The Mediocre Universe

Dating all the way back to Aristotle one of the views of the our universe was the geocentric model that saw the entire heavens as rotating around Earth. But it is another Greek, Ptolemy, (85CE – 165CE), the most influential Greek astronomer and geographer of his time, who was most identified with this position. This geocentric model became dogma during the Dark Ages, that religion-dominated period in Europe, where man was seen as the pinnacle of God's creation around whom the cosmos revolved literally and figuratively.[1]

In the 16th century another model of the cosmos was presented cautiously by Nicolaus Copernicus in a publication called, *On the Revolution of the Celestial Spheres*. Published in 1543, the year of his death, it presented the heliocentric model that states that the planets, Earth included, orbit around the sun in a circular motion. This was also an idea of the Greeks but did not find wide acceptance at the time. Copernicus not only resurrected this idea but enhanced it by creating a mathematical model based on it. Later Johannes Kepler improved this description by noting that the motion around the sun was elliptical which, conformed much more closely to observation.[2]

This transition in the motion of the planets around the sun was not only a revolution in astronomy but also a shift away from humans as the pinnacle of creation. Man no longer had a privileged place in the universe (dubbed the Copernican principle). Furthermore, this cosmic repositioning of humans began a slippery slide into the concept of the mediocre universe as articulated by Mario Livio.[3]

Since that time, particularly in the modern era, there have been a number of scientific revelations that have placed man in an increasingly mediocre universe. What this means is that man is further and further removed from that "privileged place" at the center of the universe. He is sitting on the "third rock from the sun," an unusual planet to be sure, but it is simply one of several and more dwarf planets are being found regularly.[4]

For many years it was believed that the Milky Way galaxy was the extent of our cosmic reality and here, too, we live in a mediocre universe. We live in a solar system that orbits one of many stars (200 to 400 billion). Astronomers recently discovered a technique to discern large planets orbiting other stars and the data reveal that there may be many other solar systems in the galaxy. Ours sits two-thirds out on the Orion arm, one of four of this galactic system, orbiting the center of this galaxy approximately every 240 million years.

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[1] Harman, W. (1988). *Global mind change: the promise of the last years of the twentieth century.* Indianapolis, IN: Knowledge Systems, Inc. p. 4.
[2] Ibid. p. 6.
[3] Livio, M. (2000). *The Accelerating universe: Infinite expansion, the cosmological constant, and the beauty of the cosmos.* New York: John Wiley & Sons Inc. Mario Livio is the head of the Science Division at the Space Telescope Science Institute which conducts the science program of the Hubble Space Telescope.
[4] A dwarf planet, as defined by the International Astronomical Union (IAU), is a celestial body orbiting the sun that is massive enough to be rounded by its own gravity but which has not cleared its neighboring region of planetesimals and is not a satellite.

Later it was discovered that the Milky Way is one of approximately 50 galaxies that make up the local group of galaxies but in the observable universe it is one of many billions (there are probably more than 100 billion galaxies in the observable universe).[5] So our galaxy is also nothing special and our physical reality becomes more and more mediocre. Is the homo sapien species lost in the sea of the cosmos, a place so vast and our position so insignificant that the mind cannot take it in?

From this perspective it actually gets worse. In cosmology, the study of the origin and structure of the universe, there have been three modern observations that could not be cleanly accounted for. The three problems that arise from observations of the universe are the relative homogeneity, the composition is the same in every direction; its istropism, the structure of the universe is very similar in every direction of observation; and its flatness or Omega.

Omega is the balance between two fundamental forces. One is the dramatic expansion of the universe as discovered by the astronomer Edwin Hubbell (for whom the Hubbell space telescope is named) that appears to originate from a common point and has been dubbed the "Big Bang." The second is gravity, which counters that expansion. If gravity is the dominant force, then the expansion will eventually stop and the universe will contract back to a single point. If the force of expansion is larger than the force of gravity, our universe will expand forever. It appears that Omega is maddeningly close to one, which is a near perfect balance between these two forces. Cosmologists have struggled to understand and explain why the universe has these characteristics.[6]

To explain these observed characteristics, Massachusetts Institute of Technology (MIT) cosmologist, Allen Guth, put forward a theory that stated that early in the formation of the universe there was a brief but powerful period of very rapid inflation, a brief but powerful expansion, after which the universe settled into the pace of expansion as observed today.[7] At one time Guth's theory, although intriguing, was considered a radical theory but did explain those three problems in the makeup of the cosmos. Furthermore, the theory made certain predictions about the cosmic background radiation (which evidences itself as part of the static in your radio receiver) that is the echo of the Big Bang itself. In the last few years, two scientific satellites, the Cosmic Background Explorer (COBE) and the Wilkinson Microwave Anisotropy Probe (WMAP), made careful measurements of this background radiation. Those measurements conformed exactly to the predictions made by Guth and these confirmations of his theory created wide expectance of the inflationary model.

Ever since Guth proposed this novel idea, there has been a flurry of scientific publication about its various refinements and ramifications. Two of the cosmologists that played with Guth's ideas were the Russians, Andrei Linde (now at Stanford University), and Alexander Vilenken (at Tufts University). Linde and Vilenken refined and extended Guth's theory, which led to a startling conclusion, "if one consequence of inflation,

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[5] Mackie, Glen (February 1, 2002). To See the Universe in a Grain of Taranaki Sand. Swinburne University. Retrieved on 20 December 2006 from http://astronomy.swin.edu.au/~gnackie/billions.html.
[6] There is recent dramatic new evidence that indicates the universe has in recent cosmological years begun to accelerate its expansion. See Livio p. 157.
[7] Space here does not permit me to go into the details of this theory. For interested readers see Guth's book *the Inflationary Universe* for this fascinating story.

known as *eternal inflation*, is correct…, then the entire universe may be just one in an infinite series of universes."[8]

Allen Guth called these "pocket universes" and asks the question, since when have we found one of anything? Guth concludes, "any cosmological theory that does not lead to the eternal reproduction of universes will be considered as unimaginable as a species of bacteria that cannot reproduce."[9] If we find one of any species, we assume there are more. With this theoretical extension of his theory of inflation in the infant universe, the concept of the mediocre universe is carried to its extreme conclusion. Not only are we on one planet of many orbiting a sun, one of billions, in a galaxy that is one of billions, but we live in a universe that is only one of an infinite number. Do you feel small and insignificant yet?

