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Astronomy and the Creation in the Book of Abraham

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ASTRONOMY AND THE CREATION IN THE BOOK OF ABRAHAM

Michael D. Rhodes and J. Ward Moody

The Book of Abraham is unique among the books of scripture now in our possession in that it contains a description not only of this earth but also of some of the other planets and stellar systems of our Father in Heaven's creations. It is, in a limited sense at least, a divine textbook of astronomy. Also, the account of the creation in the Book of Abraham contains many unique and important insights into the creation process, which supplement the other scriptural accounts we have. As we try to understand what the Book of Abraham tells us about astronomy and the creation, we will also refer to other relevant scriptural accounts of visions of God's creations given to prophets such as Enoch, Moses, and Joseph Smith, since most often the best explanation of a given scriptural passage comes from another passage of scripture. Our purpose is to try to understand the eternal truths about astronomy and the creation that God revealed to Abraham and these other prophets. We then want to compare the information thus obtained with the findings of modern science. This attempt is made with the explicit faith that the truths of revealed religion will agree with the truths of science. As Brigham Young said, "The idea that the religion of Christ is one thing, and science is another, is a mistaken idea, for there is no true religion without true science, and consequently there is no true science without true religion."¹

The emphasis, of course, must be on *true* science and *true* religion. When there seems to be a conflict between the two, obviously the revealed word of God must take precedence. As President Harold B. Lee said, "In all your learning, measure it and test it by the white light of truth revealed

1. *Journal of Discourses*, 17:53. The authors would like to especially thank Professor Scott Woodward of the Department of Microbiology at Brigham Young University, Professor Larry Dahl of the Department of Church History and Doctrine at Brigham Young University, and Professor John Gee of the Institute for the Study and Preservation of Ancient Religious Texts for their critical reading of early drafts of this paper and their many helpful suggestions.

to the prophets of God and you will never be lead astray.”² We must, however, also be careful in our interpretation of revealed truth. We must not wrest the scriptures, as Peter warns (2 Peter 3:16), and try to draw conclusions from them that are not warranted. We need a humble recognition of the limitations of our interpretive ability of both scripture and science. Dogmatism, pride, and prejudice can all get in the way. Above all, without the inspiration and guidance of the Holy Ghost, we can never come to an understanding of truth.³ As Moroni said, by the power of the Holy Ghost we can know the truth of all things (Moroni 10:5).

Thus, the basic principles governing this study are the following:

- The truths of revealed religion will agree with the truths of science.
- Emphasis must be on *true* religion and *true* science.
- The revealed word of God takes precedence.
- A humble recognition of our interpretive ability in both science and religion is required.
- We must rely on the inspiration of the Holy Ghost.

With these principles in mind then, let us look first at Abrahamic astronomy and then the creation.

Astronomy 101 at the University of Kolob (Abraham 3:1–17)

Abraham said that his knowledge of astronomy came from three different sources: first, from the records of the fathers (Abraham 1:31); second, through the Urim and Thummim (Abraham 3:4); and third, by direct revelation, face to face with the Lord (Abraham 3:12). This astronomical knowledge included the following concepts:

- There are many stars and planets—so many that Abraham could not see an end to them all (Abraham 3:9, 12).⁴
- Stars are not just points of light, but are in fact revolving bodies that vary in greatness (Abraham 3:3–4, 10, 16).
- There are also other planets like the earth, which are “governed” by these stars (Abraham 3:8–9).
- All these planets and stars are organized into groups, with a star that “governs” them (Abraham 3:3, 8–9; explanation of figure 5 of Facsimile 2).
- The governing star for those planets that are of the “same order” as the earth is Kolob, so named because it is nearest the throne of God (Abraham 3:2–3, 9).
- Time—years, seasons, months, and days—for each of these stars or planets is different and is reckoned according to that body’s revolutions (Abraham 3:4–5, 9).

Let us now look in more detail at the Book of Abraham’s teachings on astronomy in the light of present-day astronomical knowledge.

2. Harold B. Lee, *The Teachings of Harold B. Lee*, ed. Clyde J. Williams (Salt Lake City: Bookcraft, 1996), 341.

3. Perhaps the best definition of truth is found in D&C 93:24, “And truth is knowledge of things as they are, and as they were, and as they are to come.”

4. It seems that Abraham is making the same distinction between a star and a planet as we now do. A star is a large gaseous body consisting mostly of hydrogen, which shines by means of the nuclear fusion of hydrogen into helium. A planet is a smaller body that does not produce its own light but is visible due to the reflected light of a star.

