Flash Fiction Fugue

In Four Dimensions

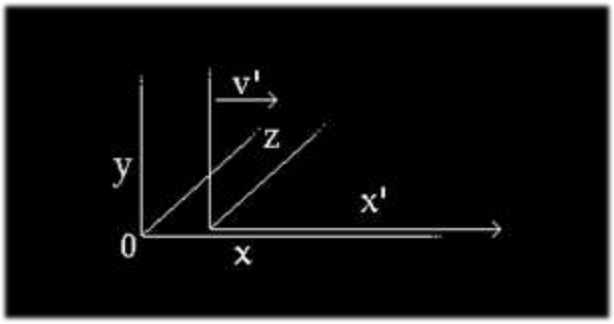
Tom Ransom 2017

Length

Well that's it, he thought, no way I can live up to that performance. This was the day in ninth grade English when each by turn was to go before the class to speak on their topic of choice and Nolen had just delivered a comical demonstration on how to unravel a golf ball to reveal the 'mystery' at its core. This was back in the day when a hundred feet of sticky rubber band preceded the discovery, which ended up in a quivering pile on the teachers desk. This was the same guy who was kicked out of concert band for sneaking a ball of twine from art class into practice, somehow managing to get the entire trombone section to wrap it around their folding chairs, with their feet—unnoticed, such that when he walked out at sessions end, twine in tow, a colliding clash of chairs piled up in the doorway. *Too* funny. Legendary. Nolen had just done his thing, everyone was laughing, and he was up next.

The preceding night had been restless, and worrisome. Such a prelude was likely to proceed any public performance, but in addition, tomorrow, Tina would be sitting in the front row of class. She was especially favored by most of the boys in school. He imagined her in that dark blue, short pleated skirt, legs crossed the way she does, making it even harder to gather his thoughts. And why in the world had he selected such a difficult topic anyway, one he could hardly understand much less explain. And yet, then again, he knew full well why he wanted to speak on this subject—it was so unbelievably cool!

And so it was that when his name was finally called the following afternoon, he stood up at the back of the classroom, all eyes upon him, and proceeded down the narrowing isle between the desks, a gauntlet of expectant faces, until he found himself at the front of the class before the blackboard, his apprehensions the night before now fully realized, whereupon having reached for the nearest nub of chalk, he wrote: Theory of Relativity. Directly below he then drew two parallel lines, with two perpendicular lines extending on the left end of each, and lettered them, just as he remembered from the encyclopedia at home.



"These two figures represent reference frames in what physicists call the Lorentz transformation," he began, "and Albert Einstein's interpretation revolutionized physics and forever changed our understanding of energy, space, and time." He went on to reveal how the Lorentz equations of motion depicted accelerations in 3-D space, how the lengths of the x, y and z coordinates contract with velocity until on final approach to the speed of light they went "singular" and *vanished*. And because all physical objects are necessarily extensions in space, they must contract with velocity as well. "Now *there's* a trick," he said in reference to Nolen's skit, "hit a golf ball the speed of light and watch it disappear!"

Clearly on a roll, his confidence on the upswing, he further explained that it was Einstein who first recognized what it means when the mathematics of motion go singular at the speed of light: "The transform equations tell us that because energy and mass are essentially the same, and it takes energy to accelerate an object, an *infinite* amount of energy would be required for anything to ever attain it. This means the velocity of light is absolute and nothing can go faster." But why, he teased, and then concluded with the 'kicker': "Because at the speed of light the metrics of not only space, but those of *time* go singular, meaning everything is happening everywhere now!"

And with that it was mission accomplished; he had turned his classmates onto the coolest *ideas* ever. He looked up from his notes assuredly, anticipating the sense of wonder on their faces, just as he had experienced; to rediscover that reality is even more amazing and mysterious than was imagined. But as he glanced across the faces of his peers he saw only bewilderment. He looked over at Ethan, the brainiest kid in class, slumped halfway down in his seat, fidgeting with a pencil. Nolen was looking out the window. Tina, expressionless, was at least sitting upright. The teacher, witnessing his disillusionment, and then virtual dissolution, felt obliged to step in and direct him to his seat.