But, as you might imagine, this is not the last word. Now, in comes quantum mechanics.

One of the fathers of quantum mechanics (QM), Niels Bohr, said, "Those who are not shocked when they first come across quantum theory cannot possibly have understood it." Nobel Prize winner Richard Feynman agreed, "... I think I can safely say that nobody understands Quantum Mechanics." So what is the big deal? The big deal is that what QM tells us about our reality gives us an entirely different picture of it. It is this aspect of a new view of reality that caused the noted physicist Sir James Jeans to conclude,

> The stream of knowledge is heading toward a non-mechanical reality; the universe begins to look more like a great thought than like a great machine. Mind no longer appears to be an accidental intruder into the realm of matter…we ought rather hail it as the creator and governor of the realm of matter.[10]

What does he mean mind ought to be hailed as the creator of the realm of matter? During one if his undergraduate lectures on QM, Richard Feynman described one of the key QM experiments called the "double slit experiment."

> I will take just this one experiment, which has been designed to contain all of the mystery of quantum mechanics, to put you up against the paradoxes and mysteries and peculiarities of nature one hundred percent. Any other situation in quantum mechanics, it turns out, can always be explained by saying, "You remember the case of the experiment with the two holes? It's the same thing." I am going to tell you about the experiment with the two holes. It does contain the general mystery; I am avoiding nothing; I am baring nature in her most elegant and difficult form.[11]

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[8] Livio, p. 158
[9] Guth. p. 262.
[10] In Henry, R.C. (2005) The Mental Universe. *Nature*. 436:29.
[11] Feynman, R. P. (1995). *Six Easy Pieces*. Reading, MA: Perseus Books. Get this lecture in audio format to get a sense of the personality of Feynman. A great way to get introduced to QM.

What this experiment highlights is the particle-wave duality of reality.[12] The wave nature of reality is not a normal wave but a probability wave which states the probability of something happening (called probability amplitude). The probability wave of something simple like a coin toss is approximately 50 percent heads and 50 percent tails but also includes highly unlikely events such as neither, the coin does not land on one of the sides but on the edge instead or no outcome at all. All probable events are represented in the probability wave, which, of course, includes mutually exclusive events (called super position). In the state of super position all events are simultaneously present including those that are mutually exclusive. Without describing the experiment (I'll do that in another article) the double slit experiment proves this and it is accepted by physicists (but as Feynman says, "no one can explain why it is that way").[13]

What changes this probability wave to the actual event? This is the best part. It is the act of measurement, the act of making the observation that changes the probability wave to the "real" thing. It is the senses of a conscious being that is the key element to creating our reality. Consciousness is the measuring apparatus that creates the event. The QM physicist would say that it is the act of observation that collapses the probability wave function into one event. The reverse then, is also true; if it isn't observed, it doesn't happen. If the tree falls in the forest and no one is there to observe it, then it doesn't fall. It is the act of observation that "causes" the tree to fall.

All of this led to a discussion between Einstein and is colleagues on the meaning of the particle-wave duality of reality. The question was, if I'm not looking at it, is the moon there? The answer for QM is that it is not, it is everywhere and Einstein understood this but didn't like it.

What does this have to do with the mediocre universe? Plenty. What it says is that the Newtonian-Cartesian mechanical view of reality is way off base. It is the mechanical view of reality that leads to the mediocre universe. It says that we are not just an infinitesimal speck on a planet like many other planets, in a solar system like many other solar systems, in a galaxy like many other galaxies, in a universe that is one of a (near) infinite number of others. No, what QM is telling us is that none of that comes into being (for ourselves) unless we are there to observe it. This is why our friend Andrei Linde stated:

> The universe and the observer exist as a pair. You can say that the universe is there only when there is an observer who can say, yes, I see the universe there. These small words— it looks like it was here— for practical purposes it may not matter much, but for me as a human being, I do not know any sense in which I could claim that the universe is here in the absence of observers. We are together, the universe and us. The moment you say that the universe exists without any observers, I cannot make any sense out of that. I cannot imagine a consistent theory of everything that ignores consciousness. A recording device cannot play the role of an observer, because who will read what is written on this recording device? In order for us to see that something happens, and say to one another that

[12] The self-imposed length of this article precludes description of the double slit experiment. I will do that in a future article.
[13] I would add humbly (as some of the great physicists have also stated), reality as we know it could not happen any other way.

> something happens, you need to have a universe, you need to have a recording device, and you need to have us. It's not enough for the information to be stored somewhere, completely inaccessible to anybody. It's necessary for somebody to look at it. You need an observer who looks at the universe. In the absence of observers, our universe is dead.

We could not be more central to our reality. We have come full circle; our universe, the one in which we each live, comes into being only when we are there to observe it by one or more of our senses.

> There is no reality in the absence of observation.[14]

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[14] The Copenhagen Interpretation of Quantum Mechanics, in Herbert, N. (1985). *Quantum reality: Beyond the new physics.* New York: Doubleday.