion years since the expansion of the Big Bang occurred. If our observer had been around since Day One of the initial explosion, he would notice the lack of gold in "*them thar hills."*

(Or certainly our observer for that matter would be keenly absent. Carbon and oxygen had not formed yet, either. There were no organic molecules whatsoever.) Indeed, elements with an atomic number greater than iron form only during a supernova explosion. These supernovae "seed" surrounding space with countless heavier elements. These seeds eventually come together under gravity's influence to form additional new stars. Dust that one day would become life. And us.

All of this would not happen for countless eons into the future. There would one day be a third planet from its sun. That sun would be called Sol. And it would light this place; a planet called Earth. But not today. The orchestration of the blocks of matter that would one day build the glittering pure gold of Jacob Waltz was being established.

The Big Bang was nearly finished. For the next fifteen billion years or so, the ratios of seventy three percent hydrogen to nearly twenty seven percent helium would be the new universe. The time now was just about three minutes after the Big Bang.

The four forces: gravity, strong nuclear, weak nuclear, and magnetism existed separately and were already making their influences felt universe-wide.

The universe was establishing itself.

*Background Music*

The dust expanded and cooled. It shoved black nothingness aside and pushed in its own light at the retreating darkness. It left dust trails wherever it went. And as it shoved all of space further into space, the entire structure vibrated. Not as an audible physical entity, mind you. But if one had a way to record the sound (using a very low frequency receiver), it would be like a low thrumming of regular forty to sixty cycles of a steady warbling of musical notes several octaves below Middle C on the piano scale. It made for beautiful pulsating background music, a sort of cosmic fugue. It was produced by the vibration of cosmic strings. Pieces of space began to shrink, enlarge, explode and collapse upon one another. Small windows and rifts in the very woven sections of three-dimensional space opened and closed like blinking lights. White light, then dark, then white again. Giant zippers of lightning bolts sparked about, ripping the fabric of space itself. It was similar to shearing clumsily the heavy fabric of a closed and opened curtain. As space tore itself open, loose threads of shimmering light pulled apart, twinkled, whipped about like flailing wind-driven flags, and then were shredded from each other. They sparked and sparkled as they disappeared. Sizzling came from the torn space remnants. They turned and floated upwards, twisted like the most complex of Moebius Strips and then evaporated. Were these the same cosmic strings themselves behaving so

violently as the universe formed? As perfect a note as possible was enhanced by each string's thrum and vibrato. They worked in unison, and separately. It was a harmony not unlike the soulful Gregorian Chant of Mixolydian Mode, but on a more, vastly perfect scale. The twelfth root of two is transcendental to us. It can never be resolved in a calculation. Yet the note was perfectly calculated from the standard of 440 Hertz by the universe itself. Its tessitura may have been the note of C2 (approximately 65.41 Hertz.) We will never know.

The note penetrated the vastness of the known universe. Perhaps it was fed by the steady white holes, the cosmic "gushers", the opposite matter makers. They are the safety valves for the black holes, the matter eaters. Both black holes and white holes constantly feed upon one another. Spreading dust and light, darkness and plasma throughout time and spatial shortcuts along their own "superhighways".

The oscillations of back-and-forth matter/energy exchanges would go on for billions of years. Gradually, the music would subside. Yes, it would still be there, but it would become nearly inaudible. The heavens were being sorted

out; the dance of the Whirling Dervish of expanding dust particles was nearly complete. It was time to build the solar systems.

Four and half billion years later: Earth appeared. It was not the Earth we saw hanging delicately in a black-velvet of space seen by the Apollo 8 astronauts during the Christmas of 1968. This ancient (albeit newly formed) planet was molten. There was no atmosphere, no oceans. Arizona cannot be pinpointed on this melted iron tempest. Gradually, over millions of years, a primordial atmosphere formed. Outgassing from volcanic activity most likely was responsible for it. This atmosphere contained very little oxygen (that would occur more than two billion years later), and would have been toxic to life as we know it today. Formation of the oceans was next.

And then it began to rain.

*A Question*

Will our universe expand endlessly? Or, is its future one of convulsing seesaws of crunches and expansions? If we are to contract to a searing, white-hot pinpoint again, we will never know. No information can ever be saved from the current universe for the next one. One day, perhaps, the

expansion of everything we know will become a reversal, and then there will be a conglomeration of stars, galaxies, planets, comets, moons, suns, dust, and heat. Everything known and unknown to us will rush toward this center.

Absolutely everything will be crushed, stampeded, pulverized, disintegrated, annihilated, flattened, and dissolved. Then dust. Compression. Energy. Light. Darkness. Timeless. Nothing. Silence. Pinpoint. Explosion. Foam.

Renewal.

*Arizona*

Supernovas abounded as the early universe took shape. Many of the heavier elements were formed from the heated dust and matter. Some of this would eventually coalesce and form gold, iron, lead and mercury. The entire Periodic Chart of the Elements awaited piecemeal discovery by Earth's inhabitants over the countless centuries. Some of it would be a part of the earth's crust. Very future volcanic eruptions would bring this mixture of gold through a vast system of intricate passages leading through a superheated, gooey quartz (silicon dioxide).

The sun took its dust from the swirling gases. Gravity compressed it into a hydrogen-to-helium fusion furnace. Its light radiated into now-empty space. Where there would one day be the future nine planets orbiting it. And as the planets formed, different characteristics abounded for each of them. Two of the planets closest to the sun could not support life. Mercury had no atmosphere, and Venus' blazing hot atmosphere was too poisonous. Earth was just right. The others beyond the orbits of Earth included Mars, Jupiter, Saturn, Neptune, Uranus and Pluto. Each planet had its own unique geology as well.

As the earth cooled, as the moon formed and the oceans experienced the tugs and pulls of tidal influences, the land masses gradually took shape. Arizona's features developed along with the rest of the future Southwestern United States in an incredibly slow, but thoroughly complete process. Surface rocks developed from a great basin of sediment -- there was liquid water and oceans by then -- and life was just getting started. Small, simple organisms lived and died in hostile seas.

These rock formations buckled up about 1.4 billion years ago, and volcanic processes shoved molten rock formed deeper in the earth into them. They

cooled slowly. Mountain chains and valleys formed, now part of a continent all of their own. The old land mass is still evident at Squaw Peak, Black Mountain, the McDowell Mountains, the Sierra Estrella, and especially the Superstitions. Most of these rocks and the landscape they were part of, easily an eight-mile thickness, gradually eroded, both chemically and physically, to absolute flatness.

One day a special region east of Phoenix would be called the Superstition Mountains. They would be located in Pinal County, between Apache Junction and Gold Canyon, Arizona. Therein is our tale. It begins off US Highway 60 and State Route 88 in Arizona.

It is just outside of Lost Dutchman State Park.