There he sat stunned and embarrassed. He could hear her reminding the class that tomorrow morning was the field trip to the planetarium, but he wasn't listening. He should have known better! He should have done his presentation on the conch shell above the fireplace mantel at home. He would have passed it around for everyone to see and touch. They could have listened to the ocean.

Depth

Stars everywhere! In all his gazing up at the sky never had he seen stars as dazzling as these. This was a dizzying display. The entire stellar dome seemed to be spinning—counterclockwise, as if the planetarium program was rewinding. But then why was he laying here on his back in the middle of this field, amid these stubbles of grass and the widgeting crickets? The Sun was going down, a chill was in the air, why hadn't he worn a jacket?

And then—he was gone! No sooner had his eyes closed he was in freefall, falling into a familiar warmth within. As if in a welcoming dream, he fully appreciated how this inner heat was all that separated him from the 'big-chill' outside, and beyond. He'd read enough biology and chemistry to fathom the depths of this inner world, and fashion an understanding, but couldn't recall ever reading what was at the bottom of it all. What was the ultimate *source* of this warmth within? So with curiosity invoked, he began to imagine what was transpiring inside.

He took a deep breath and followed the infusion of fresh air as it rushed into his lungs, watching as the oxygen molecules were drawn out, captivated by the iron-laden red cells passing in his bloodstream. He was amused when, with a convulsive pulse, they were suddenly flushed away, through the heart's chambers, into branching arteries, and out every capillary. He was again surprised by how quickly this oxygen was evacuated, sucked through the lipid membranes of adjacent cells, directly into the import pores of multitudes of microscopic "mitochondria", as if—breathing was all about them.

And it is! They're why we breathe. These tiny organelles within every living cell are the metabolic furnaces that oxidize ingested carbohydrates to produce our cellular fuel. He had read that the heat from this combustion process gets absorbed into the bloodstream and circulated throughout, gathering in the central organs. So he knew that mitochondrial respiration was the proximate source of his immediate warmth, but he also knew that to find the ultimate source would require going deeper.

He further recalled that the metabolic processes of biology were really chemical in nature, and that chemistry, when you got down to it, was happening on the atomic scale. So he began to imagine the mitochondria from within. He watched the churning molecules and proteins interplay, followed down their reaction cascades, until arriving at the source of all this kinetic activity—an electromagnetic field. It was being generated by a frenzy of agitated electrons in orbital pursuit. In fact, this intrinsic affinity between electrons and their adjacent protons is the genesis nexus of not just the biologic, but the entire material world. Now surely, if heat was the result of matter in motion, then things couldn't get much faster, or hotter.

And yet, he remembered reading that even deeper was the "quantum" domain, powered by the most primal of oscillations—the theoretical "wavefunction". For physicists, this was the bottommost feature of the reality continuum, the 'event horizon' marking the boundary beyond which nothing more could ever be directly observed. All that existed below was a dark sequestered underworld of subatomic forces, and he was feeling more dizzy and disoriented than ever.

But wait, had his imagination and the moment suddenly merged, for he was certain he was hearing something deeper in the distance… "om"? It resounded like the sacred mantra of the mystics—the Source! Holding his breath, listening in, he heard it again, only louder, closer—this wasn't some primal harmonic he was hearing, this was the sound of a distant voice, from a source *outside…*

"Tom, are you okay?"

It was one of his classmates! Sitting up, the sound of crickets again and the chill in the air, he opened his eyes to see the remains of his baseball glove splayed on the ground before him, severed lacings dangling, the ball pocket *entirely missing*.

"Dude look, that line-drive went right through the web of your mitt,
hit you in the head, and knocked you out cold."

"You were gone, for like—almost a minute!"

* Note: This is a revised version of an original submitted in the 2013 *Quantum Shorts* flash fiction essay competition.

Breadth

"No way!", the boy exclaimed. The planetarium director, taken by surprise, paused, turned toward the errant voice in the dark, and repeated again, with emphasis: "It's *true*, all the stars you see are located *within* the Milky Way. The nearest one, Proxima Centauri, is four Earth years away at the speed of light, which means even with our fastest spacecraft designs it would take tens of *thousands* of years to get there. The nearest neighboring galaxy similar to ours is Andromeda, two and a half *million* light years away. And as we look ever farther across the receding distance, countless more galaxies appear, with *billions* more light years of space between them."

