Ryan Russell

David Battisti and Stevan Harrell

Honors 220B/INTSCI 403A

9 December 2013

The Big Bang and the Multiverse – Has Science Gone Too Far?

> *6 Who verily knows and who can here declare it, whence it was born and whence comes this creation? The Gods are later than this world's production. Who knows then whence it first came into being? 7 He, the first origin of this creation, whether he formed it all or did not form it, Whose eye controls this world in highest heaven, he verily knows it, or perhaps he knows not.*
>
> *– Rig Veda 10.129.6-7*

In 1931, Herbert Butterfield defined a "Whig's interpretation" of history as the story of the triumphant progress society has made. In whiggish history of science, the past is seen by looking back and finding the origins of contemporary attitudes of science. The false-starts and dead ends of the scientific process are ignored. With this attitude many scientific advances seem to fit into an over-arching narrative. Science was constantly trying to move forward, while religion and politics held it back. *History of the Conflict between Religion and Science*, written by John W. Draper in the late 19th century, is one of the earliest and most famous works on this subject. This can also apply to politics. In the preface, he explains that he would not spend much time on Protestant and Greek churches, which had taken ever held enough political power to cause problems – the Catholic church, a political entity as well as a religious group, was his main target. From this work, historians have named the conflict thesis, the idea that religion and politics are powers constantly opposed to science. Historians today do not generally accept the conflict thesis, but there are certainly examples of politics and religion holding science back. However, if science is constantly being held back, it is also constantly trying to apply itself in more and more areas. Some modern cosmology brushes up against the limits of what science can

explain, and many think it goes too far. In trying to explain the origin of the universe, multiverse theories might be no more scientific than any other creation myth.

Multiverse theories in cosmology explain many parts of physics by proposing a multitude of universes. These universes may have laws of physics completely different than our own. Historian of science Helge Kragh, author of several papers about the history of cosmology, gives the extreme example of Max Tegmark, cosmologist at MIT. He believes that every mathematically possible universe must have a physical reality somewhere. He founded the Foundational Questions Institute to fund research that may lead to a deeper understanding of reality.

Cosmology is the study of the cosmos. It seeks to answer how the universe came to exist and evolve into its present form. It explains the structure of the universe, from the smallest atoms to the galactic super-clusters. Some scientists notice that the story of science seems to progressively remove any notion of specialness that humans may feel. Increasingly, some scientists propose that our universe is just one of many universes. This multiverse theory is perhaps the ultimate conclusion to that story. Bernard Carr, a proponent of the multiverse theory as an alternative to intelligent design of the universe, gives this particularly whiggish view of science:

> Throughout the history of science, the universe has always gotten bigger. We've gone from geocentric to heliocentric to galactocentric. Then in the 1920s there was this huge shift when we realized that our galaxy wasn't the universe. I just see this as one more step in the progression. Every time this expansion has occurred, the more conservative scientists have said, 'This isn't science'. This is the same process repeating itself.

If you view the history of science as progression, his story is correct. For all of recorded history,

until recently, cosmology was a religious study. Most cultures have a creation myth which explains the place of the Earth in the cosmos, and importantly, how humans fit in. In Western culture, the account in Genesis is probably the most famous explanation. The Genesis account explains that in the beginning, God created the heavens and the earth – seemingly placing the Earth in a different category from the heavens. Humans too, were created on a different day than other animals. Though most Christians do not take the Genesis account literally, there is still a common theme that humans and the Earth are special. Science seems to have changed this view.

Aristotle too had a geocentric universe. In his model, the element of Earth was pulled towards the center of the universe. The sphere of the Earth sat stationary, while nested spheres rotating at constant velocities held the planets. The final sphere was the sphere of the stars.

The first shift is often credited to Copernicus. In Copernicus' time, the universe was still modeled as geocentric. The Aristotelean model did not fit the observations people had made. Still, astronomy was focused on pure mathematical models. Using complicated systems of epicycles, they were able to explain most planetary motion using only circles within circles. The Earth was still at the center of the universe. Though the pure heavenly spheres of Aristotle no longer fit, astronomy was still not much concerned about the physical reality of the universe. The mathematical models worked. Copernicus, though he did place the sun at the center, was no different. His model was no simpler than other geocentric models. It was only marginally closer to reality. He was concerned that the less mathematically literate might mis-interpret Biblical passages and oppose his work, but it did not matter too much for him. The model was only mathematical. Besides, compared to the far away stars, the slight repositioning of the Earth was virtually nothing. The Earth was still in the center, basically.

