Truth, The Sum of Existence

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Introduction

Brother and sisters, good morning and aloha. I express thanks to my faculty colleagues and especially to the FAC for giving me the privilege of presenting this year's David O. McKay lecture. It has been most humbling to reflect upon the talented individuals who have given the McKay Lecture previously and to try to meet the incredibly high standard they have set. I also appreciate the administration for continuing this tradition and the financial support.

I have always had a soft spot in my heart for David O. McKay, first because I was raised near Huntsville, Utah, where he grew up nearly a century before I was born. He was also a champion of education for women. While principal of Weber Stake Academy (forerunner to Weber State University in Ogden, Utah), he was able to dramatically increase female enrollment there at a time when very few women sought a secondary education (*Teachings of the Presidents of the Church*: David O. McKay, 2003, p. xx).

He also was likely taught by his father how to fish in the same rivers and streams where my father taught me to fish. As you can see, my dad did a good job. I thoroughly enjoy fishing and was tempted to give this lecture on the intricacies of fishing. Instead, I will share just one Chinese fishing proverb. You may have heard it before: Give a man a fish, he eats for a day. Teach a man to fish, he eats for a lifetime." That statement relates to many

correct principles in life, including self-reliance, learning, and finding truth.

President McKay believed, “True education seeks … to make men and women not only good mathematicians, proficient linguists, profound scientists, or brilliant literary lights. . . . [It seeks to make] men and women who prize truth, justice, wisdom, benevolence, and self-control as the choicest acquisitions of a successful life” (*Teachings of the Presidents of the Church*: David O McKay, 2003, pp. xix-xx).

My hope today is to give honor to David O. McKay by as he put it “associating” the academic world with the spiritual. An alternative title for this presentation is “Truth: God, Man, and Mathematics.” In D&C 88:118, we read, “Seek ye diligently and teach one another words of wisdom; yea, seek ye out of the best books words of wisdom; seek learning, even by study and by faith.” I have endeavored to follow this admonition.

Circle of Truth

I believe that all “real” truth can be inscribed into one great whole. Suppose we imagine a huge sphere that encompasses all “real” truth. Then we can also imagine a much smaller sphere that represents “humankind’s” truth or knowledge. We have no idea how large the sphere would need to be to accurately represent all “real” truth. It could fill this building, our solar system, or even beyond in comparison to humankind’s knowledge.

Jack Johnson the first mathematician to give the David O. McKay lecture did so 25 years, 4 days and 1 hour ago (but who’s counting). He chose a two dimensional representation of “real” truth and man’s knowledge through overlapping circles. In honor of Jack, I will also use this two dimensional model.

Notice that not all of what is considered "human knowledge" falls within the circle of Truth. This means that some claimed "human knowledge" is bound to conflict with real truth. For instance, it was once considered fact that the earth was the center of the universe, and the sun orbited around the earth. At that time, some who suggested there was evidence indicating the earth actually revolved around the sun were put to death for heresy. The “sacred and the secular” have frequently been at odds concerning “truth.” We at BYU–Hawaii are highly interested in both these arenas of thought. How can we, as Latter-day Saint academic professionals and university students, deal with what Bruce Hafen (a long-time administrator for BYU–Provo, Provost in 1992) stated as “the natural confrontations between the sacred and our deep commitment to being part of serious university pursuits?” (Hafen, 1992, p. 2-3).

The popular author Chaim Potok struggled throughout his life with the sacred (Jewish religion and tradition) and the secular world. He suggested four possible responses for a person who faces confrontation with the sacred thought system and the secular thought system:

- First, the **lockout response**: a person escapes the conflict by erecting barriers between the sacred and the secular and **then stays entirely within one system**
- Second, **compartmentalization**: a person creates separate categories of **thought that coexist in what he called a “tenuous peace”**
- Third, **complete fusion**: a person takes down all walls and allows the **sacred and secular cultures to freely mix**, perhaps leading to a “**radically new seminal [influential] culture**”
- Fourth, **ambiguity**: in this approach, a person will take down most if not all walls and **accepts a multitude of questions** with **no intention of resolving them** (Potok, 1989)

If we consider Potok’s possible responses to conflict, we must reject the lockout approach. Part of this life is to experience “opposition in all things.” We cannot simply tune out conflicts and realities around us.

