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TASC

TASC's mission is to rebuild and strengthen the foundation of the Christian faith by increasing awareness of the scientific evidence supporting the literal Biblical account of creation and refuting evolution.

Joe Spears, MS, Chairman

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A REVIEW OF LAWRENCE KRAUSS'S BOOK, *A UNIVERSE FROM NOTHING*

By Dan Reynolds

Atheists insist that all of nature can be explained on its own terms without invoking a supernatural creator. Some argue, as does Lawrence Krauss in his recent book, A Universe from Nothing, that modern science has now made it plausible that space-time, matter-energy, and even the universe can emerge from nothing. As we shall see, these ideas are self-contradictory and not aligned with current thinking, even in the secular scientific community, concerning the possibility of a universe existing in the eternal past. Krauss does provide his readers with interesting insights into physics, the Big Bang theory, virtual particles, dark matter, inflation theory, the "landscape" of a multiverse, dark energy, relativity, string theory, and science associated with these topics. However, he does not successfully show how the universe could emerge from nothing. Much of what is in Krauss's book was brought out in a debate with William Lane Craig in 2011 at North Carolina State University, a debate Craig won in this writer's opinion. The debate is available for viewing on the internet.1

Krauss begins by making it clear that he dislikes theism. He argues that science is based on observation and experiment, religion on unprovable faith. He dislikes the definition of nothing as *the absence of the potential for existence* (he has trouble arguing against it). He starts off on a philosophical note and ends on one, with his science offered in between. He thinks that the direction of scientific discovery is progressively eliminating the need for God as an explanation for natural phenomena and the origin of everything. He thus thinks God is the "god of the gaps" that science will eventually eliminate the need for. Much of his science is speculative and based on unproven assumptions. He seems to be saying that what is scientifically plausible is so compelling that theism is automatically an inferior explanation. He does admit, however, that science may never have an unambiguous explanation for the origin of the universe. In a debate, he said he could become a deist.

Preface

Krauss admits his atheism. He asks: If God is the answer to the origin to the universe, then who created God? Christians believe that God is self-subsistent and exists outside of time and had no beginning, properties Dr. Krauss wishes nature had. He claims that science is epistemologically superior to revelation, and that theology has not added to knowledge for hundreds of years. He overlooks that modern science arose from a culture that assumed a Judea-Christian worldview, that believed a reasonable creator would have made a reasonable creation. He admits that Isaac Newton was probably the greatest scientist that ever lived, but overlooks that Newton was drawn closer to God by his discoveries.

Lawrence M. Krauss, Ph.D., is Foundation Professor in the School of Earth and Space Exploration and the Physics Department, Co-Director of the Cosmology Initiative, and Inaugural Director of the Origins Initiative at Arizona State University.

Dr. Krauss says "nothing" has physical properties because he assumes the eternal operation of quantum mechanics. However, theologians say a quantum vacuum is not "nothing"; "nothing" is the absence of the potential for existence. Krauss says that if that is so, then even God can't create the universe. But this definition of "nothing" simply means the absence of the possibility for existence *within itself* and does not exclude the potential for creation *ex nihilo* by God. Since God exists independently and separately from the universe, then He is the initial "something" from which all else came. It is self contradictory to say something (the universe = everything in nature) can create itself because if the universe were able to create itself, it would have to already exist (quantum mechanics) and would not need creating.

Krauss says: (1) science is best way to know things because it follows the evidence wherever it leads, (2) scientists must be willing to find evidence for and against their theories, and (3) experimental results are king, regardless of personal preference.

While these guidelines for science are commendable, Krauss does not consistently follow them. For example, William Dembski and several others in the Intelligent Design Movement have shown convincingly that the fine-tuning of physics and the information in biomolecules are strong evidence for the creative work of an intelligence and not the result of ran-

[1] ReasonableFaithOrg (2012 Apr 24) Is there evidence for God? William Lane Craig vs Lawrence Krauss. http://reasonablefaith.org/media/craig-vs-krauss-north-carolina-state-university Accessed 2012 Apr 25

dom natural processes.[2] Indeed, Krauss believes we are getting close to showing how abiogenesis may have occurred on earth when in truth no such breakthrough is near. At best, science has possibly shown how two of the four nucleotides of RNA might have emerged naturally.[3] But that is only the first step of a thousand mile journey to explaining abiogenesis.

