FQXi

Phantom instants, two-faced time, the empty bag of space, and the illusionistic nature of perception

An advantage a layperson brings to questioning basic physical assumptions is in being unconstrained by the perspectives of the academy. Scientists trained in the academy must work in their laboratories influenced by funding constraints, the ideological pressures of colleagues, and the prevailing belief system rendered dauntingly certain by the preponderance of seemingly 'incontrovertible' scientific evidence.

Because I am not a scientist but merely a science-oriented layperson, I feel it incumbent upon me to say that I was raised to trust my own instincts and to not be intimidated by the voices of authority. For the last fifty-five years I have followed a path of scientific inquiry that has been informed by what has been available to me in popular accounts of science, which I tried to read with a critical eye. I also felt free to pursue novel ideas when those ideas seemed compelling and potentially fruitful. Because I am not good at math, the development of my ideas has had to rely on forms of logic and visualization utilized in other disciplines. Five and half years ago, I formed SpaceGroup, a salon of well-educated individuals who discuss cosmology (my life-long passion) and other scientific subjects such as perception, evolution, and the nature of reality, time, and space. The roughly four-hour, twice-a-month (often-heated) meetings have attracted keen thinkers in the fields of science, space engineering, and related areas of interest. The email dialogues between members have been informative and constructive.

I should also mention that I have communicated with various scientists, philosophers, and writers around the world, most notably Geoff Grayer, a Brit who shared a Nobel Prize for the discovery of the W and Z bosons. I will long remember our exchanges because he was not prejudiced by the absence of my scientific credentials and instead took at face value the sometimes unconventional ideas and questions I was submitting for his review, some of which are presented below. On at last one occasion, my line of thinking caused him to alter one of his long-held views. I hope readers of this paper will have a similarly open mind and give serious thought to the ideas and questions I here present regarding the tenability of some of the basic physical assumptions underlying the scientific search for truth. Roughly forty years ago I met with the late Dr. I. M. Levitt, Director of the Franklin Institute in Philadelphia, and mentioned my belief that the underlying fabric of the material world might not actually be physical (in a 'concrete' sense), an idea he found preposterous. I was startled and delighted several months later when I read that the late Alfred North Whitehead, the esteemed British mathematician and philosopher who worked with Bertrand Russell, had expressed the same view. This experience in particular was formative in my decision to pursue paths of thought not supported by conventional wisdom.

There are several foundations in modern science that I believe are ripe for reconsideration. They involve the following subjects: Space, Time, Infinity, and Perception. My approach in considering these issues is aligned with the position of Professor Lee Smolin who wrote: "The standard model of particle physics was the triumph of a particular way of

doing science that came to dominate physics in the 1940s. This style is pragmatic and hard-nosed and favors virtuosity in calculating over reflection on hard conceptual problems. This is profoundly different from the way that Albert Einstein, Neils Bohr, Werner Heisenberg, Erwin Schrödinger, and other early-twentieth revolutionaries did science. Their work arose from deep thought on the most basic questions surrounding space, time, and matter, and they saw what they did as part of a broader philosophical tradition, in which they were at home."

THE ILLUSIONISTIC NATURE OF PERCEPTION

Sometimes, commonplace language is not up-dated to reflect contemporary discoveries in science. One such area deals with perception. For five and half years I've been struggling to get my SpaceGroup members to understand my notion of the *illusionistic nature of perception*. Admittedly, it is an unfortunate phrase because the word illusionistic conjures up so many off-putting or confusing side notions. However, I am pleased to report that half the members now seem to understand what I'm trying to convey, but the ideas are not simple. Some of the conclusions involve unfamiliar ideas such as that color and sound do not exist in the 'real' world we see out there in the world we inhabit. I feel that if scientists in general, and lay people as well, had a better grasp of this concept, it would free them to think more critically about the underlying nature of physical reality. I write a column for a local paper on design and related subjects and I'll draw on that article to present my idea of the illusionistic nature of perception.