Compartmentalization may on occasion be used as a coping mechanism when one must maintain both the

sacred and the secular thoughts that are in conflict. For instance, occasionally, a teacher at BYU–Hawaii may resort to compartmentalizing academic "knowledge" that is not consistent with religious beliefs in order to acquaint students with the leading secular theories of the day. Hopefully, this occurs only on rare occasions and is tempered with gospel principles.

We also cannot accept the complete fusion approach that accepts all ideas without prioritizing and with no regard for truth or error. The fusion response reminds me of the phrase "the philosophies of men mingled with scripture" (quoted from Hartman Rector Jr., 1974).

Potok's final response choice is ambiguity. Although I agree that we must live with some degree of ambiguity and uncertainty, I feel uncomfortable resigning myself or others to "a multitude of questions" with no intention of searching for answers. It seems a rather lazy way to respond to conflict. There will undoubtedly be discrepancies between the secular and the sacred that will not be answered in our lifetime, but searching for answers has its own rewards. And, by examining and working with seemingly opposing thoughts, we may find undiscovered truths that otherwise would not have been sought after.

None of Potok's suggested approaches seems very satisfying to me. My professional field of study and the gospel of Jesus Christ teach us to continue to seek for truth and knowledge. I believe there must be a fifth alternative for responding to discrepancies between the sacred and the secular. This approach could be called the "eternal perspective" that is taught in the scriptures and in the temple. It is the realization that when there are conflicting ideas, we must continue to search for "real" truth that coincides with the teachings of the gospel of Jesus Christ. The eternal perspective gives us faith that absolute truth does indeed exist and someday will be discovered or revealed. We as Latter-day Saints should have no problem accepting objective and subjective reality from both the sacred and the secular thought systems. Joseph Smith stated, "We should gather all the good and true principles in the world and treasure them up, or we shall not come out true 'Mormons'" (*Teachings of the Prophet Joseph Smith*, p. 313).

One area where differences often arise concerning "truth" is between scientific knowledge and religious teachings. For example, the "truth" of how the earth was created and how life came to be on this planet is an example of conflict between the secular thought system and the sacred (religious) thought system. We recognize the lockout approach with the strict creationist Christians as well as atheistic evolutionists. Some may choose to compartmentalize by studying the secular teachings during the week and then reading the Old Testament account on Sunday. Others have chosen the ambiguity response to the theory of creation, taking a "whatever" attitude. Others have selected the complete fusion response mixing the secular and the sacred, arriving at an entirely different thought system altogether.

We are very fortunate that the restored gospel of Jesus Christ has provided the most comprehensive spiritual (sacred) explanation of life and the cosmos available to humankind. Many Latter-day Saint members find no conflict between the scriptures and secular teachings. By taking the eternal perspective, the creation of the world can be understood in a harmonious manner with emphasis that the Lord was at the helm in organizing the heavens and the earth and bringing life to the planet. Brigham Young stated, "In these respects we differ from the Christian world, for our religion will not clash with or contradict the facts of science" (*Journal of Discourses* , V. 14, p. 116). Since we are informed that the gospel of Jesus Christ embraces all truth, there can never be any genuine contradictions between true science and true religion.

Mathematics and Scripture

The other day, I came across an illustration that comments on the "purity" of the different fields of science. I found it humorous; I hope my science friends and colleagues will also and not take offense.

From left to right, each science claims more purity. Then on the far right, we have mathematics.