Chapter 1: A Cosmic Mystery Story: Beginnings

Krauss explains how Einstein's theory of relativity, our best theory of gravity, has been supported by observations such as the precession of the planet Mercury's orbit and the expansion of the universe. Krauss says science has shown that the universe emerged from a hot big bang 13.72 billion years ago, consists of 400 billion galaxies, has and continues to expand, and had a beginning (but, as we will see, he thinks ours is but one of an infinite number of universes that have been popping out of nothing for all eternity).

Krauss explains the evidence for the expansion of the universe from Edwin Hubble's work on galactic redshifts. Galaxies are made of stars and stars are made of mostly hydrogen. The energies associated with the transitions of electrons between the orbitals of the hydrogen atom are quantized. Hence a given transition has an particular energy which can be measured as a specific wavelength of electromagnetic radiation that is absorbed or emitted as electrons move from lower to higher orbitals or vice versa, respectively. The most likely transitions give a pattern of wavelengths (lines in a spectrum) that are a fingerprint for the element. Hubble found that the same pattern of wavelengths seen for hydrogen in the laboratory was also seen in "nebula", except all the wavelengths were longer by a set amount; they were *redshifted*. Hubble came to realize that the "nebula" were actually other galaxies like the Milky Way that were moving away from us due to the expansion of space-time. The expansion lengthened the wavelengths in a way proportional to the speed at which a given galaxy moved in relation to us. Hence Hubble found empirical support for general relativity.

Cosmological Microwave Background Radiation (CMB)

Another piece of evidence for the expansion of space and consistent with the hot big bang theory is the cosmic microwave background radiation or the CMB. The CMB was predicted by George Gamow in 1946. Alpher and Herman predicted (1948) that the CMB would correspond to radiation emitted from a black body at 5 K (a black body is a perfect absorber and emitter of radiation in thermal equilibrium with its surroundings). In 1965, Wilson and Penzias discovered the CMB and won the Nobel Prize in 1978. The hot big bang model says the universe started as a very dense and hot plasma. As the universe expanded (caused by inflation and relativity, more later), the plasma cooled to about 3000 K when the first atoms formed. The photons of light were then reflected by the atoms into space. Since then, space has expanded 1000-fold, and the wavelengths of that first light have lengthened (redshifted) 1000-fold, are now in the microwave region of the electromagnetic spectrum, and correspond to a temperature of about 3 K. The CMB allegedly contains information about the distribution and temperature of the matter in the universe at the time the first atoms formed. Allegedly, the slight heterogeneities in the distribution acted upon by gravity over billions of years eventual-eventually became galaxies, galaxy clusters, and stars.

Abundances of Light Elements

Another piece of evidence offered in support of the big bang is the distribution of light elements (H, He, D, Li) in the universe. These abundances were predicted with the right *ad hoc* assumptions about the density of protons and neutrons in the early universe and the rate of expansion. The Big Bang could only produce H, D, He, and Li. Heavier elements up to Fe formed in stars. Elements heavier than Fe formed in supernovas. However, recent research suggest small supernovas may only be able to produce elements no larger than tin.

The expansion of the universe described above is a relativistic expansion of space-time itself and not the movement of matter through space to occupy a larger volume. Relativity says space can expand or contract. To see this, imagine buttons glued to a balloon. Think of the buttons as galaxies and the balloon as space-time. Now imagine the balloon inflates. As the balloon inflates, the buttons move away from each other. Notice that the buttons grow apart because of the expansion of the balloon and *not* by moving across the balloon's surface. Relativity says nothing can move *through* space faster than the speed of light. However, that speed limit does not apply to the relativistic expansion of space.

