Science and Mormonism: Past, Present, Future

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In 1832, while Joseph Smith was organizing the Mormon church, Ralph Waldo Emerson wryly observed, "The Religion that is afraid of science dishonours God and commits suicide."[1] One hundred sixty-four years later, as the church faces a new century and a new millennium, issues in the arena of science and religion are still before us.

Will the church be able to retain the essence of its theology in the face of challenges from science? Will the church's discourse on scientific topics be marked by fundamentalism, isolationism, or progressivism? Will the church be able to retain its large contingent of professional scientists? Will it be able to produce new scientists in fields germane to this discussion? Will Mormon youth be able to sort out conflicts between faith and science? What will be the likely outcome of the faith *versus* science issues currently being discussed in LDS literature? What entirely new issues will emerge? What is the likelihood that the church will be able to deal with these new issues?

A Glance at the Past

Before answering these questions we first need to review briefly the history of scientific thought in the LDS movement. Additional information can be obtained in the helpful works by Duane Jeffery[2] and Erich Robert Paul.[3]

At a time when other Christian faiths were still smarting from the

1. From Ralph Waldo Emerson's journal, cited in J. L. Davis et al., eds., *A Treasury of American Literature* (New York: Grolier, 1948), 1:703.

2. Duane Jeffery, "Seers, Savants and Evolution: The Uncomfortable Interface," *Dialogue: A Journal of Mormon Thought* 8 (Autumn 1974): 41-75.

3. Erich R. Paul, *Science, Religion, and Mormon Cosmology* (Urbana: University of Illinois Press, 1992). Sadly, Paul died of cancer in October 1994.

Copernican revolution, Joseph Smith's revelations included frequent references to God's vast creations—"worlds without number" (D&C 76:24, 88:37-39, 93:10; Moses 1:29-35; Abr. 3:9). In another departure from Christian orthodoxy, Joseph taught that God works in accordance with natural laws: "True science is a discovery of the secret, immutable and eternal laws, by which the universe is governed."[4] Joseph specifically denied creation *ex nihilo,* teaching instead that matter is eternal (D&C 93:33).

Other early church leaders expressed similar views. Orson Pratt, who authored a number of scientific and mathematical works, advocated the Platonic view that scientific truths are known to God and that humans merely rediscover them as their knowledge progresses.[5] Orson's older brother Parley P. Pratt emphasized that LDS theology encompasses all of human knowledge, including "philosophy, astronomy, history, mathematics, geography, languages, the science of letters."[6] Brigham Young was also receptive to the pursuit of scientific knowledge, emphasizing its beauty, practical value, and divine origin. He was particularly open-minded about such issues as the age of the earth and the questionable reliability of the Bible as a scientific text.[7]

In his monumental opus *The Truth, The Way, The Life,*[8] B. H. Roberts attempted to harmonize modern secular and scientific knowledge with LDS theology. He included many details of the current understanding of astronomy and astrophysics, even Hubble's expanding universe and Einstein's relativity. He acknowledged the antiquity of the earth and the existence of pre-Adamic life, including beings resembling modern-day humans.[9] He repeatedly emphasized that both science and revelation are indispensable in the search for ultimate truth. For example, with regard to the Creation he taught,

> On the other hand, to limit and insist upon the whole of life and death to this side of Adam's advent to the earth, some six or eight thousand years ago, as proposed by some, is to fly in the face of the facts so indisputably brought to light by the researcher of science in modern times; . . . [t]o pay attention to and give reasonable credence to their research and findings is to link the church of God with the highest increase of human thought and effort.[10]

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4. *Times and Seasons* 4 (15 Dec. 1842): 46.

5. *Journal of Discourses,* 26 vols. (Liverpool, Eng.: Latter-day Saints' Bookseller's Depot, 1855-88), 7 (12 Feb. 1860): 157.

6. Parley P. Pratt, *Key to the Science of Theology* (London, 1855), 2.

7. *Journal of Discourses* 7 (6 Oct. 1850): 271; 8 (3 June 1860): 278; 9 (31 Aug. 1862): 369; 13 (25 Sept. 1870): 247-48; 14 (14 May 1871): 116; 15 (11 Aug. 1872): 127.

8. Brigham H. Roberts, *The Truth, The Way, The Life: An Elementary Treatise on Theology* (San Francisco: Smith Research Associates, 1994).

9. Ibid., 260-74, 339-64.

10. Ibid., 363-64.

However, by about 1930 this positive approach to science began to change. One indication was the dispute among Roberts, Joseph Fielding Smith, and James E. Talmage over the church's stance toward the theory of biological evolution.[11] This dispute arose when Roberts attempted to gain permission to publish *The Truth, The Way, The Life* as an official lesson manual, which Smith opposed because of its mention of "pre-Adamites." The matter ended inconclusively in 1931 when the First Presidency declined to publish Roberts's book and issued a memorandum declaring, "Leave geology, biology, archaeology and anthropology, no one of which has to do with the salvation of the souls of mankind, to scientific research, while we magnify our calling in the realm of the Church."[12]