In Shakespeare's A Midsummer Night's Dream, Helena declares, "*Love looks not with the eyes but with the mind*." Shakespeare, so perspicacious about so many subjects, could have reached even further in this observation (if the fruits of modern science had been available to him), and asked Helena to proclaim more broadly 'We look not with the eyes but with the mind.' That phrase sounds so simple and innocent. We're inclined to embrace the poetic and figurative implications of the notion even though many of us are dead certain we actually see the world with our eyes. The fact is, however, we don't see with our eyes. Vision is an illusionistic phenomenon that is so overwhelmingly convincing that it's hard to believe—some might say impossible to believe—that we don't actually see **what's out there** on the world-side of our eyeballs. Nonsense, many will assert, we **certainly** see what's out there.

Let's parse the word *see* and update it to account for recent discoveries in neuroscience. Take the phrase '*in the distance she could **see** the blue ocean*.' We understand this to mean that she is looking out across space and sees ***out there*** the ocean glittering in the sunlight. What I intend to illuminate is that it is physically impossible to see anything **out there** and that the very experience of seeing is fundamentally and necessarily illusionistic. Seeing is an image-making phenomenon that occurs only in the brain. No image, ready made, enters the eye, nor does it enter a camera. As Shakespeare rightly claimed, we see with the mind. What we think we see **out there** is really what the complicated process of cognition constructs **in here** (tap your skull, please). When I share this notion with friends, they ask with alarm, 'You don't really mean to suggest that what I see with my eyes is an illusion and that there is really nothing out there—that seeing essentially is a hallucination. No, I am not saying that. There **is** something out there but it's different from what we perceive (read: cognitively fabricate).

Lift your eyes from this page and look at something or somebody nearby. Not for a

moment do you doubt that you see across the space that separates you from the person or thing you're observing. You're convinced that you see your subject across space and he or she is real. Right? Yes, they are real. But no, you don't see them **out there**. It is physically impossible to see anything **out there** on the far side of your eyes. But why?

The ancient Greeks, specifically Empedocles and Plato, believed there was some form of fire inside the eye, a spear of which shoots out of the pupil the way light shines from a flashlight. They believed that that spear of what I might call 'eyefire' darts out, touches, and brings back to the observer the essence of the object seen. Science, however, tells us the eye is simply a part of one's brain that acts like a passive funnel and merely collects a tiny portion of the countless billions of photons per second that bombard your face.

Roughly 1500 years after the Greeks, an Arab by the name of Alhazen understood that the eye is but a dark chamber and light enters in carrying information from the outside world. But the light doesn't carry a ready-made picture; the picture we experience must first be fabricated as something is fabricated in a factory from raw material that is totally unlike the experience of what is seen. Light simply carries energy packets of varying wavelengths on a one-way trip into the cranium. Rods and cones at the back of the eyeball convert the energy into electro-chemical impulses, sending those impulses in a micro-fraction of a second to nature's astounding cognition factory that is the brain. Impulses are shot back and forth between various processing centers in the gray matter where the impulses are shaped and reshaped using, in part, a lifetime of your memories to build the image. Some brain cells, for instance, only recognize vertical lines, others only horizontal lines, and still others only diagonal lines. Thousands of other cognitive picture-building activities occur in a billionth the time it takes to wink. It's a miraculous process evolved over eons to serve organism survival; your survival. Avoid that car. Find your next meal. Look for a companion.

Too incredible to believe? Consider this. Imagine someone has slowed down light to a snail's pace while you're looking at a mountain. While you're still facing the mountain, you close your eyes. Just before you open your eyes, a vast lead curtain a football field away, descends between you and the mountain totally blocking the view. You open your eyes. What do you see? The slow crawling light beam that originally emanated from the mountain now travels from your side of the lead curtain into your eyes. Voila! You 'see' the mountain for a short time with **exactly** the same detail as before the curtain had descended and yet the view of the mountain is totally blocked by the opaque curtain of lead. Such is the illusionistic nature of perception. Although the actual process occurs more quickly because light travels at light speed, the result is the same. We see nothing out there. From this, one must also conclude that color is not a real aspect of the world **out there**, but a constructed sensation that exists **only in the minds** of some sentient beings. That booming crash when a tree falls in the forest. There is no boom, no crash. There is only a burst of sound waves, no sound. It takes an ear and a mind to convert the waves into sound. Refreshing our understanding of what perception is really about will cause us to rethink our connection with what we call reality. We inhabit a world of experiences that have some connection with what's out there, but caution is in order when one says, seeing is believing.