For the students attending the show that morning, this was amazing stuff to behold, for sure, but for the astonished boy sitting in the dark, it was one of those defining 'before and after' moments. He had unexpectedly been reawakened to the *enormity* of being.

So how great is the breadth of our known universe? Well, by way of the biggest standard measure they have—the speed of light, scientists estimate it would take a light beam around a hundred thousand Earth years to traverse the diameter of our home galaxy. As for the entire universe, they consider how many light years have passed since the 'big bang' Origin, plus how much the space between the objects within has likely expanded since. From this they figure a spherically expanding, 13.7 billion year universe, would have a radius of some 47 billion light years.

The planetarium director continued: "Now the radius of a sphere is the measure taken from a common point of origin to every point on its exterior. But is the measure of a sphere its interior radial volume, or the surface area of its exterior shell? Is the breadth of our expanding universe the volume within, *where* its been—its past, or is it the size of its *present* surface?"

"Well, let's stop and consider that for a moment", he said, stepping out from behind the master console and proceeding down an isle to the pedestal base of the prime projector, an impressive multiplex of appendages glittering in the dark. "Scientists believe the observable universe began as a singular instantaneous pulse that's been omni-expanding at the speed of light ever since. So let's imagine the light source at the center of this projector is the origin of our radiant cosmic bubble. We look up and see a celestial dome representing a fractional portion of this expanding cosmic sphere. We see what appears to be the heavens above as if from *within* the sphere looking out, but this is an illusion. Sentient observers such as ourselves are necessarily *on* the surface of the cosmic bubble. We are residents of the present looking across the 'hypersurface' of a continuous star studded sphere. The spatial distances between the stars and galaxies are geodesic arcs across the surface of our luminous expanding universe."

Mind altering indeed, but it wasn't until he left the darkened dome of the planetarium and stepped into the bright midday sun that the full significance of what he had just heard became apparent. Yesterday in English class one of his classmates had presented the idea that at the speed of light everything was happening everywhere at once. So if every propagating photon from the Sun, or any other star, no matter how far, is a regenerative pulse refreshing everywhere now, then from the *field-of-view* of light, the breadth of the universe would appear to be *instantaneous*.

He stopped in midstep: but then what about time? If the entire radiant universe is simultaneously omnipresent, and absolutely nothing is thought to exist prior to it, then there's no 'place' for time. Does it even really exist? If not, and all this *is* happening now, then upon 'what' are the notions of succession, expansion, and duration predicated? What do our clocks represent? Ah, the mystery of time—a worthy topic of choice!

Wrapping his mind around the apparent absence of time, however, ironically would have to wait, as the bus was now boarding for the ride back to school. The remainder of the day should go quickly, and then, if he biked home fast enough, there still might be sufficient daylight remaining to run to the park and hit some fly balls before dark.

Duration

Tossing the bedspread off to the side he abruptly sat up. A certain chill was present in the basement bedroom air, but no sound of crickets. He felt for the subsequent lump on his forehead—nothing! Getting knocked out by a baseball *was* all in a dream. A welcomed relief, for what remained sorely real was that he was unable to sleep, school was just hours away, and this was the day he was to stand before class and give a presentation.

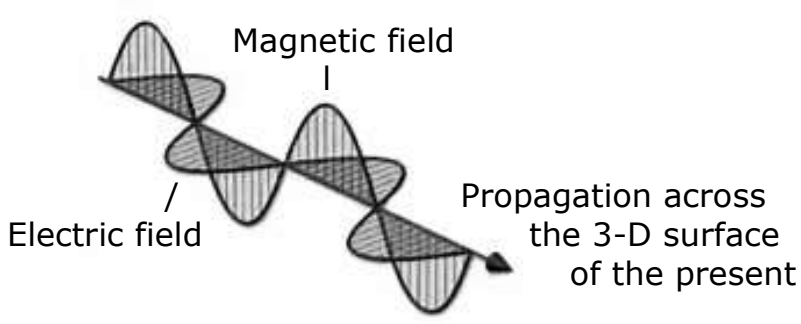
Glancing across the room to his desk, he got up and went over to revisit the notes he had prepared on his chosen subject. It was so cool! Most of the explanation he had figured out; he could make a drawing on the blackboard to illustrate Einstein's theory. But still, the entire idea of "time dilation" seemed so illusive. How was he to convince his classmates that clocks upstairs in their houses really run faster than those in the basement? Now there's an idea: Maybe if he went upstairs to sleep it might shorten this interminable night!

