

## The View From The Center Of The Universe – New Thoughts For A New Year

Most of us, I suspect, have had an experience that humbles in the face of cosmic vastness or natural forces greater than oneself. One that I clearly remember was many years ago on my first visit to Hawk Mountain, the world famous nature preserve on the Kittatinny ridge west of Reading. On the north lookout, your eye follows that endless mountain ridgeline for miles. Off in the distance, thousands of migrating hawks blink into view as little dots, getting larger and larger in your view until they glide past you on their way farther south.

It was exciting to see their almost effortless gliding flight and their physical beauty. I felt privileged. But what stayed with me was my feeling of being an irrelevancy – of being a silent witness to one of the great cosmic cycles that began eons before my birth – or yours or anyone we know or have ever known – and would continue long after we're all gone. It was a humbling sense of proportion – of my smallness in the presence of cosmic vastness.

I had a somewhat similar experience many years later the first time I visited the newly opened Rose Center for Earth and Space at New York's Museum of Natural History. It's dominated by a sphere that's 85 feet in diameter – that's about 7 stories. Using that giant sphere as a constant reference point, the Rose Center demonstrates size relationships on vast scales. For example, if the sphere were the size of the sun, then our earth would be about the size of a bowling ball; but if the sphere were the size of the earth, then we would be about the size of just an e-coli bacterium! I couldn't begin to visualize myself against the sphere if it were the size even of the milky way much less the visible universe as a whole.

Once again I was presented with a concrete sense of my smallness, my irrelevancy, in the grand scheme of things. And this has been evolving as the dominant view of ourselves ever since the 16<sup>th</sup> century when the sun displaced earth as our cosmic center.

*".... behold, in the center of all resides the sun. For who in this most beautiful temple would set his lamp in another or a better place, from whence to illuminate all things at once? ... Truly indeed does the sun, as if seated upon a royal throne, govern his family of planets as they circle about him."*

*Copernicus. De Revolutionibus Orbium Coelestium. 1:10.*

This hymn to the sun was written by Mikolaj Kopernik – Copernicus (1473- 1543) -- the Polish priest, lawyer, physician and astronomer. In 1543 he published the earthshaking idea that Earth is not the center of the universe but one of the planets and that it, like all the others, revolves around the sun. His revolutionary thinking and the revolutionary technology of the printing press -- less than 90 years old at this time -- released a flood-tide of science- supported astronomy. In short order:

In 1572 Tycho Brahe and Johannes Kepler in 1604 demonstrated that what was thought by many to be a new stars could only be explained as what we now call a supernova.

In 1609 Galileo read about the Dutch invention of the telescope. Building one for himself, he discovered other planets and moons within our own solar system.

And then in 1642, scarcely 100 years after Copernicus' publication, Galileo died and Newton was born. With his "discovery" of gravity and the astronomical mathematics of large-scale planetary motion, the last timbers holding up Ptolemy's celestial spheres were knocked out and the spheres came crashing down.

Taken together the heliocentric model of the universe this astronomic model of the motions, positions, and behavior of astronomical objects, demolished not just Ptolemy's spheres but also millennia of cosmological thought about the very nature of the universe and humanity's place in it.

By way of a short review, the Babylonians, who saw the Earth as a big circular plane surrounded by a river, believed that the god Marduk mixed his own blood with the earth to make humans.

The ancient Egyptians conceived the sky as a roof placed over the world supported by columns placed at the four cardinal points. The gods created the Earth as a flat rectangle, longer from north to south, whose surface bulges slightly and having the Nile as its center, of course. After creating sky and earth, the gods then taught the arts and sciences to the Egyptians.

But it was the Greek worldview that was the most long-lived in the history of scientific cosmology, continuing from ancient Greece through medieval Islamic civilization to sixteenth and seventeenth-century Europe. The Greeks set themselves the task of envisioning the universe as a set of physical objects in mathematical relationship. Aristotle, who dominated this thinking, taught that rotating spheres carried the Moon, Sun, planets, and stars around a stationary Earth. The Earth was unique because of its central position and its earthy material composition.

The natural place for heavy earthy material, they concluded, was down at the center of the universe because they could see that on earth such material tended to move to its natural place, the lowest point. There could be no other worlds scattered throughout this universe, because their earthy nature would have forced them to move toward their natural place at the bottom – the center -- where the earth already was and where humans were at the apex of all things living.