Why is mathematics considered the “purest” of the fields of science? (Other than because I am a mathematician, and I am giving the lecture?) Mathematicians prove a concept true by using other valid/true mathematics. This practice implies that all mathematics that can be proved falls into the circle of Truth so long as the few original assumptions or axioms are true. Applied mathematicians, often called scientists, look for natural phenomena to study. Their theories are created from what can be observed and verified. Often, more than one theory can explain what is observed.

If mathematics is the purest “science,” then can we assume there are no conflicts between mathematics and spiritual truth? There are actually a few discrepancies with mathematics and scriptures. The most noted one is found with the stated dimensions of the baptismal font constructed for Solomon’s temple found in 1 Kings 7:23 (and 2 Chronicles 4:2, 5). In mathematics, if the circumference of a circle is divided by the diameter of the circle, a constant number is obtained called pi (?). Pi is an irrational number since it cannot be written as a fraction; it is, however, often approximated by 3.14 or 22/7, neither of which is precise. In 1 Kings 7:23, we read he made “a molten sea, ten cubits from the one brim to the other: it was round all about … a line of thirty cubits did compass it round about.” We see 30/10 is 3, thus indicating pi = 3.0. This scripture does not concern me as a mathematician; I am not going to start teaching my students that pi = 3.0. Although included in the scriptures of the Old Testament, it was not the Lord speaking; rather, it was someone recording measurements. Also, there are several possible explanations for the apparent conflict over the value of pi. First, was the font perfectly round as implied? If it was just a little elliptical or oval in shape, then that could explain the discrepancy. Or since the scripture speaks of a brim, is that like a lip on top that may extend past the round portion of the font? If so, the length from brim to brim would be slightly larger than the actual diameter of the font.

This example demonstrates the rare instance where the secular is true and scripture may be in error if interpreted literally. The fact that the ratio of the circumference of the circle to the diameter of the circle is a fixed irrational number we call pi should go in the circle of Truth, and not 3.0. (* . ** See references for information on legislation involving the value of pi.)

Intelligent Life in the Universe

Another question on the minds of people through the ages has been “Is there any other intelligent life in the universe?” Until only recently, there was absolutely no scientific evidence to suggest existence of life elsewhere in the universe. Just over two decades ago, the most powerful telescopes could not detect even one planet outside our solar system. By the year 2000, astronomers knew there were billions of stars in our galaxy similar to our sun, yet only eight planets were definitely known to exist outside of our own solar system, and no evidence had been found that any of these eight planets could sustain life.

Then in 2009, NASA launched the Kepler Space Telescope. This telescope was programmed to simultaneously look at 150,000 stars within the Milky Way galaxy, searching for possible planets orbiting a star similar to our sun. In four years of data collection and analysis, more than 3000 candidates for planets have been identified, a few of which have been confirmed to be potentially life-sustaining (that is they are rocky in nature and orbit in their sun's "habitable zone," the region in the planetary system where liquid water might exist on the surface of a planet) (Colten, 2014).

Using the data obtained, scientists extrapolated the results and now estimate that there are hundreds of billions of planets in our galaxy alone and that there could be as many as 11 billion earth-sized planets orbiting in the habitable zones of sun-like stars within the Milky Way galaxy (Khan, 2013; Petigura, Howard, & Marcy,

2013).

Additionally, in 2003, another space telescope called the Hubble Telescope was used to examine a very dark portion of the universe thought to be empty space. The telescope focused on a tiny part of the night sky equivalent to what could be seen looking through an eight-foot long soda straw. From the data, the Hubble Ultra-Deep Field image (HUDF) was obtained and recently made public. What was found in the image is astounding (Courtesy of NASA, ESA, S. Beckwith (STScI), and the HUDF Team)

We see a field filled with thousands and thousands of stars that was thought to be empty space. As you look closer, you notice that many of the stars are not just specks of light; rather, there are spirals and ellipses. Thus, each “light” you see in the photograph is actually a distant galaxy containing hundreds of billions of stars. The photograph shows about 10,000 galaxies in this tiny dark spot in the sky. (To see other exciting images of the cosmic sky, refer to the August 2013 *Ensign* article entitled "Worlds without Number" by R. Val Johnson.)