Some LDS figures, mainly those of scientific or intellectual backgrounds, continued to advocate a positive and open-minded approach to scientific questions. An example was John A. Widtsoe, one of Mormonism's first academically trained scientists and an apostle for several decades. In *Evidences and Reconciliations* he discussed, among other things, the increasing weight of evidence for an old earth and even presented a detailed tutorial on the technique of uranium isotope dating.[13] In an article published in the *Improvement Era*, he mentioned the existence of "human-like" beings before Adam and explained that "the mystery of the creation of Adam and Eve has not yet been revealed."[14]

Voices such as Widtsoe's came to reflect a minority view. In 1954, after Talmage, Roberts, and Widtsoe had passed away, Joseph Fielding Smith, with the encouragement of several other general authorities, published his manuscript *Man: His Origin and Destiny.*[15] Even though the book had not received official approval, it quickly gained widespread acceptance. Elder Smith's anti-science philosophies were further developed in subsequent works such as his *Doctrines of Salvation.*[16]

In these works Smith promoted a highly literal interpretation of the scriptures. On the age of the earth, he asserted that the earth's temporal existence "is to endure for just one week, or seven days of 1,000 years each."[17] He insisted that Noah's flood literally and completely immersed

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11. Richard Sherlock, "We Can See No Advantage to a Continuation of the Discussion: The Roberts/Smith/Talmage Affair," *Dialogue: A Journal of Mormon Thought* 13 (Fall 1980): 63-78.

12. Ibid., 71.

13. John A. Widtsoe, *Evidences and Reconciliations* (Salt Lake City: Bookcraft, 1951), 149.

14. John A. Widtsoe, "Were There Pre-Adamites?" *Improvement Era* 51 (May 1948): 205.

15. Joseph Fielding Smith, *Man: His Origin and Destiny* (Salt Lake City: Deseret Book Co., 1954).

16. Joseph Fielding Smith, *Doctrines of Salvation*, 3 vols. (Salt Lake City: Bookcraft, 1956).

17. Ibid., 1:80.

the earth.[18] He condemned the theory of evolution as "falsehood absolutely."[19] His views gained even greater circulation when they were cited in Bruce R. McConkie's popular reference *Mormon Doctrine*.[20]

During the 1950s, 1960s, and 1970s, some LDS authorities, notably David O. McKay and Hugh B. Brown, continued to emphasize a positive outlook on science. President McKay, who apparently believed in evolution, quietly assured those who inquired of his office that the church had not taken an official position on the issue.[21] Brown once declared, "We should be in the forefront of learning in all fields, for revelation does not come only through the prophet of God nor only directly from heaven in visions or dreams. Revelation may come in the laboratory, out of the test tube, out of the thinking mind and the inquiring soul, out of search and research and prayer and inspiration."[22]

Yet other leaders during this time emphasized the dangers of science. Mark E. Petersen raised concern about the "tenuous and fragile theory that the universe and all life came about in some mysterious spontaneous, accidental manner."[23] Harold B. Lee listed "science so-called" with communism as among the sources of "untruth" challenging the world.[24] Bruce R. McConkie termed Darwin's theory of evolution as one of the "seven deadly heresies."[25] Ezra Taft Benson urged members to use the Book of Mormon to combat falsehoods such as "socialism, organic evolution, rationalism, humanism."[26]

The Present Situation

So where do we stand today? One recent example of scientific commentary by an LDS general authority is a talk given by Elder Boyd K. Packer at a BYU Book of Mormon symposium in 1988, where he declared,

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18. Smith, *Man*, 414-36.

19. Smith, *Doctrines*, 1:140.

20. Bruce R. McConkie, *Mormon Doctrine*, 2d ed. (Salt Lake City: Bookcraft, 1966), 256.

21. William L. Stokes, "An Official Position," *Dialogue: A Journal of Mormon Thought* 12 (Winter 1979): 90-92; David O. McKay, *A Message for LDS College Youth* (Provo, UT: BYU Extension Publications, 1952), 6-7; *Conference Reports*, Apr. 1968, 92; *Gospel Ideals* (Salt Lake City: Improvement Era Publications, 1953), 49; Sterling M. McMurrin and L. Jackson Newell, "McMurrin's Heresies, History, and Humor," *Sunstone* 18 (Apr. 1995): 55-62.

22. Edwin B. Firmage, ed., *An Abundant Life: The Memoirs of Hugh B. Brown* (Salt Lake City: Signature Books, 1988), 139.

23. Mark E. Petersen, "Creator and Savior," *Ensign* 13 (May 1983): 63-65.

24. Harold B. Lee, *Conference Report*, Apr. 1964, 21-25; also Oct. 1968, 59-62.

25. Bruce R. McConkie, "The Seven Deadly Heresies," BYU Fireside, 1 June 1980, transcript in my possession.

26. Ezra Taft Benson, *The Teachings of Ezra Taft Benson* (Salt Lake City: Bookcraft, 1988), 60. Benson did acknowledge the scientific evidence for evolution; see Steve Benson, "Ezra Taft Benson: A Grandson's Remembrance," *Sunstone* 17 (Dec. 1994): 29-37.