Johannes Kepler was one of the first to apply physics to astronomy. His laws, though not

completely correct due to relativistic effects, are still taught in physics classes today. He defended Copernicus' heliocentric model of the universe, and discovered that the motion of the planets could be explained using ellipses. These ellipses were a further departure from Aristotle's spheres, but removed the complications that circles required.

The nature of stars took a while to discover. On human time-scales, they seem to stay stationary relative to each other. Aristotle placed them all in the same sphere. Many had proposed that the sun was a star, going back to Greek philosophers. However, no one was able to prove this until Friedrich Bessel in 1838. He measured the distance to a star without any presuppositions about its character. It was soon discovered that the sun would appear just like a star if it were far enough away.

Just as we realized that Earth was just another planet and the sun just another star, we realized that there were multiple galaxies. The heavenly feature known as the Milky Way was found to be an arm of a spiral galaxy which we know call the Milky Way. The extra-galactic nebulae were found to be galaxies, some like ours.

If viewed progressively, science has shown that humans have no special place in the universe. In fact, modern cosmology is founded on the cosmological principle. This states that the universe is homogeneous when viewed on a sufficiently large scale. It also holds that the Earth is at no special place in the universe. The laws of physics here are the same as the laws of physics elsewhere in the universe. Were it not so, science could not get very far. This idea is similar to Einstein's quote that God is subtle but not malicious. Einstein was not using God in the Christian sense, nor even in a personal sense. He refers to the universe or the workings of the universe. If the laws of physics here were different from the laws of physics elsewhere, that would be malicious. The universe would be conspiring to stop us from understanding it.

Bernard Carr's view of the history of science makes some sense. Aristotle's model has been completely rejected. The earth has no special position in the universe. He takes it further, however. Because the science has shown that the Earth is not special, neither is the sun, and neither is our galaxy, the universe probably is not either. This assumption is attractive, because it fits the overall narrative, but has not received the same evidence that the other theories have.

Evolution provides another field where religion can be seen to conflict with science. Intelligent design advocates, mostly religious, claim that the species of Earth were designed by some intelligence. The Earth *is* still special as the only place we know that harbors life. Life as we know it could only exist in a narrow “Goldilocks zone” distance from a star. Still, NASA's Kepler mission, which searches for planets around other stars, has discovered that planets are not rare. They expect that most stars have a number of planets. It is plausible that the apparently fine-tuned position of the Earth arose by chance. Out of trillions of planets, it is plausible that Earth happened to be one that could harbor life.

The position of the Earth is not the only thing that is apparently fine-tuned. Physicists have identified dozens of physical constants that must be measured. There is no theory that allows them to be derived. Physicists are working to find a theory that contains no free variables. If so, Einstein would describe it that God had no choice when creating the universe, but no theory seems to be forthcoming.

Georges Lemaître, a Belgian priest and astronomer, is widely credited as the inventor of the Big Bang theory. In 1927 he published a paper which challenged the view prevalent view of a steady-state universe. In a way that could be compared to Aristotle's perfect spheres, the universe was thought to be perpetually in motion. Two years before Hubble, he independently discovered Hubble's law, which says that, on an extra-galactic scale, the further away an object is, the faster

it is moving away from Earth. This led to the conclusion that the universe must be expanding. Lemaitre reasoned that the universe may have started as a single, homogeneous entity – a primeval atom with approximately the same mass as the universe has today. That atom would decay, just as radioactive elements decay. According to quantum theory, the ordinary laws of physics break down when there are only a few quanta, so this primeval atom could not be said to exist in time. The single quantum of the universe would become several, and those would split as well, until the laws of physics would start to apply. The universe has continued to expand since then.