Between the ancient Babylonians and Egyptians on the one hand, and the Greeks on the other, one sees very little correspondence between their views of the structure of their known universe. But all agreed on one cosmological constant – earth was central and humans were at the focal point – indeed the point of it all.

And so you see that Copernicus set in motion not only revisions in our understanding of astronomy the result of which has earth a smallish planet orbiting a pedestrian star out on the edges of an ordinary galaxy with nothing in particular to distinguish itself from its billions of neighbors with their trillions of stars. It also set in motion a revolution in our cosmological thinking about ourselves which ends with these words of Carl Sagan from our reading earlier:

*.... how can anyone seriously believe that we are central — physically or in any way -- to the purpose of the universe?*

No doubt our ancient ancestors got their science all wrong, and our post-Copernican/ Newtonian science has set the science right. But what if in getting the science of it finally right, we've gotten the psychology – the cosmology – wrong?

That, my friends, is the heart of the new book, "The View From The Center Of The Universe" by physicist Joel Primack and his lawyer-wife Nancy Abrams. In their words

"Many people today contemplate the stars and the vast distances in between and conclude how insignificantly small we are compared to the universe. This view has contributed to a sense of alienation and sometimes even despair that have for more than three centuries been a reaction to humanity's demotion from the pinnacle of God's creation to a tiny speck floating in endless space. But now we understand something

we didn't know before: *Everything in the universe is significant on some scales, insignificant on others.*

We humans exist on the only size scale where great complexity on the one hand and immunity from relativistic effects (like the speed of light) on the other are both possible. *Real thinking is the job of our size scale* — beings more or less our size, bigger than an ant, smaller than a mountain. Our consciousness is as natural a blossoming on this special scale as a star is on its size scale or an electron in its own." (pp. 173-75) **In the expanding universe, human beings are not only significant — we are central .... "**

Primack and Abrams build their near-400 page book around seven ways in which human beings are central to the universe

First, we are made of the **rarest material** in the universe. Except for hydrogen, which makes up about a tenth of our weight, the rest of our body is stardust, that is the heavier elements – carbon, iron, etc – the elements thrown off by exploding stars. But in all the universe, those elements make up only .01% of all the universe's mass. I invite you to look at the first two figures on the reverse side of today's order of service to see this illustrated, using the familiar figure from our one-dollar bill.



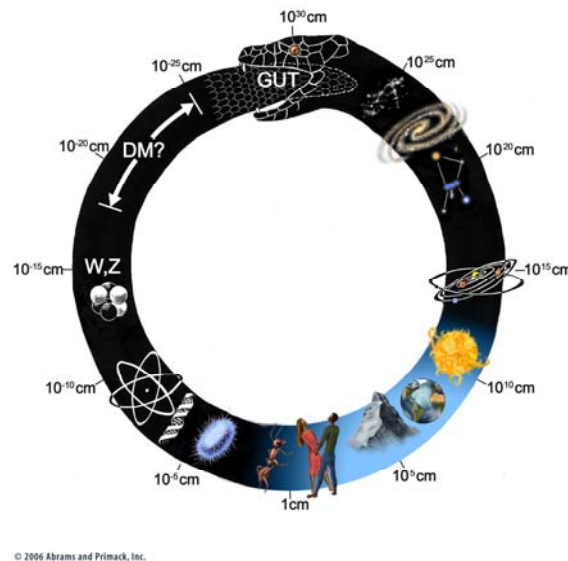
It illustrates the small percentage of all visible matter represented by the heavier elements, that is the small peak of the pyramid – everything else is hydrogen and helium created in the early life of the big bang before there were any stars. But also consider the next figure:



This shows that all visible matter is at most 1% of the total mass of the universe – most of the rest being dark matter and energy. And rarest of all – represented by the "eye" -- is that small, almost infinitesimal fraction of heavy elements that have come together to form intelligent creatures such as ourselves – and at our present level of knowledge – only ourselves.

Second, we live at **the center of our Cosmic Spheres of Time** and third, we live at **the midpoint of time**, the peak period in the entire evolution of the universe for astronomical observation. An astounding recent discovery related to dark energy is that not only is the universe expanding – we've known that for a long time – but that the expansion is accelerating. As a result, the most distant galaxies – ones which thanks to the Hubble space telescope we have *just* acquired the ability to see – are already beginning to disappear over the cosmic horizon. The universe *as we are observing it today* will truly become mythic. It will become the lost Golden Age – a fabulously rich sky that our distant descendants will know once actually existed but they will never see.