Shakespeare was on the right track again when he wrote, "When most I wink, then do my eyes best see."

THE EMPTY PAPER BAG OF SPACE

Cosmologists seem to regard space as an empty paper bag that they can fill with all sorts of contradictory attributes drawing out what is necessary to suit their theory of the moment. They have alternately characterized space as curved, flat, expanding, oscillating, empty, filled, without an edge, boundless, finite, three-dimensional, and more recently, even composed of multiverses. Another profound attribute that was added, of course, is that space is part of a four-dimensional space-time continuum. Curiously, according to my readings, cosmologists and physicists have never really said definitively what space itself is, but perhaps they leave that question to philosophers. To add even more confusion, space has been regarded alternately as an entity, a relationship between entities, or part of a conceptual framework. So I ask: how is it possible, how is it tolerable, that scientists can refer to one or another of these qualities to support their particular cosmological theory without, in the first place, tying down the very nature of space itself. A speculative claim is one thing; a proof is another. To my mind conceptual uncertainty creates a level of theoretical license that invites fool-hearty speculation. For instance, although there **seems** to be overwhelming evidence that space is expanding, there is no sure proof that it ever did expand, or even could expand . . . and yet the scientific community buys into the notion of expanding space because the currently held Big Bang theoretical model in cosmology **requires** space to expand.

To me, this is risky business. It smells of a profound tautology that scientists have conveniently swept under the rug. In short, the tautology is this: red-shift has been interpreted to mean that (in most instances) objects in the universe are receding from one another, a conclusion that Edwin Hubble, to his dying day urged cosmologists to regard with great caution. But caution appears to have been thrown to the wind and an *immaculate conception* of cosmic origin has been wholeheartedly embraced because subsequent 'evidence' has seemed to support the notion of cosmic expansion, such as the Cosmic Microwave Background Radiation, an observation for which other explanations are possible if one accepts the idea of a spatially infinite volume of space, in which space is not expanding. The expanding universe model, driven by a negative-pressure vacuum energy, has been accepted almost globally and yet the model is largely dependent upon the idea that space can and has expanded. Through the years funding has been provided for research and concept development that regards the hot expanding Big Bang model as an incontrovertible Basic Physical Assumption. But is it an incontrovertible Basic Physical Assumption? It would seem there should be good reason for doubt or at least greater caution in claiming that space can expand and/or contract, particularly in light of the fact that the paper bag of ideas to explain space has been so filled over the years with many contradictory notions. I feel, for instance, that money would be well spent to investigate the issue of what conditions occur at the interface where the leading face of the volume of expanding space meets nothing. It is a concern that has been too readily dismissed, a head in the sand mode of behavior seemingly supported by exotic mathematics that suggests that space, whatever that might eventually be deemed to be composed of, can terminate miraculously at the 'edge' of nothing. In my mind it is too simple to dismiss the matter by saying that space has no edge.

RED-SHIFT CONUNDRUM

The question I raise regarding red-shift is this: How is it possible for us to receive light from the era following the proposed Big Bang if that light, travelling at light speed, forever escaped the expanding volume of the early universe.? To understand my question, imagine a light emitting body on the leading 'edge' of the expanding cosmic sphere. Light leaving that body will either shoot off into empty space (a separate issue to reconsider in a subsequent paper) or more critically travel toward the center of the expanding universe, first traversing one hemisphere of the globe and then continuing to travel through the other hemisphere and off into nothingness. Therefore that light from the universe's early history could never be visible to observers in any galaxy unless it turns around and travels back toward the galaxies in the expanding sphere.

If a cosmologist says there is no nothingness outside the expanding sphere, then that cosmologist will have to explain what happens to that light ray. It seems to me that that light ray and other light rays escaping the swelling sphere of space of the Big Bang will produce a corona of sorts similar to what might pour out of an expanding star. Visible to a god, if there is one, but not visible to any ordinary observers in the universe.