The distances to objects in the universe are measured in several ways. One is to use Type 1a supernovas. Type 1a stars are usually in a binary star system. The star that will become a Type 1a supernova starts as a small white dwarf star. Material from the white dwarf's partner accumulates on the white dwarf until a critical mass is reached when the star, due to gravity, contracts and then explodes (supernovas). The brightness and longevity of the explosion is always the same for a Type 1a supernova. The brightness of an object is inversely proportional to the square of its distance. Using this information, astronomers can identify Type 1a supernovas in distant galaxies and determine their distance. Type 1a supernovas are so bright that their light can exceed that of the combined light of the other stars in the same galaxy for a brief period.

Chapter 2: A Cosmic Mystery Story: Weighing the Universe

Astronomers have discovered that the visible matter in the universe can't account for the rotational behavior of spiral galaxies; there is not enough mass. Another related problem is that the visible number of protons and neutrons are less than expected based on the abundances of the light elements. Where is the missing matter? One method for weighing a galaxy cluster is to take advantage of a phenomenon called gravitation lensing. Predicted by Einstein, gravitational lensing occurs

[2] Reynolds DW (2006 May) Intelligent design <http://www.tasc-creationscience.org/content/intelligent-design-0> Accessed 2012 Apr 25
[3] Reynolds DW (2009 June) Has science found how life began and species evolved? An examination of the "RNA World" hypothesis and rapidly changing lizards <http://www.tasc-creationscience.org/content/has-science-found-how-life-began-and-species-evolved-examination-rna-world-hypothesis-and--0> Accessed 2012 Apr 25

when the light from a very distant object passes through the vicinity of a large mass (e.g., a galaxy cluster) on its way to an observer on earth. According to relativity, matter bends space. The bent space around a galaxy cluster would cause the light of the distant object to be bent or lensed on its way to earth. The amount of bending depends on the mass of the galaxy cluster. Astronomers can determine how much normal matter is in a galaxy cluster by the light from it. The entire mass of the galaxy cluster can be determined by the amount of gravitational lensing of very distant objects. What astronomers have found is that gravitational lensing says there is much more mass present in the galaxy cluster than can be accounted for from normal visible matter alone. The "invisible" mass has been called dark matter. We don't yet know what dark matter is. We do know it interacts with normal matter through gravity, but not in other ways. Presumably, dark matter could pass right through you and you would not notice. Dark matter may consist of unknown particles. It is hoped that we may produce dark matter in the Large Hadron Collider in Europe. The Bullet Nebula provides evidence for dark matter. The Bullet Nebula consists of colliding galaxies. Interestingly, the bulk of the mass associated with the galaxies lies beyond the visible matter according to gravitational lensing measurements. As the galaxies collide, normal matter objects such as stars collide and slow down while the dark matter keeps on going.

After weighing everything, astronomers say our universe consists of 4% ordinary matter, 23% dark matter, and 73% dark energy (more later).

Chapter 3: Light from the Beginning of Time

We have already had some discussion on the Cosmic Microwave Background Radiation (CMB). The CMB has been mapped by COBE, WMAP, Boomerang, and currently by Planck space probes. Astronomers have used the CMB to determine the geometry of space-time. The three possibilities are closed, open, and flat. A closed space-time would occur if the gravity of the matter (all types) of the universe exceeded the rate of expansion. In such a universe, the expansion would eventually reverse and the universe would collapse. In an open geometry, the expansion would exceed the gravity of the matter in the universe and the universe would continue to expand. In a flat universe, the gravity and expansion of the universe are balanced so that the universe expands but at a progressively slower pace. In a closed universe, reversal of the expansion could occur before stars and galaxies had time to form. In an open universe, the expansion could be so fast that gravity would never be able to pull the light elements together to form stars. Only in a flat universe are the gravitational forces and expansion rate balanced so that gravity can form stars and galaxies that then continue to exist. According to measurements of the CMB, our universe has a flat geometry. However, the geometry of our universe indicated by the amount of measured matter and dark matter is closed. The difference is due to dark energy (more later).