Innumerable Stars and Stellar Systems

Abraham said, “I saw those things which his hands had made, which were many; and they multiplied before mine eyes, and I could not see the end thereof” (Abraham 3:12). This is more than just looking up into the night sky. The word *multiplied* implies that more and more stars are constantly coming into Abraham’s view as the vastness of God’s creations is unfolded to his view. On a clear night, far from city lights, around three thousand to five thousand stars are visible. The ancients were aware of this. For example, one Egyptian designation for the starry night sky was *ḥ3-b3=s*, literally, “a thousand are her souls” referring to the number of visible stars.⁵ And while several thousand stars are a lot, “the end thereof” can be seen. God refers to the immensity of his creations when he says to Moses, “worlds without number have I created” (Moses 1:33). The ancient prophet Enoch also said, “Were it possible that man could number the particles of the earth, yea, millions of earths like this, it would not be a beginning to the number of thy creations” (Moses 7:30).

It is only within the twentieth and twenty-first centuries that science has obtained observational evidence of the vastness of the universe in which we live. Our own galaxy, the Milky Way, consists of about 100 billion stars, and it is itself part of a group of some twenty galaxies called the Local Group.⁶ This Local Group is in turn part of a supercluster of galaxies. Finally, the observable universe itself is made up of large numbers of superclusters separated by voids in which there are few galaxies.⁷ This structure of superclusters and voids extends out to the limit of visibility of our present telescopes—some 15 billion light years,⁸ and there are at least 100 billion galaxies in the visible universe.⁹ This is a vastness that is difficult to even begin to comprehend. But even with this innumerable host of stars and worlds, God assures us that although they are innumerable to man, they all “are numbered unto me, for they are mine and I know them” (Moses 1:35). And the most miraculous part of all is that this incredibly vast panorama of worlds, stars, and galaxies exists for the express purpose of bringing about “the immortality and eternal life of man” (Moses 1:39).

Additional insight into stars and planets is revealed in the Book of Moses. The Lord told Moses that many worlds had already passed away (Moses 1:35)—presumably this means passed through their mortal stage of existence and moved on to immortal worlds, as will happen with our own earth (D&C 130:9). Modern astronomers have come to realize that stars and planets do pass away, evidence of which is all around us. We see the birth of stars in dense stellar nebulae as well as the spectacular and violent deaths of stars in supernovae, where a single star gives off as much light as an entire galaxy.

Modern astronomy has opened up to our view in ways not formerly possible the incredible vastness and variety of God’s creations. Abraham saw ordered groupings of stars and planets,

5. Raymond O. Faulkner, *A Concise Dictionary of Middle Egyptian* (Oxford: Griffith Institute, 1962), 184.

6. Michael Zeilik, Stephen A. Gregory, and Elske v. P. Smith, *Introductory Astronomy and Astrophysics*. 3rd ed. (New York: Saunders College Publishing, 1992), 439–40.

7. *Ibid.*, 446–47.

8. A light year is the distance that light travels in one year at a velocity of 300,000 kilometers per second, about 9,460,000,000,000 kilometers. The nearest star, Proxima Centauri, is 4.36 light years away.

9. Cesare Emiliani, *The Scientific Companion* (New York: John Wiley & Sons, 1988), 6.

and today we recognize that stars and planets are indeed grouped together in stellar systems, galaxies, clusters, superclusters, etc. As for extrasolar planets, it is only in the last few years that astronomers have obtained direct evidence for planets around some of the closest stars. There are now eighty-seven confirmed extrasolar planets around main sequence stars, with new ones being found frequently. Thus we have modern scientific confirmation of the orderly groupings of stars and planets, and the existence of extrasolar planets—things that were revealed to Abraham some three millennia ago.

Will the Real Kolob Please Stand Up!

What about Kolob? What is it? Where is it located? First let us look at exactly what the Book of Abraham tells us about Kolob:

1. Kolob is a star (Abraham 3:2, 16).
2. It appears to be part of the first stellar system created by God (explanation of figure 1 of Facsimile 2).
3. It is called Kolob because it is nearest the throne of God (Abraham 3:3, 9, 16; explanation of figure 1 of Facsimile 2).
4. It is the greatest of the stars Abraham saw (Abraham 3:16).
5. The Lord reckons his time by Kolob, one day being one thousand of our years (Abraham 3:4, 9; explanation of figure 1 of Facsimile 2).
6. Kolob “governs” all those planets that belong to “the same order” as the earth (Abraham 3:3, 9; explanation of figure 5 of Facsimile 2).
7. Kolob gives “light” to the earth, the sun, the moon, and fifteen other “fixed planets or stars” (explanation of figure 5 of Facsimile 2).