To summarize and do just a little math, there is now scientific evidence that the Milky Way galaxy is just one of 100 to 500 billion galaxies in the universe, and astronomers estimate that each galaxy has between 100 and 400 billion planets, and up to 11 billion are possibly life-sustaining. Multiplying these numbers, we find there could be 2 x 1023 (that’s 2 followed by 23 zeroes) planets in the universe and there could be as many as 5.5 x 1021 earth-like planets in the known universe. If every single person who has ever lived on the earth each took 1000 years continuously counting different earth like planets, there would still be planets left uncounted. Does the phrase “worlds without number” come to mind? (Moses 1:33) What amazing scientific evidence has come forward in the just past few years, concerning the possibility of intelligent life elsewhere in the universe.

For us, truths about the heavens, including other life in the universe, were revealed to Joseph Smith as far back as 1831 found in the book of Moses (Moses 1:33-39). It is nice to see we have agreement between the sacred and the secular thought systems regarding the potential for other intelligent life in the universe. The existence of other intelligent life in the cosmos is in the circle of Truth.

Perhaps the reason these scientific results are so exciting to me goes back to a college physics class I took entitled “Intelligent Life in the Universe.” Since it was prior to 2000, the talk of life like ours elsewhere in the universe was sheer speculation. As part of the course requirements, we were to write a research paper, with references, either supporting intelligent life elsewhere in the universe or refuting the idea. I checked with the teacher to find out if there were any restrictions on the type of references we could use. He assured me there were no restrictions. Thinking of scriptures in the book of Moses in the Pearl of Great Price, I decided to use them to support my position. Here is the thread for the scriptures used:

- **Moses 1:37**: The **heavens cannot be numbered** by man but are numbered unto God
- **Psalms 147:4**: God numbers the *stars* and calls them by name (**a multitude of suns**)
- **Moses 1:33, 35**: **Worlds without number** have been created, and some have already passed away. Many now stand and are innumerable unto man but are numbered unto God (**planets without number**)
- **Moses 1:38**: As one earth passes away and the heavens thereof, another shall come, and there is no end to God’s works (**it’s a continuing process**)
- **D&C 76:24**: The worlds were created by God, and the **inhabitants are begotten sons and daughters of God**. (**There is intelligent life elsewhere in universe**)
- **Brigham Young**: “Eternity is without bounds and is filled with matter; and there is **no such place as empty space** (*Journal of Discourses VI* pp. 2-3, pp. 146-47)
- **Moses 1:39**: **Why** would God **make multiple worlds** and place people on them? Because it is **His work and His glory**

I was nervous how my paper would be received by the graduate TA who graded our work instead of the

professor. I do not remember the exact statement he wrote on the front page of my paper, but it reminded me of what King Agrippa said to Paul: “You almost persuadest me to be a Christian” (Acts 26:28). The TA hinted at almost believing in my faith because of what the scriptures included in my paper taught about why there must be other intelligent life in the universe.

Geometry

Let us conclude our short investigation of truth and how it can be obtained by considering ideas from a branch of mathematics called geometry. You may have heard of a famous mathematician named Euclid. Around 300 BC, he developed much of the geometry you learned in elementary and high school called Euclidean geometry. With the geometry knowledge you all have, I am going to ask you a question—don’t worry, it’s just one questions, and it’s multiple choice.

Which of the three figures would you pick to best represent a triangle?

By the show of hands how many of you picked B? If so, you are a good student of Euclid.

Did anyone pick A? You are in good company with the likes of Albert Einstein and Bernhard Riemann, both very smart and famous mathematicians-scientists. Did you happen to pick C? Then you are also in good company with Carl Friedrich Gauss (possibly the greatest mathematician of all time), Henri Poincare, and Nikolai Lobachevsky, all famous mathematicians.