> It is my conviction that to the degree the theory of evolution asserts that man is the product of an evolutionary process, the offspring of animals—it is false! . . . And, I am sorry to say, the so-called theistic evolution, the theory that God used an evolutionary process to prepare a physical body for the spirit of man, is equally false. . . . How old is the earth? I do not know! But I do know that matter is eternal. How long a time has man been upon the earth? I do not know! But I do know that man did not evolve from animals. . . . When confronted by evidence in the rocks below, rely on the witness of the heavens above.[27]

In spite of the fundamentalist tone in these excerpts, note that Elder Packer does not rule out plants and animals as possible products of an evolutionary process, nor does he rule out an old earth. In this regard he is more flexible than some of the other LDS authorities who have commented on these issues during the past few decades.

There are other indications that the literalism which has dominated LDS literature during the last forty years may have peaked. In 1987, in response to numerous inquiries from readers on the subjects of fossils, the age of the earth, and related issues, the editors of the *Ensign* asked Morris Petersen, a professor of geology at BYU, to respond. He replied with a straightforward scientific explanation of the geological record, including evidence for the earth's great antiquity and the progression of fossils from primitive to highly advanced forms.[28] The fact that such an article could be published in the church's official organ, which requires official review, indicates that many LDS leaders are now comfortable with the conventional scientific picture of an old earth.

Other examples are in the student lesson manuals used in the Church Education System (CES). The Old Testament manual currently used in institute classes, which was revised in 1981, takes a highly literalist approach. On the question of the age of the earth, the manual mentions the work of Velikovsky and Melvin Cook in defense of the position that the earth is only a few thousand years old. On the question of evolution, the manual includes several quotes by certain general authorities, which appear to rule out any possibility of a reconciliation with LDS doctrine, while leaving other viewpoints unmentioned. These quotes are followed by a lengthy excerpt (twenty-two paragraphs) from the writings of a Christian creationist.[29] Similar commentary appears in several other places.

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27. Boyd K. Packer, "The Law and the Light," in Monte Nyman and Charles D. Tate, eds., *To Learn With Joy* (Provo, UT: BYU Religious Studies Center, 1990). This published version of Packer's 1988 speech was prefaced with a strong disclaimer by the editors.

28. Morris Petersen, "Fossils and Scripture," *Ensign* 17 (Sept. 1987): 28.

29. *Old Testament: Genesis—2 Samuel Student Manual* (Salt Lake City: Church of Jesus Christ of Latter-day Saints, 1981), 28-29, 33-36.

By contrast, the Old Testament manual currently used for seminary classes, which was revised in 1990, does not include any such material. Its only allusion to evolution is in a brief question, to be considered by the student, regarding the scripture "whose seed could only bring forth the same in itself, after his kind" (Abr. 4:12). The manual concludes its discussion of the creation with the admonition, "There are still many unanswered questions about how the earth was created, but these will be answered in the Lord's own due time."[30]

A third indication of a softening in the prevailing views on scientific issues is given in the new *Encyclopedia of Mormonism,*[31] which has at least semi-official status due to its sponsorship and rigorous review by the church. The article "Science and Religion," by Erich R. Paul, author of *Science, Religion and Mormon Cosmology,* briefly summarizes LDS commentary on the subject and then concludes that Latter-day Saints "look forward to a time when more complete knowledge in both areas will transcend all present perceptions of conflict." The article "Origin of Man," by John L. Sorenson of BYU, emphasizes that there are differing views on this issue and that the official position of the church is "not definitive."[32]

The article "Evolution," by William Evenson of BYU, is also telling. It is just a few paragraphs long, mainly a quote of the First Presidency's neutral statement in conclusion to the 1931 Roberts-Smith-Talmage dispute. For this particular article, at least three earlier and much longer drafts were reviewed and rejected by the First Presidency and other church leaders. The First Presidency then supplied the 1931 statement from their files, and the ensuing *Encyclopedia* article contains little more than this short statement. Incidentally, a slightly abbreviated version of this article is now distributed by church headquarters to people inquiring about evolution. Articles on other science-related topics, such as "Abortion," "Birth Control," "Homosexuality," "Medical Practices" and "Prolonging Life," are similarly moderate and open-minded, compared with discourse on these topics from decades past.[33]

Emerging Issues

In reviewing the history of discourse on scientific topics in LDS literature, one is struck by the large amount of space that has been devoted to

30. *Seminary Old Testament Student Manual* (Salt Lake City: Church of Jesus Christ of Latter-day Saints, 1990), 18-19.

31. Daniel H. Ludlow, ed., *The Encyclopedia of Mormonism,* 4 vols. (New York: Macmillan, 1992).

32. "Science and Religion," *Encyclopedia,* 3:1270-72; "Origin of Man," 3:1053-54.

33. "Evolution," *Encyclopedia,* 2:478; "Abortion," 1:7; "Birth Control," 1:116-17; "Homosexuality," 2:655-56; "Medical Practices," 2:875; "Prolonging Life," 3:1159-60.

a single topic: the apparent difficulty in reconciling modern biology, geology, and paleontology with the LDS creation scriptures. This issue was particularly at the forefront during the period from about 1950 to 1990. Those favoring a synthesis of faith and science can draw comfort from the articles in the *Encyclopedia of Mormonism*. Also encouraging to many scientifically-minded LDS are the successful efforts of BYU faculty and administrators in resisting periodic efforts to impose creationist biology there.[34] Along this line, in 1992 the Board of Trustees approved a packet of information on evolution to be made available for perusal by interested students at the library. It includes only a few statements by various First Presidencies while omitting a large number of less conciliatory (and less authoritative) statements by other church authorities. These developments are shallow victories, however, given that most members still hold fundamentalist beliefs on many scientific questions. For example, over 80 percent of BYU students in a 1973 survey did not believe that the Creation involved evolution.[35]

In any event, it might one day be lamented in LDS circles that such an inordinate amount of intellectual energy was expended during the twentieth century debating evolution and the age of the earth, while other, potentially more significant, questions were ignored. For it now seems clear that the twenty-first century will bring a host of such issues to the forefront. Among them are likely to be the following.