Indeed, grasping the ethereal nature of "time" presents a profoundly curious challenge. Physicists are in final refinement regarding the particulars of matter and energy, but when it comes to apprehending time, ostensibly one of the most elemental features of our existence, scientists and philosophers alike have been, and are, all over the theoretical mindscape.

On yesterday's field trip the planetarium director talked about the light year distances between the stars, the geodesic arcs spanning the infinite hyper-surface of our expanding cosmic sphere. But what does it mean to say the radiant universe is "advancing in time"? What would we find were we to some-how 'advance' our hand into the "future"? Well, we can't, nor will we ever, because the absolute speed of light prohibits us from ever advancing beyond the expanding periphery of this present instant. But a light wave can extend into the future, and does, with every oscillation.

Here's how: When an oscillating electron transmits a pulse of light across the electromagnetic field—across the surface of our cosmic sphere, it does so by "transverse" wave, meaning its magnetic component extends "orthogonally" to the plane of extension of its electrical component:

Transverse Electromagnetic Wave



In fact, the reciprocating dynamic of an electric pulse and its magnetic "moment" is thought to generate the vector impetus propelling the photon's advance. But if the propagation of an electric pulse is resident on the 3-D hyper-surface of the present, then to what dimension do we assign the magnetic aspect of its wave? Of the mathematical formalisms depicting the electro-magnetic field, perhaps the most illustrative are those assigning the magnetic phase of the transverse wave to the "imaginary" plane, which was also the convention used by Albert Einstein to represent the *temporal* dimension in his "space-time" field theories.

The imaginary plane is an orthogonal extension of the 3-D coordinate system into a 4th dimension. In the mathematics of motion the "x", "y" and "z" coordinates of space represent reference frames in a static state. In order for a motion sequence to occur requires the introduction of an additional domain of freedom permitting extension by way of "duration". In proposing the existence of a 4th dimension of time, and its temporal coordinate "t", we obtain motion, distance over time—velocity. With an exigent temporal dimension we have the requisite 'space'—the potential *vacancy*, necessary for events to advance.

We can only imagine what an oscillating light beam transverses every time it frequents an 'imaginary' temporal dimension, but surely it must be out of this world, most likely—nothing at all! And if so, the presence of its absolute *absence* would make time just as real as real can be. Essential in fact, for without a vacuum manifold of empty potential, our radiant cosmic expansion would have no *when* to go.

But there was a pending difficulty with his presentation. He got up from his desk and began pacing the bedroom. In order to show his classmates why clocks upstairs run faster than those in the basement would require he bring gravity into the mix, and gravity was just as illusive as time. How would he credibly explain that because clocks onboard accelerating vehicles slow down, and gravity was an acceleration, all clocks everywhere keep time relative to the proximal strength of the gravitational field?

And they really actually do! Clocks on satellites in outer space run measurably faster then do their synchronized counterparts on the ground. Likewise, clocks upstairs, those a little farther away from the center of the Earth, tick a tiny bit faster than those downstairs. But it was a variance too small to see, the very idea too hard to believe—his classmates would think he was crazy!

Well, for all he knew, maybe all this thinking about time *was* making him crazy. Weary for sure. Perhaps now he might finally get some sleep. Anyway, enough worrying, watching everyone give their presentations was bound to be entertaining. And besides, English was his favorite hour of the day. Boy had he lucked out; he'd been assigned a seat behind the prettiest girl in school. Tomorrow, Tina would again be sitting there, legs crossed the way she does, in the front row of class.