We might ask, “Which is the correct or ‘true’ triangle?” For over 2000 years, mathematicians attempted to show that Euclidean geometry (triangle B) is the only “true” geometry. While trying to prove Euclidean geometry the only correct geometry, mathematicians in the 19th century actually discovered and proved there are three valid geometries.

Which is the best geometry? It depends on the “space” in which one is placed. These three images illustrate what line segments look like in the three geometries: Euclidean (zero curvature), Spherical (positive curvature), and Hyperbolic (negative curvature).

The first shows two ants walking straight across a flat surface “parallel” to each other. The second shows two ants traveling straight across the surface of a baseball. (Notice that straight looks curved to us, and in fact, as the ants continue around the baseball, they will cross paths not once, but twice – there are no parallel lines in spherical geometry). The third pair of ants travels across a surface that resembles a saddle in, what is for them, a straight line. (Once again, it looks curved to us as these ants appear to be getting further apart.)

Now we can see how the three triangles could be formed on their respective surfaces. We may also note an interesting fact that in spherical geometry (positive curvature), the interior angle sum in a triangle is more than 180 degrees and can be different for every triangle. In hyperbolic geometry (negative curvature), the angle sum is less than 180 degrees and again can be different for every triangle. In Euclidean geometry (flat curvature), the sum of the angles in a triangle always equals 180 degrees. Sound familiar?

Are we still thinking only Euclidean geometry should go into the circle of Truth?

The idea of a curved surface should not be unfamiliar to us; after all, we live on a planet that is roughly a sphere, so really we should use spherical geometry on Earth. Lines on a sphere are great circles (that have their centers at the center of the sphere). Line segments are part of great circles. Think of cutting the middle of a round watermelon. The knife first cuts through at a point and follows part of a great circle as it cuts through the outer surface of the watermelon.

We can also think of ships on the sea or planes in the air as they travel from one point to another on or above the Earth's surface.

An interesting fact is the shortest and usually the fastest route from one place to the next is part of a great circle with the center of the Earth as the center of the great circle formed. Let us look at a flight from Miami, Florida, to Boston, then from Boston to Los Angeles, and from L.A. back to Miami. Which type of triangle does the path resemble?

Why then, is Euclidean geometry taught in school? An answer is because "locally" it works very well and has easier formulas to use. For instance, on a relatively large surface, say a football field, the "lines" marked off in ten-yard increments look to be the same distance apart (Euclidean geometry), and if the band performing at half-time does a good job, its "lines" should look like what we think of as straight.

What about the negative curvature geometry modeled by the surface of a saddle? Even if you have never ridden or even seen a horse before, you likely have experience with a hyperbolic surface. If you have ever eaten a perfectly shaped potato chip, such as a Pringle's potato chip, you have experience with a hyperbolic surface. A Pringle's potato chip is an example of a negative curvature surface. Hyperbolic surfaces can be seen in art. M. C. Escher is the most famous for this type of artwork. He uses the Poincare model for hyperbolic geometry. Notice the hyperbolic triangles in the first picture Escher then turned into the fish. Some exotic flowers make use of hyperbolic surfaces as do some roof structures.

Therefore, all three geometries belong in the circle of Truth, perhaps with a caveat stating "in the appropriate space."

Geometry of the Universe

Since all three geometries illustrated are valid in an appropriate space, what will happen if we move to a very large space, for example outer space or the cosmos? Will we find one "true" geometry to explain the physical nature of the heavens? Can we look at a really big triangle in space with distance stars as vertices and measure the interior angles? Astronomers have actually tried only to find the measuring instruments insufficiently accurate. Possible angle sums for all three geometries fall within the margin of error of the measuring device.

Perhaps this comic strip will make sense to you now, since in non-Euclidean geometry the interior angle sum of triangles can be more or less than 180 degrees.

We currently describe the cosmos according to the General Theory of Relativity, developed by Albert Einstein. The General Theory of Relativity asserts "that space itself (not just an object in space) can be curved, and, the space of General Relativity has three space-like dimensions and one time dimension" (Dejoie & Truelove, 2001). Time is not absolute but is relative to the individual or object used as the frame of reference. As you may have guessed, there are three general possibilities for the geometry of the universe: positive curvature, negative curvature, or no curvature.