Some have assumed that “governing” means gravitational attraction, but this brings with it a problem, because more massive stars have a stronger gravitational attraction but also a shorter lifetime. Our sun, for example, is an average star with an approximate lifetime of ten billion years (about five billion of which have already passed). The smallest stars have a mass of about 1/10th that of the sun with lifetimes of trillions of years, while the largest are more than 100 times its mass, with lifetimes of only a few million years. Based on the assumption that “governing” means gravitational attraction, there have been various guesses as to the location of Kolob. These have ranged from the star Alcyone in the Pleiades¹⁰ to the center of our own galaxy.¹¹ However, recent observations have shown that rather than a star, there is a supermassive black hole at the center of our galaxy. Moving further out, one could suggest the “Great Attractor” of some 5×10^{16} solar masses, the gravitational center of the supercluster to which our galaxy belongs.¹² Unfortunately, the direction in which it lies is in the plane of our galaxy, and the intervening dust makes it impossible to see, so we do not know exactly what is located there, although observations in the infrared indicate a cluster of galaxies is there.

10. George Reynolds and Janne M. Sjodahl, *Commentary on the Pearl of Great Price* (Salt Lake City: Deseret News Press, 1965), 267.

11. J. Reuben Clark Jr., “Kolob—The Governor,” (unpublished manuscript, 1958).

12. Zeilik et al., *Introductory Astronomy*, 451.

Of course *govern* does not have to refer to gravitational attraction. It could be taken in a more abstract sense—Kolob is the center of priesthood authority over worlds like ours. If that is the case, another possibility could be that God does not dwell in this universe at all. All around us we see evidence of the second law of thermodynamics in action.¹³ Stars burn up their fuel and either slowly cool or explode as supernovas, depending on their initial mass. In other words, we see a mortal, fallen universe where everything is moving from a more ordered to a less ordered state. The state into which all living things and the earth itself eventually will enter is immortal and eternal (D&C 76:62; 77:1; 130:9). God and all immortal, resurrected beings may dwell in a separate universe where decay and corruption do not exist. The bottom line is that we simply do not have enough information to be able to say with any confidence where Kolob is or what its characteristics are.

Reckoning of Time

But whatever and wherever Kolob might be, God calls it a star (Abraham 3:16), the one “nearest unto the throne of God” (Abraham 3:2). God tells Abraham that the Lord’s time can be reckoned according to the reckoning of Kolob, and that “one revolution [of Kolob] was a day unto the Lord, after his manner of reckoning” (Abraham 3:4), it being equal to one thousand of our years. Although the term *day* can refer to an indeterminate amount of time (e.g., “in my father’s day, things were different”), it most commonly means the time for the sun to traverse or “revolve” once around in the sky, and this seems to be how the Lord is using it in this passage. He is telling Abraham that Kolob also traverses the sky from the Lord’s point of view, taking one thousand years to complete this revolution. We can conclude then that God dwells on a celestialized world (cf. D&C 130:4–8) that is orbiting near the star Kolob. The “revolution” thus described would be the rotation of that world about its axis, which has a period of one thousand earth years. Consequently, from the surface of that world, the star Kolob would be seen to rise and set once every one thousand of our years.

Next, God explained to Abraham how the reckoning of time of a given planet is dependent upon the motions of that planet (Abraham 3:5–9). A day for someone dwelling on the earth is determined by the rising and setting of the sun, a month by one complete phase of the moon, and a year by the return of the sun to its starting point on the ecliptic (the apparent yearly path of the sun with respect to the stars). These are all the result of the combination of the rotation of the earth about its axis, the moon’s orbit about the earth, and the earth’s orbit about the sun—“revolutions” as Abraham calls them. So the “set time” of the moon is “longer” than the reckoning of time for the earth (Abraham 3:7). The moon moves “in order more slow . . . therefore the reckoning of its time is not so many as to its number of days, and of months, and of years” (Abraham 3:5). Since the moon rotates more slowly on its axis, its time reckoning is longer than that of the earth. The Lord went on to explain that just as the reckoning of time for the moon is longer than that of the earth, so there are other planets with even longer time reckonings, and this continues until you come to the Kolob star system where God dwells (Abraham 3:8–9). All the statements about time in Abraham 3 can be understood in a self-consistent fashion if they are taken to refer to the rotational and orbital motions of the planets. However, we must interpret them in the general sense

13. The second law of thermodynamics states that in any closed system, entropy (disorder) is always increasing.

of perhaps teaching Abraham basic facts of the movement of the earth and planets, and that each one possesses a unique manner of motion, instead of establishing a specific cosmology that links our solar system to Kolob. No one of Abraham's day would have known these things, and the Lord revealed them to Abraham so he could better understand God's creations.