Fourth, we live at **the middle of all possible sizes** where the possibility of tremendous variety and complexity coming in small packages keeps life interesting. Sentient life of our complexity could bloom on no other size-scales. This is captured in the curious figure of a snake swallowing its tail:



Looking at the figure you'll see that there are small illustrations showing various structures and, at about six o'clock, a pair of humans represents us. Arcing to their right and left up and around the snake are structures larger and smaller than we are – their scales shown in scientific notation.

So, first, why do they say that sentient life cannot be much larger than us? Well, all life as we know it – indeed all life as we can even imagine it – would be made up of the visible matter of the universe and subject to the physics that we know, including the absolute limit of speed, namely the speed of light. This is the same speed of electromagnetic waves – such as radio -- and of thought. You can probably see where this leads. We've all witnessed the lag time in the transmission of signals even here on earth – that little delay between the question and the answer when reporting from distant points on earth. The delay only gets worse as the physical distance increases. That would be pretty inconvenient for an organism so big that its brain would be out where Jupiter is, while its stomach was where we are here at earth.

They also note that humanity sits at the midpoint of possible size, which I find both most fascinating and most accessible. If you look again at the snake figure, you'll see that the calculation of the present size of the visible universe is in the range of  $10^{25}$  -  $10^{30}$  cm -- a really big space around 13BB light years across (though expanding constantly and increasingly fast, remember). At the other end of the scale, the smallest matter that we've been able to actually measure is the protons and neutrons that make up atomic nuclei and they're  $10^{-15}$  cm. But theoretical physics tells us to expect

structure much smaller than that, down in the area of  $10^{-25}$  to  $10^{-30}$ . What would be down there? Well, strings, if they exist. In other words, the Cosmos is as small as it is large! And we are smack in the center.

I recently revisited the Rose Center and its giant sphere, but having read this book, my mind was pointed in a different direction than before – not on how small I was, but how large. This time, I asked myself, how large would I be – would you be – if the sphere were one of our protons. The answer is we'd be the size of our solar system. Now here's one: if the sphere were one of those hypothetical strings, how large would we be? The answer: the size of the visible universe!

Blake's lines on today's order of service ring true in ways that he never imagined. But as I stared at that sphere it was Walt Whitman's words from *Song of Myself* that filled my mind: **"Divine am I inside and out ... I am large, I contain multitudes."**

Let me quickly now summarize their final three points about our centrality and then discuss what all this might mean.

Fifth, we live in a universe that *may be a rare bubble of spacetime* in the infinite, seething cauldron of the eternal meta-universe – a mathematically possible infinity of universes. Outside our bubble, which we call the Big Bang, there would be neither space nor time as we know it. But here inside, there is time for evolution and history, and space across which connections can form and structures can develop. We may not be geographically central in eternal inflation, but we are very special.

Sixth, we live at more or less **the midpoint in the life of our planet**. It formed, about 4.5 billion years ago. It has about six billion more to go before it is roasted when our sun swells into a red giant star. Today is late enough for us to have evolved to our present abilities but early enough to have a potential future so vast it beggars the imagination.

Last, we live at **a turning point for our species**. From the point of view of the generations alive at this moment, it is late enough that we are sobering up to the scale of our problems, but not so late that we have lost all chance to solve them. This is a very special time that will never come again.

Which brings us to the big *"So What?"*

Anyone getting this far in their book, or my sermon, wants to know what this all means. So, the authors offer their perspectives on what they see as the most pressing problems of today – perspectives and solutions that will resonate with most or all of us here today, but that they anchor in cosmic truths. They begin their summary call for action by saying:

No human goal today is more pressing than the search for sustainable prosperity. It encompasses all other purposes including peace, justice, health, science, economics development, environmental and spiritual pursuits and without it these other pursuits will prove transient and illusory ... (But) We can't create sustainable prosperity [merely] by an act of will. It must be in harmony with the universe ... "

In their chapter, "Think Cosmically, Act Globally," the authors tackle issues of wealth, politics and the environment, suggesting policies anchored in that cosmologic harmony.