Chapter 4: Much Ado About Nothing

In this chapter, Krauss gives evidence for entities called virtual particles. They are called virtual because they have never been directly observed due to their fleeting lifetimes (less than Planck time). Presumably, empty space has a non-zero energy. Virtual particles come in pairs and consist of a matter particle and an antimatter particle. These particles allegedly pop into existence from the vacuum energy and then recombine to once again become vacuum energy. There is indirect evidence for their existence. The calculated energy levels associated with the orbitals of hydrogen differ slightly from experimental measurement. However, if a virtual particle pair is assumed to be located around the hydrogen nucleus, the calculated energy levels match experiment exactly. The existence of virtual particles is allowed by quantum mechanics. They are believed to convey the strong force between quarks in protons and neutrons. Virtual particles are usually invoked in strong fields (electromagnetic, gravitational). Hawking radiation, predicted to be a mechanism by which black holes could "evaporate", depends on the existence of virtual particles but has not been observed so far. The energy calculated for empty space assuming virtual particles is 10^{120} times greater than reality. This is a long-standing unsolved problem.

Chapter 5: The Runaway Universe

The expansion rate of the universe is accelerating. Astronomers used Type 1a supernovas to determine this. When Einstein first realized that his theory of relativity required the universe to be expanding or contracting, he thought it was wrong and added a fudge factor, the so-called cosmological constant, to make his equations give a static universe. Later, after Hubble showed the universe was indeed expanding, Einstein called his fudge factor a great blunder. However, in light of the accelerating expansion of the universe, it appears the cosmological constant is real after all. The cosmological constant means that there is an energy that causes space to expand. This mysterious energy has been dubbed dark energy. The nature of dark energy is a major problem for physics. Eventually all galaxies will be moving away from us at speeds greater than c, the speed of light.

Krauss claims the universe is not rotating, but this is still an open question ("axis of evil"). Polarization of light from galaxies and CMB both point to a similar axis (more later).

Chapter 6: The Free Lunch at the End of the Universe

Krauss says that the flat geometry of space-time requires very specific initial conditions and expansion rate. There is nothing known in physics that required these conditions to exist.

There is another problem in cosmology called the horizon problem. The problem is that the CMB is very smooth (almost the same temperature). There has not been enough time for thermal equilibrium to be reached between the different parts of the universe. A theory called Inflation allegedly solves this and the flatness problem.

Inflation says that within a fraction of a second after the big bang, the universe expanded by a factor of 10^{28}. (Recall that relativity allows the relativistic expansion to be faster than the speed of light.) The expansion then settled to a rate similar to today. The predicted pattern of density fluctuations in the CMB that would result from quantum fluctuations during inflation is what is observed in the CMB. Quantum fluctuations would be "frozen" by inflation. No one knows why inflation would start or stop. The universe became flat because the originally dominant matter density was diluted during inflation to the point that gravity and the expansion were balanced.

According to Krauss, the creation of the universe from nothing is not a violation of the first law of thermodynamics. This is because the energy associated with gravity is thought to be negative. Hence the sum of all matter/energy, kinetic energy, and gravitational potential energy would be zero.

Chapter 7: Our Miserable Future

In this chapter, Krauss discusses what will happen to our universe if the expansion accelerates indefinitely. He says that eventually other galaxies will be receding from us at speeds greater than the speed of light so they will disappear. Supposedly at some distant future time even atoms will be torn apart.

Chapter 8: A Grand Accident

Physicists have looked for a theory that would explain everything—why we have the physical laws and constants we have, a theory that would require our universe to be the way it is. However, no theory like this has ever been developed. As far as we know, there are no laws of physics that require our universe to have the constants and laws it has. It is well known that many of the laws and constants of nature are exactly what they must be for life as we know it to exist. Change any of these constants just a little and you get different elements, different stars, a different geometry of space-time, a different universe! In other words, our universe appears to be fine tuned for life for no apparent physical reason. Christians point to this fine tuning as evidence for intelligent design consistent with the existence of the God of the bible.