Systems of Astronomy

One question that has arisen in studies of the astronomy of the Book of Abraham concerns the assumed point of view. Heliocentric (or sun centered),¹⁴ geocentric (or earth centered),¹⁵ and even Pythagorean¹⁶ have been suggested. The prevailing view of astronomy at the time of Abraham was geocentric, and at least some of what is described in Abraham chapter 3 can be viewed from a geocentric position. Understanding a geocentric perspective would have helped Abraham in presenting these things to the Egyptians (see Abraham 3:15 and the explanation to Facsimile 3). But there are also elements of the description the Lord gives to Abraham that argue against a geocentric system. For example, Kolob is said to "govern all those which belong to the same order as that upon which thou standest" (Abraham 3:3). In other words, Kolob governs many planets like the earth. The concept of a number of planets of "the same order" as the earth is incompatible with a geocentric point of view. If anything, it would be a Kolob-centric system. Moreover, the Lord showed Abraham the "things which his hands had made," stars and planets, which "multiplied" before his eyes until he could not see an end to them (Abraham 3:12). The Lord makes it clear to Abraham that the earth is anything but the center of the universe. The Lord certainly could and in fact did reveal to at least one other ancient prophet a more accurate perspective. In the Book of Mormon we read, "Surely it is the earth that moveth and not the sun" (Helaman 12:15).

It is especially important to recognize that Abraham's purpose in recording this astronomical knowledge was "for the benefit of my posterity that shall come after me" (Abraham 1:31)—it was not written for the Egyptians, but for us. What we then want to do, as Nephi said, is to "liken all scriptures unto" ourselves "for our profit and learning" (1 Nephi 19:23). In other words, we want to try to understand what Abraham is telling us on the basis of our own experience and knowledge. In describing these various stars and planets, the Lord kept stressing to Abraham that time—days, months, and years—is reckoned according to the rotational and orbital motions of the planet on which one resides. In terms of cosmological systems, this is neither a heliocentric nor a geocentric one. There is, in fact, no absolute reference frame for reckoning time—it depends on one's location.

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14. R. Grant Athay, "Worlds Without Number: The Astronomy of Enoch, Abraham, and Moses," *BYU Studies* 8/3 (1968): 255–69. R. Grant Athay, "Astrophysics and the Gospel," *New Era*, September 1972, 14–19. H. Kimball Hansen, "Astronomy and the Scriptures," *Science and Religion: Toward a More Useful Dialogue, Volume II—Background for Man: Preparation of the Earth*, ed. Wilford M. Hess and Raymond T. Matheny (Geneva, IL: Paladin House Publishers, 1979), 181–96. Fred Holmstrom, "Astronomy and the Book of Abraham," in *Sydney B. Sperry Symposium, The Pearl of Great Price*, 30 January 1982 (Provo, Utah: BYU, CES, 1982), 105–16.
 15. See John Gee, William J. Hamblin, and Daniel C. Peterson, "And I Saw the Stars: The Book of Abraham and Ancient Geocentric Astronomy," in this volume.
 16. William E. Dibble, "The Book of Abraham and Pythagorean Astronomy," *Dialogue* 8/34 (1973), 135–37. In the Pythagorean system, the earth was thought to orbit not about the sun, but about a central fire. The sun, the moon, and the other five planets were also thought to orbit about this central fire.

Borrowed Light

One puzzling thing mentioned in the explanations to Facsimile 2 is that the sun borrows “its light from Kolob through the medium of Kae-e-vanrash, which is the grand Key, or, in other words, the governing power, which governs fifteen other fixed planets or stars, as also Floese or the Moon, the Earth and the Sun in their annual revolutions” (explanation to figure 5 of Facsimile 2). What it means to “borrow light” is not clear. The light of the sun is produced by the fusion of hydrogen atoms into helium in its core. Does this mean that the fusion reactions in the Sun are in some way controlled from Kolob? This passage seems to be a description of the Light of Christ which “proceedeth forth from the presence of God to fill the immensity of space” (D&C 88:12) and “is in the sun, and the light of the sun, and the power thereof by which it was made” (D&C 88:7) as well as the light and power of the earth, the moon, and the stars (D&C 88:8–10). This light is also said to be “the law by which all things are governed” (D&C 88:13).

In summary, as we have looked at the descriptions in the Book of Abraham concerning the creations of God—stars, planets, and the relationships between them—we have found that they appear to be consistent with modern scientific understanding of physics and astronomy. Moreover, they match modern concepts better than those of either the nineteenth century or ancient times.