1. The recent discovery of an "ozone hole" over Antarctica, and the increasing weight of evidence that this phenomenon is due to fluorine compounds emitted by the industrialized nations, has convinced many observers that the environmental crisis must be taken seriously.[36] Other crises include steadily growing levels of atmospheric carbon dioxide, due principally to the burning of fossil fuels, the destruction of tropical rain forests, and the ongoing extinction of numerous species of plant and animal life. Are there scriptural suggestions of these calamities? How should world governments respond? Is it prudent for the church to become involved in these matters? If so, should LDS members be instructed, especially in light of early church teachings and scriptures charging us with

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34. Gary J. Bergera and Ronald Priddis, *Brigham Young University: A House of Faith* (Salt Lake City: Signature Books, 1985), 131-71.

35. Armand L. Mauss, *The Angel and the Beehive* (Urbana: University of Illinois Press, 1994), 179. According to BYU zoologist Duane Jeffery (private communication), BYU students today are at least as literalist in their beliefs on evolution as they were in 1973.

36. Owen B. Toon and Richard P. Turco, "Polar Stratospheric Clouds and Ozone Depletion," *Scientific American* 264 (June 1991): 68-75; Sasha Nemecek, "Holes in Ozone Science," *Scientific American* 272 (Jan. 1995): 26-27.

responsibility for *stewardship* over nature?[37]

2. Hand in hand with the environmental crisis is the burgeoning world population. LDS authorities have historically discouraged the practice of birth control, although the church's current official position on this issue is moderate.[38] In any event, the question of worldwide population control is coming explosively to the fore as it appears that the green revolution of the past few decades may have run its course and that the food supply cannot be increased much further without incalculable environmental damage.[39] In China, for example, even though a draconian birth control program has reduced the country's annual population growth rate to only 1.4 percent, the nation grows by 17 million people per year. Analysts project that by the year 2030 China alone could consume all the surplus grain produced in the world today, just to meet the most basic nutritional needs of its population.[40]

If pressure continues to build for limiting population around the world, what counsel should be given to prospective LDS parents on family size? Should families in all regions of the world be given the same counsel?

3. Advances in biological science are certain to bring significant questions of medical ethics to the fore. An example is the detection of genetic defects by DNA analysis.[41] If a person is diagnosed with a hereditary genetic defect, should he or she still be encouraged to have children? Which defects are serious enough to justify formal or informal restrictions? One key question here is whether or when abortion should be considered for fetuses diagnosed with serious defects. At the present time the church's official condemnation of abortion excepts cases where "a severely defective fetus cannot survive birth."[42]

A related issue is the possible "cloning" of living organisms, including humans.[43] If this becomes possible, under what circumstances should it be done? Still another issue along this line is the commercialization of human gene therapies, as well as the creation and patenting of new spe-

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37. Larry L. St. Clair and Clayton C. Newberry, "Consecration, Stewardship, and Accountability: Remedy for a Dying Planet," *Dialogue: A Journal of Mormon Thought* 28 (Summer 1995): 93-99.

38. Lester E. Bush, Jr., *Health and Medicine Among the Latter-day Saints* (New York: Crossroad, 1993), 152-59; Smith, *Doctrines*, 2:87; Ezra Taft Benson, *Conference Report*, Apr. 1969, 10-15; Mark E. Petersen, *The Way to Peace* (Salt Lake City: Bookcraft, 1969), 266; *Encyclopedia*, 1:116-17.

39. John Bongaarts, "Can the Growing Human Population Feed Itself?" *Scientific American* 270 (Mar. 1994): 36-43.

40. Eugene Linden, "Showdown in Cairo," *Time* 144 (4 Sept. 1994): 52-53.

41. Philip Elmer-Dewitt, "The Genetic Revolution," *Time* 143 (17 Jan. 1994): 46-57.

42. Bush, *Health and Medicine*, 159-67; *Encyclopedia*, 1:7.

43. Philip Elmer-Dewitt, "Cloning: Where Do We Draw the Line," *Time* 142 (8 Nov. 1993): 64-67.

cies by genetic engineering.[44] What are the implications of such new technologies for traditional LDS teachings about *a priori* spirit creations in the pre-existence?