This is where Krauss gets philosophical. He embraces the anthropic principle and the idea of a multiverse. The anthropic principle says that the universe looks the way it does because if it did not, we would not be here. The multiverse idea means there are countless universes with different physical laws and constants (the landscape); we just happen to be in a universe where the expansion rate allows for galaxies, planets, and people.

The idea of the multiverse is consistent with some particle physics and string theory. Inflation could explain a multiverse. During expansion, some regions may exit inflation while others continue to inflate; this is the eternal inflation model. Regions that exit will become causally isolated universes. However, inflation models are not eternal in the past (more later).

String Theory holds that tiny vibrating strings determine elementary particles and forces. Scientists would like to have a theory of everything, so efforts have been directed at combining relativity with quantum mechanics to produce a quantum theory of gravity. String theory is an attempt at this fusion. String theory says gravitons are the force carrying particle of gravity but only if strings can vibrate in 26 dimensions. By adding the math of super-symmetry, the number of dimensions is reduced to 10. By this reasoning, we live in a 10-dimension universe where there are 4 large dimensions and 6 dimensions that are so small they elude detection. Physicists speculate that some of the compactified dimensions may be revealed with the Large Hadron Collider. It now appears that branes (membranes) may be the fundamental object, not strings. We still don't know if string theory has anything to do with the real world.

Krauss says that the difference between speculative physics and spiritual realities is that the former can be measured in principle (quote on p. 133). However, this ignores personal spiritual experience, the fulfillment of prophecies, the empirical detection of design in nature, the historical accuracy of the scriptures, the over 500 eyewitnesses to the resurrection of Christ, etc. These spiritual realities have been measured *in fact*.

Krauss says all this speculation (e.g., string theory) challenges the notion that our universe is unique. String theory says there may be as many as 10^{500} universes with 10 dimensions, 4 of which are large like ours. The theory of everything becomes the theory of anything. Each universe would have different particles, forces, space-time, physics, etc. Allegedly, we just happen to be in one of the universes that has the physics required for our existence. Krauss hopes for a theory of everything that confirms the multiverse and eternal inflation; he would then have support for the landscape and anthropic principle.

Chapter 9: Nothing is Something

Krauss starts off talking about Newton, revelation versus science, and some philosophical issues. He again mentions how he does not like the definition of nothing as the absence of even the possibility to exist.

He claims we are getting closer to explaining how RNA could have arisen naturally. He apparently thinks the RNA world theory is how life began. He believes Darwinism explains the emergence of complex life since the first cell.

He thinks science is progressively eliminating God as an explanation for natural phenomena. However, he admits that the plausibility of naturalism is all that science may ever achieve.

He states that the Newtonian gravitational energies of galaxies moving with the Hubble expansion is zero and space-time is flat according to observation.

Assuming the existence of empty space and the laws of physics, space has a non-zero energy. During inflation, the expansion dumps energy into empty space as it becomes flatter and flatter. When inflation stops, the energy of space gets turned into the energy of real particles and radiation (Big Bang). Quantum fluctuations leave some irregularities in space-time and hence in the distribution of particles, radiation—allegedly reflected in the CMB. Krauss then says that this proves you can get something from nothing given the energetics of empty space and the law of gravity! So he says you can get a universe from nothing if you can start with empty space with non-zero energy and the laws of gravity and quantum mechanics. He then admits empty space with non-zero energy is something!

Chapter 10: Nothing is Unstable

Empty space is boiling with virtual particles that pop in and out of existence on time scales too small to measure (shorter than the Planck time). Quantum mechanics allows for violations of the 1st law of thermodynamics over brief periods of time. Krauss says nothing always creates something if only for an instant. Quantum mechanics can sneak energy from empty space as long as it is returned before anyone can observe it. Krauss invokes Hawking radiation to support this. However, Hawking radiation has never been observed!