The Creation

Let’s turn now to the creation account in Abraham. The Book of Abraham (and the other scriptures as well) makes clear that the creation was not simply a mechanistic unfolding of events driven by “natural law.” Rather, God played an intimate, integral, and continuous part in the creation—he didn’t just “wind the clock” at the beginning and stand back and let things develop on their own. There are numerous examples from the scriptures that describe God’s personal involvement in the creation. For example, when the Lord tells Moses of the vastness of his creations, he says, “innumerable are they unto man; but all things are numbered unto me, for they are mine and I know them” (Moses 1:35). Christ taught of God’s individual concern, not only for his children, but even for animals: “Are not five sparrows sold for two farthings, and not one of them is forgotten before God? But even the very hairs of your head are all numbered. Fear not therefore: ye are of more value than many sparrows” (Luke 12:6–7). God’s omnipotence and omniscience does not prevent him from having a personal and detailed interest and involvement in all his creations.¹⁷

God makes it clear to Abraham that the earth and its solar system are not created out of nothing, but out of existing matter: “We will go down, for there is space there, and we will take of these materials, and we will make an earth whereon these may dwell” (Abraham 3:24). The Lord explicitly told Joseph Smith that “the elements are eternal” (D&C 93:33). Moreover, “there is no such thing as immaterial matter. All spirit is matter, but it is more fine or pure” (D&C 131:7). Thus the elements, the building blocks of the creation, have always existed. There is no such thing as creation out of nothing. Intelligences are also eternal and uncreated; they “have no beginning; they existed before, they shall have no end, they shall exist after, for they are gnolaum, or eternal” (Abraham 3:18). Spirit matter is also eternal and self-existent (D&C 131:7). Thus God’s creative work involves

17. Elder Neal A. Maxwell discusses this at length in “Our Creator’s Cosmos,” *The Religious Educator*, 3/2 (2002).

organizing three eternally existing constituents: physical matter (D&C 93:33), spirit matter (D&C 131:7), and intelligences (D&C 93:29, Abraham 3:18). To these could be added energy, but that is simply another form of matter, as Einstein's well-known equation $E = mc^2$ makes clear. God organizes spirit matter into spirit bodies for intelligences (true for human beings as well as all living things); he organizes chaotic physical matter and energy to provide planets, stars, and physical bodies for all living things. At the beginning the Lord said, "We will take of these materials, and we will make an earth whereon these may dwell" (Abraham 3:24). The gods "prepared" the earth and the waters to bring forth life (Abraham 4:11, 20, 24), and they "watched those things which they had ordered until they obeyed" (Abraham 4:18). We get a picture of God carefully watching over all that is happening, fine-tuning and making adjustments as needed to ensure that all unfolds in accordance with his perfect design. A governing principle in all his work is agency—"All truth is independent in that sphere in which God has placed it, to act for itself, as all intelligence also; otherwise there is no existence" (D&C 93:30). The creation account in Abraham makes it clear that this principle of agency applies not only to mankind but to plants (Abraham 4:12), animals (Abraham 4:24–25), and even to what we would call inanimate matter, since "the Gods watched those things which they had ordered until they obeyed" (Abraham 4:18; see also Abraham 4:10). God thus organizes and arranges all things so as to fulfill his eternal purposes while still respecting the agency of all things.

In dealing with the creation, especially looking at it from a scientific standpoint, numerous questions arise. How long was each of the creative periods? What is the actual age of the earth? Was there death among plant and animal life before the fall of Adam? What are all these fossils of strange plants and animals that are no longer found on the earth? What about these manlike creatures that lived on the earth thousands or even millions of years ago? What about evolution? Before we address these issues, it is important to note what Elder Bruce R. McConkie said some years ago:

Our knowledge about the Creation is limited. We do not know the how and why and when of all things. Our finite limitations are such that we could not comprehend them if they were revealed to us in all their glory, fulness, and perfection. What has been revealed is that portion of the Lord's eternal word which we must believe and understand if we are to envision the truth about the Fall and the Atonement and thus become heirs of salvation. This is all we are obligated to know in our day.¹⁸

The words of Elder James E. Talmage are also applicable here:

Discrepancies that trouble us now will diminish as our knowledge of pertinent facts is extended. The Creator has made record in the rocks for man to decipher; but He has also spoken directly regarding the main stages of progress by which the earth has been brought to be what it is. The accounts cannot be fundamentally opposed; one cannot contradict the other; though man's interpretation of either may be at fault. . . . Let us not try to wrest the scriptures in an attempt to explain away what we cannot explain. The opening chapters of *Genesis*, and scriptures related thereto, were never intended as a textbook of geology, archeology, earth-science or man-science. Holy Scripture will endure, while the conceptions of men change with new discoveries. We do not show reverence for the scriptures when we misapply them through faulty interpretation.¹⁹

18. Bruce R. McConkie, "Christ and the Creation," *Ensign*, June 1982, 10.

19. James E. Talmage, "The Earth and Man," *The Instructor*, December 1965, 475.

In looking at the creation then, we must be humbly aware of our very limited knowledge. We must also recognize that the accounts of the creation we do have in the scriptures are in no way meant to be a scientific treatise on the subject; hence, we must be very careful in trying to apply modern scientific knowledge to the accounts. Also, we must not “wrest” the scriptures—twist meaning from them which is not really there. With these warnings in mind, let us first look at these questions about the creation. Then we will look at the actual creation account in detail.