The entire overlying superstructure of the Big Bang model is predicated on the belief that red-shift must be interpreted as a manifestation of cosmic recession. If this fundamental assumption is wrong – that in fact red-shift has little or nothing to do with cosmic expansion even though it is a reliable marker of distance - then the Big Bang model will face an onslaught of challenges. Of course, if the universe is spatially infinite and therefore not expanding, then red-shift takes its rightful place as an indicator of distance and the problem then becomes what are the factors or factor that causes the electromagnetic spectrum to loose energy over distance. The tired-light theory has been discredited so it will be other factors, some of which I have read about, would have to be further explored.

TWO-FACED TIME

Although Newton's idea of and method of measuring time is still used for almost all commonplace earthly measurements, it is generally believed that Einstein's idea regarding the Relativity of time replaced and superceded Newton's idea of Absolute time. Is this a basic physical assumption that is wrong? The concept here proposed is that that the two forms of time, Absolute and Relative, are not mutually exclusive but in fact legitimately coexist and functionally coexist. This proposed integration of seemingly opposed temporal circumstances is what I sometimes call Hybrid Time, or in a more jocular manner, Two-faced time, for reasons I'll explain below.

The primary case against the notion of Absolute time was the introduction and eventual confirmation of Relativity. Prior to Relativity, the idea of Absolute time worked quite well. It made good sense because it worked in all earthly circumstances. But does it still? Beyond its convenient aspects for time keeping on earth, I think it also makes cosmological sense (and necessarily so) for the reasons that follow.

Begin by thinking about the past, the present, and the future. We all agree that the past is that collection of (what we call) events that has already occurred and which is no longer retrievable other than being embedded in the present in a variety of forms. The future consists of those events that have not yet occurred and which can only be imagined and/or

forecast. Consequently, the Present falls between the Past and the Future, between events already passed and events yet to occur.

Picture time as a loaf of bread. If time is finite, the loaf is of limited extension. If time is infinite, eternal, without beginning or end, then the loaf has no beginning and no end. (It could have a beginning and no end; Big Bang cosmology, in which case it could still be infinite as a potentiality, but that is a subject for a later paper). Now let's slice through the loaf with a cut that separates those events that have already occurred from those that have not yet occurred. The present therefore is simply a dividing line, a boundary that one might call the *Phantom Instant* because of necessity it has no temporal duration. Understand that the portion of the loaf representing the Past is, like the past, non-existent, it is nowhere to be found. And the future, a body of imagined or forecast conditions also does not (yet) exist and therefore that portion of the loaf is also non-existent.

So the past no longer exists, the future does not yet exist, and the present is a Phantom Instant without duration that separates what was from what will be and yet it has 'presence,' at least in our minds as qualia. But is the present without duration? Is the *present* actually a second long, or maybe a millionth of a second long, or a billionth of a second, or even a billion-billionth of a second? Can we actually measure the duration of a dimensionless slice through time? But if the present has no duration how can it be measured? Before addressing that conundrum, one should ask if the present, that timeless Phantom Instant between past and future is the same for everyone on earth? Certainly the time on the watches of everyone on earth, if they were to run accurately, varies from time zone to time zone. But seen by an observer on the moon, the entire earth is 'experiencing' now at the same instant, the same Phantom Instant even though it is 10Am in Philly and 7AM on the West Coast. As seen from the moon, no part of the earth is in the past while another part is in the future; the earth is, in its entirety, North Pole to South Pole, in the one and only present. Let's call this Earth Time. This illustration introduces the idea of Hybrid Time, or two-faced time. One face is earth-time and wristwatch-time is the other face. So are we still in Newtonian time? Apparently, yes, so no serious problem of horology has yet emerged.

Before moving on to the issue of integrating Absolute and Relative time, I wish to put forward the idea that the present, that dimensionless Phantom Instant that separates past from future, exists concurrently everywhere in the universe. Consequently, it can be said that there is no place in the universe that time-wise is ahead of the time on earth, for instance, or behind the time on earth, or in fact any place in the heavens. Therefore, if that claim cannot be disputed, it would suggest that time is absolute; there is no *before* us or *ahead* of us time-wise anywhere in the universe. Everywhere, EVERYWHERE in the universe, is *now* at the same Phantom Instant. So perhaps that is what Newton was thinking or should have been thinking when he advanced the idea of absolute time. If one questions the validity of the universal cosmic instant, the universal cosmic *now*, (albeit probably impossible to confirm using clocks because of relativity, but possibly confirmable through logic), then one is forced to accept the competing idea that time varies from place to place throughout the cosmos. That idea is obviously problematic for it allows for the possibility that a distant galaxy could be a million or so years ahead or behind us time-wise. But if that were the case, then all the measurements in contemporary cosmology become suspect. Implicitly, cosmology accepts and even works with the notion of universal cosmic time, that earth's **now**, our **present**, is shared throughout the universe. If that were not the case, then it would be possible to see a galaxy a million light years away as that galaxy exists in earth's now, at the time it's light

