

Why Do You Dream Flat Tires?

Discover how the misuse of models can limit understanding.

You may recognize the title of this article as a line from a Joni Mitchell song. I found it so poignant that it has stuck with me from the time I first heard it so many years ago. All of recorded history is replete with the evidence of how the human race has dreamed flat tires by creating models of the physical universe that were later found to be in error. One of the most famous was a model of the Earth as the center of the universe. As a person watches the ever-changing position of the sun and moon across a diurnal cycle and ties that information to the idea that the Earth seems to be still, it is no surprise that the intuitive conclusion would be that the heavens are in motion around one centrally positioned planet.

In modern times, the prevailing opinion about why the masses were loathe to give up this idea, even when given mathematical evidence to the contrary, was that being on a planet that was at the center of the universe also included a privileged position for its inhabitants with the creator of that universe. But, that's not entirely the reason behind the delay in enlightenment. History education often focuses on the few brilliant minds who came along and lifted us out of these Dark Age ideas. What history generally does not show are the bright minds who devised equally impressive mathematical models that entrenched the accepted notions. The Ancient Greek astronomer, Claudius Ptolemy built a very sophisticated machine of gears that not only demonstrated the travel of the sun around the Earth, it even accounted for the retrograde motion of the planets known at that time. This model was so overwhelmingly convincing that it stood for nearly 1000 years. Even though his idea had fallen out of favor by 1492, Ptolemy's work was still so revered that Columbus used his world maps when setting sail to find new lands. The diagrams on these maps were precisely why Columbus thought he had landed in India.

Given the sophistication of our technology, it is likely we would discredit any notion that we live in a time of limiting models like the one in the example above. The truth is, instead of building precisely engineered models with gears, we use powerful super-computers to mathematically extrapolate the motion of the heavens over eons of time. This is exactly how the professors at Princeton developed the theory of dark matter and dark energy. Ptolemy's machine perfectly accounted for the data gathered from observation. In other words, Ptolemy already knew what the result should be before he built the machine.

The Princeton super-computer experiment did the exact opposite. The professors plugged in the data gained by observing the universe and then asked the computer to spin the universe through billions of years of motion. To their surprise, the entire universe flung itself into oblivion. They deduced that there simply had to be more gravity present than could be accounted for by observable mass and that extra gravity had to be what was holding the universe together. From this theory they developed a precise mathematical model to account for the extra gravity. In this model, the universe is comprised of only 4% visible matter, 22% cold dark matter, and 75% dark energy. So far this formula has held up to rigorous investigation. In fact, if the percentages are changed by only a little, the computer models cause the universe to fly apart. The real question is, will this theory hold up over time? Ptolemy's theory of a geocentric universe held for a millennium. Perhaps as telescopes become more powerful and varied, the observed data will change. Just such an advancement recently changed our ideas about the speed we think our own galaxy is spinning. Or, perhaps another theory will surface to replace the current idea. Recall that a helio-centric system eventually replaced Ptolemy's long-standing paradigm.

For many lay people, ideas about cosmology are merely mind-candy. They don't seem to have any real bearing on day-to-day life. But there are plenty of limiting models in recent history that do. In the 1920s, folks were so enamored with the novelty of the first electroencephalogram (EEG) measuring brain waves that they were sure it was evidence of telepathy. Today, neurologists are claiming to measure exact thoughts because they have developed a way to control a robotic arm to mimic the motion of a monkey's arm simply by mapping the neurons that fire when the monkey thinks about moving its arm. This is a major breakthrough that will lead to

the development of devices that will unlock a quadriplegic's ability to manipulate objects again. While this achievement is worthy of celebration, we must also be careful that we don't lock ourselves into a limiting model by stating that actual thought energy is being recorded. Brain activity is the shadow of the thought process. For instance, if you are singing a song in your head, your brain activity can be measured and recorded, but not the song itself. Japanese scientists have come a step closer in realizing this sort of dream by claiming that they can externally reproduce an image the eyes are seeing simply by measuring and recording very specific brain activity associated with vision. Again, this is a major breakthrough in brain research, but is it measuring thought energy?

Technologically speaking, we are on the verge of several major research breakthroughs such as those already mentioned. Great care must be taken in how we construct our models so that we do not fall into Ptolemy's trap of framing our ideas around a limiting concept. Otherwise, it may be another millennium before a brilliant mind comes along showing that we were merely dreaming flat tires.

Some content excerpted from [The Sage Age – Blending Science with Intuitive Wisdom](#)
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