We now know that the primeval atom did not exist as Lemaitre described it, but it did inspire the current theories of a Big Bang. It is interesting to note the philosophical implications of the theory. Most scientists at the time accepted the idea that the universe had an infinite age. There was other evidence – non-uniform light from the stars, radioactive elements that had not decayed, and the laws of thermodynamics which gave evidence for a finite universe. Even without Lemaitre's paper, the same conclusion would have been reached eventually. Still, the current scientific consensus at the time ran counter the account given in the Bible and many creation myths. Though it required a very old universe – billions instead of thousands, Lemaitre's theory better fit religious views of creation. This complicates the conflict thesis. The current scientific consensus – a big bang – is closer to religious views than previous ideas.

As a Jesuit priest, he would have known this that his work helped to validate the creation story. Perhaps his work was not so coincidental. Historian of science Helge Kragh notes that the primeval *atom* was not his first idea. Physicists Millikan and Cameron proposed in 1923 that the cosmic rays were high energy photons. Over time these photons condensed into matter as we know it. They described the cosmic rays as the birth cries of the universe. This paper left him interested in the idea of a primeval *photon*. The universe would begin with light. The light would

spread in all directions, and crystallize into the structures we find in the universe, from neutrons to galaxies. In later years he condemned this hypothesis as having no scientific value, but it is strikingly similar to the account Genesis 1. God said, “Let there be light.” His religious beliefs may have influenced his decision to pursue the idea of a start to the universe, though the religious and philosophical explanations did not pan out. He was opposed to using science as evidence for religion. Pope Pious XII, the same pope who officially acknowledged that evolution was compatible with Catholicism, thanked Lemaitre for providing evidence for Christianity, but Lemaitre thought the idea was impossible. Science and religion were separate spheres. There was no evidence that he intended his work to be apologetic.

In fact, many scientists thought that the origin of the universe was best left to philosophy. One physicist mentioned the idea of a Big Bang, then dismisses it, saying they would move on to topics they could know something about. In the current day, the Big Bang is generally accepted by scientists and the public.

Philosopher Karl Popper described two main ways of knowing. The confirmation method has a theory and uses data to confirm that the hypothesis is correct. Usually, the theory is so broad that nothing could possibly contradict it. Falsification, on the other hand, seeks to find evidence against the theory. If evidence is found, the theory is falsified. Otherwise, the theory gains more prestige. It can never be confirmed. He might say that the belief in an unobservable creator is unfalsifiable, and therefore not scientific. However, multiverse theorists often reject Popper's classification. Kragh notes that Jesuit cosmologist William Stoeger says that multiverse theories could be retroductively testable. Retroduction first finds evidence, then makes theories. The evidence we have can make a theory that includes testable and untestable portions. The other universes are unobservable, but parts of the multiverse theory may be testable. If they fail to be falsified, then that provides evidence for multiple universes.

In response to Carr, George Ellis says (quoted in Kagh):

> The very nature of the scientific enterprise is at stake in the multiverse debate. Its advocates propose weakening the nature of scientific proof in order to claim that the multiverse hypothesis provides a scientific explanation. This is a dangerous tactic. . . . Can one maintain one has a genuine scientific theory when direct and indeed indirect tests of the theory are impossible? If one claims this, one is altering the meaning of science. There are many other theories waiting in the wings, hopening(sic) for a weakening of what is meant by 'science'. Those proposing this weakening in the case of cosmology should be aware of the flood of alternative scientific theories whose advocates will then state that they too can claim the mantle of scientific respectability.

In one sense, multiverse theories would complete the narrative that scientific progress has made. However, science is not always progressing. Kragh gives the example of phlogiston. Before the role of oxygen was discovered, combustion was thought to be a release of a material called phlogiston. Using retroduction, the theory of phlogiston would have been validated for a long time. Though we could not observe the particles, they behaved quite predictably. But combustion is actually the absorption of oxygen, not release of phlogiston. Certain elements gain mass when burnt. This discovery led to the discovery of combustion with oxygen – but first, people concluded that phlogiston particles must have negative mass. Each piece of evidence was used to support the existence of these particles, though they do not.