Addressing the disparities of wealth, they draw upon the laws of gravity and motion to argue that capitalism as practiced today is out of cosmic harmony. Left unchecked, both capitalism and gravity tend to concentrate “richness” that would leave vast tracks destitute. This happens in the world today – especially here where, growth has been concentrating in the upper 1% and where, for example, the average CEO pay today has ballooned to 264 times that of the average worker. But in the universe excessive concentration of matter doesn’t happen because gravity is balanced by universal motion. Examples of that motion-principle that could -- and they argue should – be in place on a worldwide human scale would include universal free public education, universal public health and sanitation, and universal health care.

What about politics and social order? Here again, they say that the universe tells us something, namely that the size of things in the universe determine how they work. Every few powers of ten – larger or smaller – brings into play hitherto irrelevant laws of physics. In observing ourselves, they see what they call “scale chauvinism” such as our fanciful use of the term “family” when talking for example about corporations – the Johnson and Johnson Family of companies – or even about the “family” of nations. We delude ourselves by such metaphors, they argue, when because of scale dynamics, companies and nations work and behave nothing like families – or even like humans, although made up of them. They don’t feel human values like honor, honesty or compassion. Furthermore, their indefinite life spans and ability to be in many places at once mean that they don’t even follow all the laws of biology and physics that we humans are subject to, or the consequence of scale on which we humans actually experience our problems and must experience our solutions.

Finally, turning their thoughts to growth and the environment, they argue that the dizzying rate of growth of the past century or so will inevitably – and soon – end, driven by the same laws at play in the original cosmic inflation. Cosmic inflation was the instant lasting perhaps as brief at  $10^{-32}$  seconds just before the big bang. In that infinitesimally small fraction of a second the size of the universe expanded exponentially, so wildly fast that the part of the universe now inside our cosmic horizon grew by as large a factor as it has in the entire 14BB years since. And like that cosmic inflation, the exponential growth we’ve been experiencing in population and energy consumption will reach an upper limit and will end, perhaps smoothly but perhaps abruptly and catastrophically. Catastrophe was not the how cosmic inflation ended because the while the inflationary rate of growth stopped, growth did not. The emergence of gravity thankfully acted like a brake pedal beginning to be applied, and the universe settled into a slow and steady expansion. Only then could the universe enter into its most creative phase, producing galaxies, stars, planets and life.

The cosmic lesson for us today is that we have to stop fearing the coming changes as material sacrifice and see instead the cosmic opportunity not to acquire more but to become more. As the Zen saying goes, “Enough is a feast.” Our lives would continue to be enhanced indefinitely if we can find a rate of sustainable prosperity – just slow enough so that our creativity in restoring the earth stays ahead of the impact of our resource demand.

The final cosmic lesson is that we are part of, and central to, something vastly bigger than we ever realized. Navigating between these worlds of scale difference is a constant challenge to any person who is trying to live consciously at the center of a meaningful universe. Our challenge is to live joyfully while doing everything we can to improve the odds for our planet, which for the foreseeable near future is our only home.

In that spirit of joyful challenge to be in harmony, thinking cosmically and acting globally, I offer these closing words from Maya Angelou’s poem, ***A Brave And Startling Truth***

We, this people, on a small and lonely planet  
Traveling through casual space  
Past aloof stars, across the way of indifferent suns  
To a destination where all signs tell us  
It is possible and imperative that we learn  
A brave and startling truth

*And when we come to it*  
To the day of peacemaking  
When we release our fingers  
From fists of hostility  
And allow the pure air to cool our palms .....

*When we come to it*  
Then we will confess that not the Pyramids  
With their stones set in mysterious perfection  
Nor the Gardens of Babylon  
Hanging as eternal beauty  
In our collective memory .... These are not the only wonders in the world.

We, this people, on this small and drifting planet  
Whose hands can strike with such abandon  
That in a twinkling, life is sapped from the living  
Yet those same hands can touch with such healing, irresistible tenderness ...

*When we come to it*  
We, this people, on this wayward, floating body  
Created on this earth, of this earth  
Have the power to fashion for this earth  
A climate where every man and every woman  
Can live freely without sanctimonious piety  
Without crippling fear

When we come to it  
We must confess that we are the possible  
We are the miraculous, the true wonder of this world  
That is when, and only when  
We come to it.

Happy New Year and Blessed be!

James M. Walters, PhD