4. Even though there have been advances in medical technology during the twentieth century, the pace of progress is likely to accelerate during the twenty-first. While these developments will be a boon to the majority of humankind, they are certain to pose more and more dilemmas in prolonging the lives of terminally ill patients.[45]

What portion of our resources should be devoted to extending the lives of those who at best have only a few months left, as opposed to measures that will improve the quality of life for others? When does meaningful life end? When should "the plug be pulled"? Is euthanasia ever warranted? Is a "brain-dead" person still alive in the LDS sense of being inhabited by a spirit? At the present time the church condemns any form of euthanasia, although it permits artificial life support systems to be disconnected after prayerful consideration.[46]

5. Recently scientists have found evidence that homosexuality is very probably partly determined by heredity and other biological factors. Other scientists vigorously contest this evidence.[47] Historically the church has regarded homosexuality as a sinful choice, although its current official position no longer condemns homosexual *orientation per se*.[48] If the evidence for a biological connection grows stronger, how should the church respond? How might such developments affect the church's policy towards same-sex marriages?

6. There are striking similarities between humans and certain animals, particularly primates, not only in anatomy, but also in behavior. Some animals have even been taught to use rudimentary language.[49] To what extent can animals think? What distinguishes us from the animal kingdom? How much of human behavior derives from an evolutionary past? How much of our "darker" nature can be overcome by individual

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44. Richard Stone, "Religious Leaders Oppose Patenting Genes and Animals," *Science* 268 (26 May 1995): 1126; Kenneth L. Woodward, "Thou Shalt Not Patent!" *Newsweek*, 29 May 1995, 68-69.

45. C. Everett Koop and Timothy Johnson, *Let's Talk—An Honest Conversation on Critical Issues* (Grand Rapids, MI: Zondervan Press, 1992), 39-60.

46. Bush, *Health and Medicine*, 36-39; *Encyclopedia*, 3:1159-60.

47. Simon LeVay and Dean H. Hamer, "Evidence for a Biological Influence in Male Homosexuality," *Scientific American* 270 (June 1994): 44-49; William Byne, "The Biological Evidence Challenged," *Scientific American* 270 (June 1994): 50-55; Larry Thompson, "Search for a Gay Gene," *Time* 145 (12 June 1995): 60-61.

48. Bush, *Health and Medicine*, 173-78; Benson, *Teachings*, 280; Spencer W. Kimball, *The Miracle of Forgiveness* (Salt Lake City: Bookcraft, 1969), 78-89; *Encyclopedia*, 2:655-56.

49. Carl Sagan and Ann Druyan, *Shadows of Forgotten Ancestors* (New York: Random House, 1992); Eugene Winden, "Can Animals Think?" *Time* 141 (22 Mar. 1993): 54-63.

agency? Can scientific research offer perspectives on the eternal struggle between good and evil? Would such findings be acknowledged or accepted by the church?

7. The "big bang" cosmological theory is the currently accepted model for the origin and evolution of the universe, although some questions remain regarding its evolution since then.[50] How can the notion of a finite age universe be accommodated in LDS doctrine, which has historically taught that matter is eternal, and which has favored a steady-state cosmology? Was God the architect of the universe at the big bang? Does God exist in time and space, as a physical member of this universe, or does he exist elsewhere, beyond time and space?[51] If he exists beyond time and space, how can he influence our present world?

8. Current formulations of the big bang cosmology seem to indicate that the fundamental laws of physics are exquisitely tuned to permit the existence of matter, stars, and sentient beings.[52] Are these facts evidence of the existence of a creator, or are there other, more prosaic explanations? Why does the universe exist at all? Why is there something and not nothing?[53]

9. Quantum theory, a cornerstone of modern physics, draws into question our basic notions of reality and causality. One of its assertions, that there is a fundamental uncertainty in all physical measurements, has been solidly confirmed in a number of experiments.[54] Furthermore, the emerging field of chaos theory tells us that many physical processes exhibit the "butterfly" property: an arbitrarily small change to present conditions can dramatically affect the future state of the system.[55] Thus there appear to be fundamental limits to our ability to predict future events.

How can God's foreknowledge and the principle of prophecy be interpreted in light of them? Do these theories shed any light on the princi-

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50. Corey S. Powell, "The Golden Age of Cosmology," *Scientific American* 267 (July 1992): 17-22; R. Cowen, "Hubble Telescope Eyes a Younger Universe," *Science News* 146 (29 Oct. 1994): 278; Michael D. Lemonick and J. Madeleine Nash, "Unraveling Universe," *Time* 145 (6 Mar. 1995): 77-84.

51. Robert Wright, "Science, God and Man," *Time* 140 (28 Dec. 1992): 38-44; Paul Davies, *God and the New Physics* (New York: Simon and Schuster, 1983).

52. Paul Davies, *The Accidental Universe* (New York: Cambridge University Press, 1982); John D. Barrow and Frank J. Tipler, *The Anthropic Cosmological Principle* (New York: Oxford University Press, 1986); Steven Weinberg, "Life in the Universe," *Scientific American* 271 (Oct. 1994): 44-49.

53. Andrei Linde, "The Self-Reproducing Inflationary Universe," *Scientific American* 271 (Nov. 1994): 48-55; Paul Davies, *The Mind of God* (New York: Touchstone, 1992), 39-72, 161-93; Steven Hawking, *A Brief History of Time* (New York: Doubleday, 1988).