Carl Sagan also thought that science had repeatedly proven that humans have no special place in the universe. *Pale Blue Dot*, the title of one of his books, refers to a picture of the Earth as viewed from the Voyager I spacecraft. In it, the Earth is a blue dot scarcely larger than a star. He thought that religion got this idea wrong:

> How is it that hardly any major religion has looked at science and concluded, “This is better than we thought. The Universe is much bigger than our prophets said, grander, more subtle, more elegant?” Instead they say, “No, no, no! My god is a little god, and I want him to stay that way.” A religion, old or new, that stressed the magnificence of the Universe as revealed by modern science might be able to draw forth reserves of reverence and awe hardly tapped by the conventional faiths.

If science is being held back by other domains anywhere, America seems like a likely place. It's no secret that Americans often disagree with the current scientific consensus. The most recent Gallup polls have a 46% plurality in favor of God creating humans in their current form, contrary to the scientific consensus that humans evolved from other hominids. A 57% majority believe that humans cause global warming, but contrary to the latest IPCC report, 64% say that it will not pose a serious threat to their way of life in their lifetime. Public opinion polls have not studied people's acceptance of multiverse theories. The research is still preliminary. However, there is a debate among scientists over the validity of multiverse theories. Some, like George Ellis, say that universes that are unobservable must be left to philosophy. Others think that science must accommodate the theories. Though the conflict thesis is not correct in general, it may explain why this could happen. Cosmology has always been a religious discipline. As such, it gives philosophies in a way that science never could. Over time, the science of cosmology has explained more and more. The conflict between some religious views of cosmology and some scientific views of cosmology force the science to explain more and more. Perhaps we have reached the edge of what science can explain. Multiverse theories work well as philosophies, but are not yet able to be falsified. If science were not expected to explain everything – if no conflict existed, then multiverse theories could remain happily as philosophies.

Works Cited

"About." *FQXi - Foundational Questions Institute*. N.p., n.d. Web. 11 Dec. 2013. <http://www.fqxi.org/about>.

Folger, Tim. "Science's Alternative to an Intelligent Creator: The Multiverse Theory." *Science's Alternative to an Intelligent Creator: The Multiverse Theory* 10 Nov. 2008: n. pag. *Discover Magazine*. Web. 11 Dec. 2013.

Harrison, Edward R. "Cosmology after Newton and before Einstein." *Cosmology: The Science of the Universe*. Cambridge: Cambridge Univesity, 2000. N. pag. Print.

Gould, Stephen J. "Nonoverlapping Magisteria." *Natural History* 106 (1997): 16-22. *The Unofficial Stephen Jay Gould Archive*. 2002. Web. 5 Dec. 2013.

"Kepler: Planet-finding News." *Kepler: Planet-finding News*. NASA, n.d. Web. 11 Dec. 2013. <http://kepler.nasa.gov/news/newsaboutplanetfinding/>.

Kragh, Helge. "Contemporary History of Cosmology and the Controversy over the Multiverse." *Annals of Science* 66.4 (2009): 529-51. Print.

Kragh, Helge S., and Dominique Lambert. "The Context of Discovery: Lemaître and the Origin of the Primeval-Atom Universe." *Annals of Science* 64.4 (2007): 445-70. *Academic Search Complete*. Web. 5 Dec. 2013.

Lemaître, Georges. "A Homogeneous Universe of Constant Mass and Increasing Radius Accounting for the Radial Velocity of Extra-galactic Nebulae." Trans. Jean-Pierre Luminet. *Annales De La Société Scientifique De Bruxelles* 47.A (1927): 49-59. Print.

Lemaître, Georges. "The Beginning of the World from the Point of View of Quantum Theory." *Nature* 127 (1931): 706. *Springer Link*. Web. 5 Dec. 2013.

Matthen, Mohan, and R. J. Hankinson. "Aristotle's Universe: Its Form and Matter." *Synthese* 96.3 (1993): 417-35. Print.

Russell, Colin Archibald., R. Hooykaas, and David C. Goodman. *The "Conflict Thesis" and Cosmology*. Milton Keynes: Open UP, 1974. Print.

"Venus." *Wikipedia*. Wikimedia Foundation, 12 May 2013. Web. 08 Dec. 2013.

"Who Discovered That the Sun Was a Star?" *Stanford SOLAR Center -- FAQs*. N.p., n.d. Web. 10 Dec. 2013. <http://solar-center.stanford.edu/FAQ/Qsunasstar.html>.