One unsolved mystery is why there is an excess of mater in our universe; this is the Matter/antimatter problem. Why is the universe only made of matter? Matter/antimatter particles annihilate each other to produce radiation. Radiation coverts to equal amounts of matter and antimatter. Krauss says that the CMB suggests the photon to proton ratio was a billion. He says that by "plausible quantum processes" the universe started out with 1 part per billion more matter than antimatter. Most of the matter and antimatter combined to make photons. Later he admits we still don't really know how this asymmetry between matter and antimatter began. He also claims there are plausible organic pathways to RNA (in reality still many problems).

He says most biochemists now embrace abiogenesis. This may be so, but we are light years from understanding how this could have happened by natural processes alone.

A quantum theory of gravity would mean quantum mechanics applies to space, not just to objects in space. Then we could say that space-times pop in and out of nothing if the total energy is zero. But we don't yet have a quantum theory of gravity.

Krauss says a universe where the total mass/energy is balanced by the potential gravitational energy has zero net energy and so could pop into existence from nothing without violation of the 1st law. These universe should, however, collapse and disappear in periods shorter than the Planck time unless inflation allows it to exist beyond the Planck time.

He admits this speculation does not prove our universe arose from nothing, but says it makes such a scenario more plausible. And plausibility is apparently all he needs to justify rejection of God. So much for basing his worldview on hard cold facts alone.

Chapter 11: Brave New Worlds

Kruass gives many of his reasons for not liking God as an explanation for the origin of the universe (intellectually lazy, no evidence, god of the gaps, etc.). He says if God is the answer, what determined God's rules? He says there is no evidence for God—thinks he can explain everything with the Landscape and the Anthropic Principle. He says a first cause is needed for a universe with a beginning but it does not have to be the God of the Bible. (He has admitted elsewhere that deism might be true.) He suggests the universe might be eternal in the past and future and that physical law may have always existed. He admits that this raises the question of where the laws came from and how did they get to be what they are. He says that one can't define nothing as the lack of the potential to exist since then even God could not create anything. (This is not true if God is outside of and separate from nature.) He says the universe will eventually die a heat death, even protons and neuneutrons will decay.

Epilogue

He says we must choose what we believe based on fact, not revelation. Yet his *faith* is based on unproven *speculation*.

He says science has made it possible to not believe in God (sounds like Dawkins). But God has always made it possible for people to deny him.

Conclusion

1. Krauss must assume quantum mechanics so the universe does not actually come from nothing.

2. Most recent scholarship on major cosmological theories all require a beginning.[4] No current theory allows an eternity past! Hence all current theories say there still had to be a beginning.

3. Fine tuning is still a problem for materialists. There is no evidence so far for hidden dimensions, other universes, string theory, etc.

4. The matter/antimatter problem is still unsolved.

5. Krauss admits deism may be right. His rejection of Christianity seems to based more on personal rather than scientific criteria.

6. Young earth/old universe cosmologies such as Russell Humphrey's can explain the CMB, abundance of light elements, "axis of evil", expansion of the universe, and the starlight-time problem.

7. Even if the landscape and the anthropic principle are correct (there is no evidence they are), one still has to explain origin of life and evolution. However, there is still no evidence for hidden dimensions, other universes, Hawking radiation, etc.

8. Much of Krauss's scenarios are speculative and depend on a quantum theory of gravity, which is not currently available.

The universe had a beginning (Genesis 1:1) and was created by God for his glory (Psalm 19:1). God has hidden in mystery how the universe came to be (Eccl 3:11). Science may help us see more of God's glory, but only He can reveal what He has hidden.

COMING EVENTS

Thursday, May 10, 7:00 P.M., Providence Baptist Church, 6339 Glenwood Ave., Raleigh, Room 631
Everett Coates will speak on geological features known as "unconformities" that are found frequently in the rock record all over the world. These unconformities, or breaks in the deposition sequence, supposedly represent hundreds of millions of years of non-deposition and erosion. But is this true? Do these

[4] Grossman L (2012 Jan 11) Why physicists can't avoid a creation event. *New Scientist* **2847**:6-7

features present a challenge to the Genesis account of a global Flood?