54. Abner Shimony, "The Reality of the Quantum World," *Scientific American* 258 (Jan. 1988): 46-53.

55. James Gleick, *Chaos: Making a New Science* (New York: Viking Penguin, 1987).

ple of free agency?[56]

10. As noted above, LDS literature, especially in the nineteenth century, is replete with references to beings on other worlds. Indeed, many scientists have assumed that life must exist elsewhere, and they have investigated numerous scenarios for the detection of extra-terrestrial civilizations. Since at present the most reasonable approach appears to be the detection of microwave signals emitted by other societies, extensive astronomical searches of the microwave region of the electromagnetic spectrum are being conducted. Unfortunately, these and other scientific searches have so far turned up nothing.[57]

Are we alone? If not, where are these other beings? Is their biology based on carbon chemistry and DNA, like ours, or on a completely different biochemical system? How do they think, communicate, and govern themselves? What are their religious beliefs? If these searches continue to come up empty-handed, how might this affect LDS theological discourse? On the other hand, if intelligent life is detected elsewhere, how might this momentous discovery be accommodated, especially if that life turns out to have forms drastically unlike our image of God?

11. Many people imagine that the work of a mathematician largely consists of repetitive and mechanical manipulations of mathematical expressions. In fact, the process of mathematical discovery is usually a highly intuitive process, with deep abstract contemplation followed by sudden bursts of brilliant insight. Often it takes months after this flash of insight to work out all the technical details.[58]

How is it possible to sense intuitively the outcome of a long train of abstract and difficult mathematical reasoning? If, as many philosophers believe, mathematical truths exist independent of the universe, human beings, and our particular physiology, how can our minds discover them? Is religious revelation another manifestation of this process? If so, what can be learned about revelation? Why does the universe appear to be governed by profound and elegant mathematical laws?[59]

12. A far-reaching discovery by twentieth-century mathematician Kurt Godel rules out the possibility of proving the logical consistency or completeness of formal mathematics. In other words, we can never be ab-

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56. See David B. Timmins, "Free Agency, Determinism, and Chaos Theory," *Dialogue: A Journal of Mormon Thought* 28 (Fall 1995): 163-70.

57. Barrow and Tipler, 576-612; Paul, 193-227; Carl Sagan, "The Search for Extraterrestrial Life," *Scientific American* 271 (Oct. 1994): 92-99; Carl Sagan, *Pale Blue Dot: A Vision of the Human Future in Space* (New York: Random House, 1994), 351-65.

58. John D. Barrow, *Pi in the Sky: Counting, Thinking and Being* (New York: Little Brown and Co., 1992); Robert Kanigel, *The Man Who Knew Infinity* (New York: Washington Square Press, 1992); Barry Cipra, "Princeton Mathematician Looks Back on Fermat Proof," *Science* 268 (26 May 1995): 1133-34.

59. Davies, *Mind*, 140-60.

solutely certain that the basic axioms used in mathematics are logically consistent; and even if we assume that they are, there will always be questions which cannot be answered either affirmatively or negatively.[60] In the field of fundamental particle physics, we already are pressing the limits of our ability to construct (and society's willingness to pay for) experiments that can decide among competing theories. Although some scientists remain optimistic that we will soon discover a "final theory," it may be that we will be forever frustrated in this quest. In any event, we can never be absolutely certain that we completely understand the fundamental laws of the universe or that our formulation of them is the most elegant possible.[61]

In other words, even in the two most "certain" and "precise" of the sciences, absolute certainty appears forever out of reach, and there may be questions which can never be conclusively answered. Do these principles have analogies in theology? Is God's knowledge limited in this manner?

13. In recent years some scientists have speculated on the possibility of immortality, proposing various scientific scenarios for how this might be achieved. Some suggest that advances in technology predicted for the next few decades will result, among other things, in medicines that slow or even reverse the aging process. Others look forward to a time when humanity will free itself from its historic reliance on flesh, blood, and brainpower.[62] To what extent can doctrines such as immortality be submitted to scientific examination? Do LDS scriptures and literature offer insight into these questions?

14. The phenomenon of human consciousness is being investigated by biologists, psychologists, physicists, philosophers, and even computer scientists. Some argue that it is fundamentally impossible to model or understand consciousness, while others dismiss such arguments and say that it is only a matter of time before computers can realistically model human thought.[63] What exactly is human consciousness? What is the relationship between consciousness and the "soul" or "spirit" in LDS theology?

15. If the breathtaking pace of scientific and technological advancement of the past half-century is any clue, we will see new and intriguing developments in the twenty-first century that can now be only dimly

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60. Barrow, *Pi*; Douglas R. Hofstadter, *Godel, Escher, Bach: An Eternal Golden Braid* (New York: Random House, 1979).

61. Steven Weinberg, *Dreams of a Final Theory* (New York: Vintage Books, 1994); John Horgan, "Particle Metaphysics," *Scientific American* 270 (Feb. 1994): 96-106; David Lindley, *The End of Physics* (New York: Basic Books, 1993); Davies, *Mind*.

62. K. Eric Drexler, *Engines of Creation: The Coming Era of Nanotechnology* (New York: Doubleday, 1990); Marvin Minsky, "Will Robots Inherit the Earth?" *Scientific American* 271 (Oct. 1994): 108-13; Frank J. Tipler, *The Physics of Immortality* (New York: Doubleday, 1994).