How Long Were Each of the Creative Periods?

As Elder Widtsoe once pointed out, within the Church of Jesus Christ of Latter-day Saints there are at least three prevailing positions on the age of the earth: (1) each day of the creation was 24 hours, (2) each day of the creation was actually one thousand years, and (3) the creation of the earth extended over very long periods, the duration of which we do not yet accurately know.²⁰ Of the three, we adopt the last here—the creative periods were of very long duration, since this seems to best fit the present scientific evidence. The Abrahamic account of the creation also replaces the word *day* with *time* (Abraham 4:8, 13, 19, 23, 31). In fact, even in the Genesis account, the Hebrew word translated as “day” (יִום) can also mean “time” in a general sense.²¹ It also is important to note that the creative periods were not all necessarily of the same duration. As Elder McConkie observed, “Each day [of the creation] . . . has the duration needed for its purposes. . . . There is no revealed recitation specifying that each of the ‘six days’ involved in the Creation was of the same duration.”²² We thus assume that the creative periods described in the Abrahamic creation account are of very long periods of varying length.

What Is the Actual Age of the Earth?

The answer to this question is clearly related to how long the creative periods were. An added problem is the question of when the fall actually occurred, and whether there was death among plant and animal life before the fall. The traditional chronology of the Irish Anglican Archbishop James Ussher (b. 1581, d. 1656), places the fall at 4004 B.C. To arrive at this number, Ussher worked back from known dates using the data for births and deaths given for the various patriarchs in the text of the book of Genesis. Unfortunately these numbers are not consistent in the various manuscripts and versions of the Bible, and we have no way of knowing which, if any, of those that have come down to us are accurate. One interesting statement by the prophet Nephi, son of Helaman, in the Book of Mormon, seems to indicate that the fall may have occurred considerably earlier than 4000 B.C. Speaking around 20 B.C., he states, “there were many before the days of Abraham who were called by the order of God; yea, even after the order of his Son; and this that it should be shown unto the people, *a great many thousand years before his coming*, that even redemption should come unto them” (Helaman 8:18; emphasis added). Only 4,000 years before the coming of Christ does not seem to qualify as “a great many thousand years.”

20. John A. Widtsoe, *Evidences and Reconciliations* (Salt Lake City: Bookcraft, 1960), 146.

21. Francis Brown, S. R. Driver, and Charles A. Briggs, *A Hebrew and English Lexicon of the Old Testament* (Oxford: Oxford University Press, 1907), 399.

22. McConkie, “Christ and the Creation,” 11.

William W. Phelps, who worked as a scribe for Joseph Smith in his translation of the Book of Abraham, made this interesting statement in a letter to William Smith, the Prophet's brother (which was later published in the *Times and Seasons*): "Eternity, agreeably to the records found in the catacombs of Egypt, has been going on in this system, (not this world) almost *two thousand five hundred and fifty five millions of years*."²³ An age of 2,555,000,000 years is within an order of magnitude of present scientific estimates of the age of the solar system (around 4.6 billion years).

Scientists date the earth and the solar system using a variety of radiometric dating techniques. Radioactive isotopes of elements such as uranium, thorium, potassium, and carbon are unstable. Their radioactivity is the result of their nuclei giving off subatomic particles. As a given nucleus emits a particle, it decays, or changes into another element or isotope. Ultimately the nucleus reaches a point where it is stable and decays no longer. Uranium, for example, ultimately becomes lead. This radioactive decay occurs at a very predictable rate. The term *half-life* is used to describe this rate. It is the amount of time it takes half of all the atoms of a radioactive substance to decay. This varies considerably from element to element. For uranium 238 the half-life is 4.5 billion years, whereas carbon 14 has a half-life of only 5,730 years. Taking a sample of rock, a scientist can compare the ratio of the radioactive element to its nonradioactive end product in that rock and then calculate its age. The process is, of course, more complex than this, but that is the basic idea. Using such techniques, the oldest terrestrial rocks are estimated to be about 3.8 billion years old.²⁴ Since the earth is very active geologically and is subject to weathering, rocks from its earliest period will not have survived. On the moon, which is not geologically active and which has no weathering, the oldest rocks found there by the Apollo astronauts are around 4.2 billion years old. Radioactive dating of meteorites gives ages of 4.5 to 4.7 billion years.²⁵ All of this evidence taken together seems to point to the formation of the solar system and this earth around 4.6 billion years ago.

Was There Death among Plants and Animals before the Fall?