arrives at earth. We would not be seeing that galaxy as it existed a million light years earlier as measured by earth time, but how it exists today in earth time at the moment its light is received. To my knowledge, every sane cosmologist looking into the red-shifted light of distant galaxies would roundly reject this notion.

So, if one accepts the notion that there is something called earth-time, and if one accepts the concomitant notion there is also a universal cosmic now, and if one accepts the idea the past is gone and the future is not yet here, and one accepts the idea that a phantom instant of zero duration separates the past from the future, what then is time and how do we account for the elastic time-keeping of Relativity?

The notion of time developed as a means to measure the duration of events and the duration between events and to provide a metric for rates of change such as the motion of objects. Therefore, people say that time is nothing if it isn't measured; the measuring of time is the very essence of time. According to this line of thinking, the simplest definition of time is what clocks measure. But here lies the heart of the problem.

Events and the timepieces that measure the duration of events and the duration between events require atomic structure and then later, subatomic structure. No clock exists that is not constructed of matter. But all atomic and subatomic structures are influenced by velocity and proximity to gravitational forces. Consequently the devices we use to measure the passage of time are subject to 'distortion' or variation due to motion and gravity.

In 1911, several years after publication of Einstein's Special Theory of Relativity, originally published as a paper titled "*On the Electrodynamics of Moving Bodies,"* Einstein advanced the 'twin paradox" idea to illustrate the consequences of his theory. The paradox is based on the fact that biological processes, despite their insufficient "regularity," can be regarded as clocks in the physical sense. The processes 'tic' somewhat like a metronome, reflecting the beat, or rhythm, or aging of any particular organism's biological processes. The 'paradox' was intended to illustrate that time does not tic at a regular, invariant absolute rate, as Newton believed, but rather is influenced by the velocity of the clock moving through space. The paradox, as Einstein originally presented it, did not attract much attention, but a more vivid elaboration of Einstein's deduction by the French physicist Paul Langevin a few months later caused a sensation and is still used today in discussions of relativity.

Langevin's thought experiment was this: start with a pair of human twins, one of whom remains on Earth while the other, placed in a Jules Verne cannonball, goes off on a journey through the universe. Moving at a velocity close to the speed of light, the traveling twin will return to Earth aged by a mere two years, while his brother would have long since died - two hundred years having elapsed on earth. Some people at the time questioned this notion of time dilation, which the paradox was meant to illustrate while others dismissed the paradox as nonsense. However, a half-century later the effect was convincingly demonstrated through the use of an extremely accurate atomic clock that was carried around the world in a plane confirming, through comparison with a synchronized clock that remained stationary on Earth, that the passage of time registered differently for the two clocks. The clock in the airplane ticked slower than the stationary clock and the difference was caused by the velocity of the clock as it moved around the Earth in the plane.

To understand the paradox, it is important to understand that the 'measuring mechanism' in an atomic clock is a Cesium atom, which vibrates at a very particular rate. The Earth is also made of atoms, as are biological creatures. These atoms all vibrate and can be regarded as clocks, so to speak, of varying periodicity and precision.

Consequently, and contrary to current theory, the *twin paradox* model seems to prove unexpectedly that time is **both** relative and absolute. And it is so in this way, and for this reason: The measurement of time (as well as the measurement of change in biological process as well as all atomic processes) is affected by velocity and therefore they tic at varying rates. But the ticking is always occurring in the present—a 'present' or 'now' experienced throughout the universe, as my explanation above seems to prove. Consequently, the *passage* of time must be regarded as absolute and distinctly different from the *measurement* of time, which involves the unfolding of baryonic (atomic) processes that vary with velocity and proximity to gravitational forces. But the two phenomena are inextricably two faces of the same clock.