63. Barrow, *Pi*; Hofstadter, *Godel*; Minsky, "Robots"; Tipler, *Immortality*; John Horgan, "Can Science Explain Consciousness?" *Scientific American* 271 (July 1994): 88-94.

imagined. How well will the LDS church cope with these advances?

The Challenge of Science

Conflicts between science and religion are as old as recorded history. In the sixth century B.C.E. a mathematician in the Pythagorean philosophical school was able to prove that the diagonal of a square is incommensurate with its sides. In our modern mathematical terminology we would say he proved that the square root of two is an irrational number: it cannot be expressed exactly as the ratio of two whole numbers. This discovery precipitated a major crisis for the Pythagorean school and its numerology-based religion, since one of its fundamental beliefs was the assumption that all reality could be described by using whole numbers. The school reportedly drowned one of its number who publicly discussed this unsettling discovery.[64]

In the Middle Ages growing exposure to ancient Greek and Middle Eastern writings caused considerable consternation among medieval Christian theologians. As a single incredible example, theologians were once disturbed at the discrepancy between the biblical value of the ratio between the circumference and diameter of a circle, namely 3.0 (based on the dimensions of the circular pool in King Solomon's temple [1 Kgs. 7:23; 2 Chron. 4:2]), and the more accurate values (approximately 3.14159) obtained by mathematicians in ancient Greece and medieval Europe. As late as the eighteenth century Bible commentators were still attempting to explain away this discrepancy, using such imaginative dodges as speculating that the circular pool in Solomon's temple was really hexagonal in shape.[65]

The most serious challenge of the expanding corpus of scientific knowledge was to the geocentric, flat-earth cosmology that had been assumed in the Judeo-Christian world for centuries. Many Christian scholars, who noted the numerous instances in the Bible of the "four corners," the "foundations," the "pillars," and the "ends" of the earth (see 1 Sam. 2:8; 2 Sam. 22:16; Job 28:24, 38:4; Ps. 75:3, 102:25; Isa. 11:12; Heb. 1:10; Rev. 7:1), could not see how these scriptures could be reconciled with the scientific notion of a spherical earth. The last straw for these theologians was Copernicus's heliocentric cosmology, in which the earth was but one of several planets orbiting the sun. Many felt that this cosmology was so clearly incompatible with numerous biblical scriptures (see Josh.

64. Bertrand Russell, *Wisdom of the West* (London: Crescent Books, 1959), 22; D. W. Hamlyn, *A History of Western Philosophy* (New York: Viking Penguin, 1987), 18-19.

65. Petr Beckmann, *A History of Pi* (New York: St. Martin's Press, 1971), 75-76. Beckmann references a seven-volume history of mathematics, in German, by Jerome Tropfke, published in 1923. Tropfke in turn quotes original eighteenth-century sources.

10:12-13; Job 9:6-7; Ps. 93:1, 104:5; Eccl. 1:5; Amos 8:9) that both the Bible and the church would lose their authority if it prevailed. The Jesuits considered the theory more dangerous than the heresies of Luther and Calvin. The Inquisition forced Galileo to recant his arguments in support of it.[66] Martin Luther, who taught that the Bible was the infallible word of God, rejected the Copernican theory because Joshua commanded the sun, not the earth, to stand still (Josh. 10:12-13).[67] In the nineteenth century similar warnings were voiced in Catholic and Protestant circles about Darwin's theory of evolution. The same is true to a lesser extent in the twentieth century about theories such as the "big bang."

If there is a lesson to be learned from these examples, it is that scientific challenges which may seem to present insuperable difficulties for religious faith in one era are almost always found to be compatible with faith in another. The Bible today still contains the many passages that reflect the geocentric, flat-earth cosmology of antiquity; yet only the most ardent literalists lose sleep over them. It is now widely appreciated that the writers of the Bible wrote from their own world view, often in a poetic style, and no one expects that they could have anticipated every principle of modern science. Similarly, while many are still uncomfortable with the theory of evolution, others now view it as an elegant and effective mechanism used by God in the process of creation. Some further argue that any attempt to read the scriptures as scientific documents, against the intent of the original writers, only obscures the deeper spiritual messages contained in them.[68]

How can the LDS church best cope with the challenges of science during the next century? Some Mormons may dismiss such issues, believing that the second coming of Jesus Christ will occur soon after the turn of the century, thus rendering these issues moot. But others note scriptures such as Matthew 24:36 and conclude that we must face these issues.

On one hand, it seems clear that if the church adopts, even implicitly, a strict, fundamentalist approach, with a rigid creed that precludes a harmony between science and religion, then it risks losing many educated members, especially in developed countries like the U.S., Canada, Europe, and Japan. Particularly at risk are young Latter-day Saints at colleges and universities, who usually lack the sophistication to see beyond superficial conflicts to the deeper issues. The tensions that many of these

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66. Will and Ariel Durant, *The Story of Civilization* (New York: Simon and Schuster, 1961), 7:600-12.

67. Ibid., 6:858.

68. Keith E. Norman, "Adam's Navel," *Dialogue: A Journal of Mormon Thought* 21 (Summer 1988): 81-97; Karen Armstrong, *A History of God* (New York: Knopf, 1993), 395; John S. Spong, *Rescuing the Bible from Fundamentalism* (New York: Harper, 1991), 25-36.

students now experience will only increase if they are required to choose between the increasingly dominant world of scientific knowledge and a narrowly defined religious orthodoxy.