This is a question that has generated much discussion within the Church, with strong opinions held on both sides. In the late 1920s and early 1930s Elder B. H. Roberts, senior president of the First Council of Seventy, wrote and spoke extensively of his beliefs concerning pre-Adamites and death among plant and animal life before the fall. His views were strongly opposed by Elder Joseph Fielding Smith of the Quorum of the Twelve. Elder Smith's arguments centered on the passage from 2 Nephi 2:22 that if Adam had not fallen, "all things which were created must have remained in the same state in which they were after they were created; and they must have remained forever, and had no end." Each attempted to have his views confirmed by the church. Both Elder Roberts and Elder Smith formally presented their views to the First Presidency and the Quorum of the Twelve. After careful consideration, the First Presidency issued a report. Dated 5 April 1931 and addressed to the Council of the Twelve, the First Council of the Seventy, and the Presiding

23. *Times and Seasons* 5/24 (January 1844), 758. This number may have been arrived at as follows: 7,000 years of the Lord's time of 1,000 years per day (i.e., 2,555,000,000 = 1,000 x 365 x 7,000).

24. Emiliani, *Scientific Companion*, 197.

25. Frank H. Shu, *The Physical Universe: An Introduction to Astronomy* (Mill Valley, Calif.: University Science Books, 1982), 462.

Bishopric, the report stated: “Neither side of the controversy has been accepted as doctrine at all.”²⁶ Thus, the First Presidency made it clear that the Church has no official stand concerning the existence of pre-Adamites and death among plants and animals before the fall.

Soon after this the First Presidency invited Elder James E. Talmage (who was a geologist by profession) to give a talk on the issue. He gave this talk, entitled “The Earth and Man,” in the Tabernacle on 9 August 1931 and stated that the earth was extremely ancient. He also confirmed that life and death occurred on the earth long before the coming of man:

But this we know, for both revealed and discovered truth, that is to say, both scripture and science, so affirm—that plant life antedated animal existence, and that animals preceded man on earth. . . . These [plants and animals] lived and died, age after age, while the earth was yet unfit for human habitation.²⁷

In November of that same year, 1931, the First Presidency approved the publication of this speech with slight changes, and it appeared in the church section of the *Deseret News* on 17 November.²⁸ It was subsequently made available as a church pamphlet and was republished in *The Instructor*.²⁹ While this does not constitute official church approval, it does show that there was no disapproval.

It is important here to stress that although there may have been death among plants and animals before the fall, this does not apply to Adam and Eve. The scriptures and the teaching of the Brethren make it absolutely clear that before the fall Adam and Eve were not yet subject to death, and it was only by partaking of the forbidden fruit that they became mortal.

Elder Talmage certainly supported the view that among plants and animals there was death before the fall. If there were no death before the fall, it would be very difficult to account for all the fossilized remains of now extinct flora and fauna located in geologic strata all over the earth. In addition, ancient fossil bones show signs of tumors, rheumatic disorders, arthritis, abscesses, and breakage; and fossil plants show spot fungi, burls, and insect galls.³⁰ All these seem to indicate that death and disease were part of living things millions of years ago.

Some have tried to account for these fossilized remains by maintaining that the earth was formed from parts of other earths. For support, they refer to a quotation from Joseph Smith that “this earth was organized or formed out of other planets which were broken up and remodeled and made into the one on which we live.”³¹ This is not, however, a direct quote from Joseph Smith, but it comes from an entry in William Clayton’s journal.³² William McIntire was at the same sermon and

26. James B. Allen, “The Story of The Truth, The Way, The Life,” in B. H. Roberts, *The Truth, The Way, The Life, An Elementary Treatise on Theology*, 2nd ed., ed. John W. Welch (Provo, Utah: BYU Studies, 1996), 709. This article has an extensive description of this controversy between Elders Roberts and Smith as well as supporting documentation.

27. Talmage, “The Earth and Man,” 474–75.

28. Allen, “The Story of The Truth, The Way, The Life,” 711.

29. James E. Talmage, “The Earth and Man,” 474–77; January 1966, 9–11, 15.

30. Patricia Rich et al., *The Fossil Book: A Record of Prehistoric Life*, 2nd revised ed. (Mineola, N.Y.: Dover Publications, 1996), 15.

31. Franklin D. Richards and James A. Little, *A Compendium of the Doctrines of the Gospel* (Salt Lake City: Deseret News, 1882), 287.

32. Andrew F. Ehat and Lyndon W. Cook, comps. and eds., *The Words of Joseph Smith: The Contemporary Accounts of the Nauvoo Discourses of the Prophet Joseph* (Orem, Utah: Grandin Book, 1991), 60.

recorded what Joseph said somewhat differently: “this Earth has been organized out of portions of other Globes that has ben Disorganized.”³³ Here McIntire uses “globes” rather than “planets,” which could refer to any celestial body: planet, comet, asteroid, or star. All the elements out of which this earth is formed (with the exception of hydrogen and some helium) were formed inside stars. The elements up to iron are formed in the various stages of fusion a star goes through during its lifetime. Elements heavier than iron are formed primarily in supernova explosions and are then dispersed throughout the galaxy by that same explosion. Thus the elements of this earth did indeed come from other “globes” that were disorganized—a supernova is a fairly substantial disorganization.

