Billy Pilgrim Blues by Jeff Schmitz (schmitzjm@aol.com)

Slaughterhouse Five by Kurt Vonnegut Jr. expanded the possibility of a novel by playing with our concept of time. The story of Billy Pilgrim was told in the style of the word salad of a schizophrenic or that of a space alien that sees equally in time as well as space. The possibility of stepping outside of time has lead to some good and a lot of bad fiction. This essay is not about building a time machine, if anything it might be in the "time machines are impossible" category. The reason I bring up the topic of time-travel fiction is that writing about time is difficult because we are fish that swim in a sea of time. Because time is intertwined in our thoughts and language, I have made no attempt to remove time explicitly or implicitly from my prose. This inability to step away from time, if only for a moment (see what I mean), is the heart of the problem I wish to address.

We have time all wrong. Time is very important, but it is not a fundamental thing. Time is a function of entropy. What I mean by this, why I think this is important, what indications exist that show time is a function of another quantity and how this effects how we understand physics will be explored.

We measure length by a ruler with each tick mark showing a unit of length. In the same way we can use a pendulum to measure time with each swing a showing passing of a set unit of time. The tick marks on a ruler are different physical objects. What is the difference between each swing of the same pendulum? Each swing of a pendulum is the same object, but the object itself changes. The pendulum runs down a little, due to energy loss from friction. The pendulum gets older with each swing, for example, an iron pendulum might rust a little more each swing or have a bit more dust on it or it's bearing will wear a little more. What if we had a perfect dust free pendulum that never rusted? Just by looking, we could not tell the difference between the second swing and the thousandth swing. If the pendulum were in a closed box, then there would be no way to tell how many swings had occurred. This also means that each swing would be physically and experimentally identical to other. Time as measured by our pendulum would be undefined.

This all seems unlikely, an unchanging pendulum kept in a closed box with no interaction with the outside world, but at the scale of an atom this is common. An electron does not age. At the scale of an atom, the light used to see an electron in an atom (or an atom sized imaginary pendulum) would have a significant effect on what is observed. The pendulum (or atom) itself would be smaller than the light used to observe the object. At the atomic scale, we know when something has been observed because of the changes in the system due to observation (the basis of the Heisenberg uncertainty principle).

There is an uncertainty of position of a particle, Δx (actually Δvolume). This Δx describes not only the inherent effects of measurement stated by the Heisenberg uncertainty principle, but the interaction between particles at a distance. The ability of a particle to instantly effect two distant locations at once would seem to violate relativity (instant being faster than light speed). This is known as the problem of non-locality, which was the subject of the famous Bell's inequality.

One solution to the problem of non-locality is to have an atomic scale distance look different than macroscopic distance. The tick marks on an atomic scale ruler might constantly move in relationship to each other. Two distant points might, at times, be next to each other perhaps by folding of an unseen dimension. In short, space might be discontinuous with gaps appearing between two infinitesimally close points.

We can look at this problem in a different way. We normally think of speed as function between two continuous values, position and time, but what if the speed of light, not space and time, is the continuous quantity?

The speed of light, c, is a constant rate for continuous time and/or space we have

$c = dx/dt$

but for discontinuous time and/or space and a continuous speed of light we cannot have a true infinitesimally small ideal derivative.

$c = \Delta x/\Delta t$, where $\Delta \neq 0$

because of this $\Delta x = c\Delta t$.

The importance of the above relationship means the source of non-locality (or discontinuity) in position could equally be time or position.

Using only discontinuous (non-local) space instead of discontinuous time is a fundamental mistake because discontinuous space needs a source. Time already has source of its discontinuity, a dependency on something else - entropy. To determine the entropy state, one normally must look at a collection of many particles in a macroscopic state. At the atomic size scale, entropy is undetermined for the energies and densities we on Earth normally encounter.

Entropy is the disorder of the inner state of an object, there are many ways disorder can appear, but we need to only look at energy to explain way time is dependent on this quality. In the example of the pendulum, time became defined when the pendulum changed with time or communicated another swing of the pendulum. There is a problem, what if the energy from one perfect pendulum went to a second perfect pendulum and that energy went back to the first pendulum without lost of any energy? In the case of linked pendulums, we would have the same problem as a single pendulum, we would lose count and time would be undefined. Our energy would have to go off to a place where it could not come back to us without loss. Energy lost to a sea of particles with an astronomical number of possible states would be our irreversible change needed to mark time. This change of energy from pendulum swing energy to disordered vibrations of a sea of particles (in reality heat) is our increase in entropy. Entropy is needed to define time, a lack of entropy leads to undefined time. What is undefined time? This is where language fails me, time is not going or maybe time is fuzzy. The more entropy events the more in step something is with time, the increase in events do not increase the rate of time. The idea of a chronon or smallest unit of time is different than this because unit would always be the same size. Discontinuous time would mean that time step could vary widely even within the same object and that there is no limit to how small or large a unit time can be. These linked pendulums (or electrons) in this undefined state, I call in a “repetitive mode”.

Metals are good conductors of electricity due to free electrons: metals are also good conductors of heat due to the same reason. Electric current flow can cause heat flow and heat flow can cause electric current flow. When a metal becomes a type I superconductor, it becomes a very poor conductor of heat. How do the electrons know to conduct electricity, but not heat? I feel that the electrons are in this repetitive mode and are not flowing like water through a pipe, but more like sound waves that travel through a material.

Something as simple as a photon can come into question with discontinuous time. A photon might just be the point where time is defined. Light interference patterns where only one photon at a time is let through, yet the interference pattern still exists could be explained by a rethinking of the photon.

Why sound travels at consistent rate for a given temperature and frequency with little loss of energy, while wind has no set speed and great loss in energy might also be explained by repetitive modes.

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