For example, recently there has been an explosion of scientific discoveries in molecular biology and evolution. These include DNA computing,[69] the recovery and analysis of ancient dinosaur DNA fragments,[70] the resuscitation of 25-million-year-old microbial spores,[71] and the tracing of modern humans to a common ancestor of 270,000 years ago.[72] Among other things, such developments herald a new era in biological research, one that Darwin in his wildest dreams might not have imagined possible: the direct study of the course of evolution (including human evolution) at the DNA level through eons of time. Imagine the dilemma faced by a young college student, particularly one with aspirations for a scientific career, who is bombarded by news of these exciting discoveries in the academic environment but hears only creationist doctrines and somber warnings of the dangers of science in his/her church environment. Fortunately, as mentioned, there are indications that the scriptural literalism which has dominated LDS science discourse in recent decades may be giving way to a more open-ended approach. It remains to be seen, however, if this approach will be truly acceptable to church leaders or rank-and-file members, many of whom have adopted a highly literal understanding of scripture.

On the other hand, an isolationist approach appears equally doomed to failure in a world increasingly pervaded by science and technology. Some separation of science and religion is certainly appropriate: surely there is no point in the church's delving into matters which are largely irrelevant to its theology or which are still highly tentative from a scientific point of view. Even in most other cases it may well be best for the church simply to remain silent. It is certainly unwise for anyone in the church to make seemingly "final" statements about anything in the ever-expanding world of scientific knowledge.

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69. Leonard M. Adleman, "Molecular Computation of Solutions to Combinatorial Problems," *Science* 266 (11 Nov. 1994): 1021-23; Robert Pool, "A Boom in Plans for DNA Computing," *Science* 268 (28 Apr. 1995): 498-99.

70. Richard Monastersky, "Dinosaur DNA: Is the Race Finally Over?" *Science News* 146 (19 Nov. 1994): 324; Ann Gibbons, "Possible Dino DNA Find Is Greeted with Skepticism," *Science* 266 (18 Nov. 1994): 1159. The researcher here is Scott Woodward of BYU.

71. Raul J. Cano and Monica K. Borucki, "Revival and Identification of Bacterial Spores in 25- to 40-Million-Year-Old Dominican Amber," *Science* 268 (19 May 1995): 1060-64; J. Madeline Nash, "Return of the Living Dead?" *Time* 145 (29 May 1995): 55-56.

72. Svante Paabo, "The Y Chromosome and the Origin of All of Us (Men)," *Science* 268 (26 May 1995): 1141-42; Robert L. Dorit, Hiroshi Akashi, and Walter Gilbert, "Absence of Polymorphism at the ZFY Locus on the Human Y Chromosome," *Science* 268 (26 May 1995): 1183-85.

Yet if Mormonism is isolated from science, or if meaningful discussion of scientific topics is ruled off-limits in the church, then it risks being viewed as sterile and irrelevant. Widtsoe warned about such an isolationist approach: "Scientific truth cannot be theological lie. To the sane mind, theology and philosophy must harmonize. They have the common ground of truth on which to meet."[73] In a similar vein physicist-theologian Frank J. Tipler recently warned, "If religion is permanently separated from science, then it is permanently separated from humanity and all of humanity's concerns. Thus separated, it will disappear."[74] Thus one hopes that the church and its members will steer a middle course, applying their collective gifts of intelligence and inspiration to careful consideration of these matters and their significance for the LDS faith. Certainly LDS scientists must participate in this dialogue. We thus look forward to an improvement, as we enter the next century, in the intellectual atmosphere that heretofore has often seemed so tense.

Fortunately, the church has one important advantage over many other religious denominations in dealing with the challenges of science: its fundamental belief in continuing revelation, as declared in the ninth Article of Faith. One implication of this principle is that current church teachings at any given point in time should never be considered final, absolute, complete, or infallible. Instead, they should be considered as representing the best present understanding and certainly subject to change as knowledge and understanding grow.

Conclusion

An ancient Chinese curse holds: "May you live in interesting times." Clearly we find ourselves living in "interesting times" today. For every scientific development that seems to pose a difficult challenge to religion in general and to the LDS religion in particular, another suggests that genuine faith can be successfully enlarged to accommodate modern scientific discoveries, with both science and religion being enriched in the process. As religious historian Karen Armstrong observed: "In our scientific age, we cannot think about God in the same way as our forebears, but the challenge of science could help us to appreciate some old truths."[75] In fact, there is sublime, spiritually-rewarding pleasure in discovering truths previously known only to God. Perhaps it is a good thing that he always holds some of the most fascinating and fundamental truths just beyond our research so that we always have something to seek for and wonder about. Perhaps within our lifetimes we will be able to an-

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73. John A. Widtsoe, *Joseph Smith as Scientist* (Salt Lake City: Bookcraft, 1964), 156.
74. Tipler, *Immortality*, 332.
75. Armstrong, 395.

swer some of the above questions of science and religion. If so, then we will come one step closer to "knowing the mind of God."[76]

76. See Hawking, 175; and Davies, *Mind of God*.