Currently, cosmologists (applied mathematicians) have differing theories about the geometry of the universe

and have not come to complete agreement. The current trend seems to be leaning towards a Euclidean (flat universe) or hyperbolic (negative curvature universe) where the universe will continue to expand forever.

I also have not found any statements in the scriptures or teachings of the prophets revealing the geometry of the universe. However, there are scriptures that have fascinating possibilities in regard to the general theory of relativity. The principle of no absolute time seemed to be given to Joseph Smith and recorded in D&C 130:4–5: "Is not the reckoning of God's time, angel's time, prophet's time, and man's time, according to the planet on which they reside? I answer, yes." In D&C 3:2, we read, "For God doth not walk in crooked paths, neither doth he turn to the right hand nor to the left, neither doth he vary from that which he hath said, therefore his paths are straight, and his course is one eternal round." Could this scripture provide a connection to the general theory of relativity? It could indicate Euclidean geometry as "his paths are straight," but as we saw previously, the ants traveled in what appeared to them to be a straight course relative to the surface they were on. The last three words of the scripture could suggest that the shortest distance between two points in a 4-Dimension space-time world is a curved path, which is a basic concept of Einstein's general theory of relativity. Is this scripture suggesting a spherical or hyperbolic universe? We do not know. And I do not wish to speculate.

For now, we must live with ambiguity, with more questions than answers regarding the curvature of the universe and its fate, having faith that someday the answers will be found. In 1 Nephi 10:19, we read, "For he that diligently seeketh shall find; and the mysteries of God shall be unfolded unto them, by the power of the Holy Ghost."

Conclusion

In our search for truth, we need to keep in mind that the main objective of science is not to bring us closer to God and neither are the scriptures intended to be used mainly as a science textbook. We should consider ourselves very fortunate when spiritual thought and secular thought both witness of the same truth. As teachers, administrators, and workers at BYU–Hawaii, one of our highest purposes should be to help our students confront questions in ways that strengthen both their minds and their faith. We know that truth will be uncovered "line upon line, precept upon precept" both in the secular world and in our own spiritual journey (2 Nephi 28:30; Isaiah 28:13). If we search and do not find the answers we seek, then there may be other truths we need to learn first. God does want us to have the answers, but He wants us to be prepared for them. Until we are ready, we may have to experience some ambiguity, but we are promised the understanding that is needed will come to us when the time is right. The important thing is that we keep seeking to learn the truth by study and by faith and with the wisdom to realize that there are still many great and important truths to be discovered.

Last Verse of "Oh Say, What Is Truth?" (Hymn 272)

"Then say, what is truth?
Tis the last and the first
For the limits of time it steps o'er.
Tho the heavens depart
and earth's fountains burst,
Truth, the sum of existence,
will weather the worst,
Eternal, unchanged, evermore."

In the name of Jesus Christ, Amen.

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*On a similar note, there are urban legends circulating that Alabama, Tennessee, or Kanas passed a law decreeing pi to be exactly 3.0 according to the Bible scriptures. The myth spawned from an article written by Mark Boslough as an April fool's joke that circulated on the internet April 1, 1998. This article continues to be distributed, but now as fact. Be careful what you read on the internet.

** In 1897, Taylor I. Record did introduce Bill #246 in the Indiana House of Representatives. Different parts of the bill proposed different values of pi including 3.2, 4, and 3.23, but not 3.0. The approximations were from an amateur mathematician who apparently was a friend of Taylor Record. The bill passed the house, but got stalled in the Senate, not because of the values proposed for pi; rather the legislators did not think it was an appropriate subject for legislation. What a scary thought, that ideas that are absolutely wrong, clearly outside the circle of Truth, can be made into law by a legislative body. Here we have an example of conflict between secular truth (true value of pi) and a secular law determined by political manipulation.