Moreover, it is reasonable to assume that our own earth is typical of what God does in preparing worlds for his children. That being so, then after an inhabited world has passed through its mortal state, it is not disorganized and thrown into a pile for use in forming other worlds but rather is resurrected and celestialized.

Another telling argument against fossils being the remains of plants and animals from fragments of other worlds is the sequential way in which they are preserved—in layers, or strata. Fossilized plants and animals found at great distances from each other all over the earth are found in equivalent strata and in the same order within these strata. Were this earth formed from bits and pieces of other planets that would likely not be the case.

What about the Fossil Remains of Manlike Creatures?

What about these manlike creatures that lived on the earth thousands or even millions of years ago? The scriptures do not mention them. What are they? What is our relationship to them? They are certainly creations of our Father in Heaven, but what their purpose is in his plans he has not revealed to us. In any event, whatever they are, they are not our ancestors, as the First Presidency statement on the origin of man makes clear:

It is held by some that Adam was not the first man upon the earth, and that the original human being was a development from lower orders of the animal creation. These, however, are the theories of men. The word of the Lord declares that Adam was “the first man of all men” (Moses 1:34), and we are therefore duty bound to regard him as the primal parent of our race. It was shown to the brother of Jared that all men were created in the *beginning* after the image of God; and whether we take this to mean the spirit or the body, or both, it commits us to the same conclusion: Man began life as a human being, in the likeness of our heavenly Father.³⁴

Evolution

Since the authors of this paper have received their advanced degrees in physics and astronomy, with no formal training in biology, we will take the prudent course and let those who are more knowledgeable on the subject deal with evolution. For us the critically important point is that God is the source and author of all life and was intimately and continuously involved in bringing it

33. Ibid. 61; original spelling, punctuation, grammar, and crossed out words are retained.

34. Joseph F. Smith, John R. Winder, Anthon H. Lund, “The Origin of Man,” in James R. Clark, *Messages of the First Presidency* (Salt Lake City: Bookcraft, 1965), 4:205.

forth on this earth—it was not and indeed cannot have been, as some scientists maintain, the result of “nothing but a set of individually mindless steps succeeding each other without the help of any intelligent supervision.”³⁵ The details of how God accomplished the placing of life on this earth are not explicitly stated in the scriptures, but his intimate involvement is made absolutely clear.

The Sequence of Events during the Creation

Those familiar with the temple account of the creation will recognize that there are some differences both in sequence of events as well as what is done on a given “day.” As Elder Bruce R. McConkie stated, “The temple account [of the creation], for reasons that are apparent to those familiar with its teachings, has a different division of events. It seems clear that the ‘six days’ are one continuing period and that there is no one place where the dividing lines between the successive events must of necessity be placed.”³⁶ The divisions into days or periods may, in a sense, be artificial, since, as Elder McConkie points out, the creation is really one continuous event.

Spiritual versus Physical Creation

Some have suggested that the account of the creation in Abraham is about the spiritual rather than the physical creation. Elder McConkie suggests otherwise:

The Mosaic and the temple accounts set forth the temporal or physical creation, the actual organization of element or matter into tangible form. They are not accounts of the spirit creation. Abraham gives a blueprint as it were of the Creation. He tells the plans of the holy beings who wrought the creative work. . . . Then he says they performed as they had planned, which means we can, by merely changing the verb tenses and without doing violence to the sense and meaning, also consider the Abrahamic account as one of the actual creation.³⁷

This seems reasonable, and on this basis, we will treat the creation account in Abraham as dealing with the physical and not the spiritual creation.

The Seven Creative Periods

In looking at the creation account in Abraham, we will also refer to the accounts in Genesis and Moses when added information is found in them. The three scriptural accounts all agree that “in the beginning” God (or the gods) created the heavens and the earth. But is this the beginning of the entire universe? The account in Moses makes it clear that it is not: “Behold, I reveal unto you concerning *this* heaven, and *this* earth (Moses 1:35; 2:1; emphasis added). As already noted above, God made it clear to both Abraham and Moses that his creations were innumerable to man and that this earth is not the first of his creations. Thus, the scriptural creation accounts do not describe the creation of the universe but only of *this* earth and *this* heaven, a description that seems

35. Daniel C. Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (New York: Simon and Schuster, 1995), 59.

36. McConkie, “Christ and the Creation,” 11.

37. *Ibid.*

to include what we now designate as our solar system, and perhaps other local stellar systems that collapsed out of the same cloud as our solar system.

The following paragraphs are our attempt to correlate the events of the creation described in scripture with the latest scientific evidence and theories of the formation of the earth and our solar system. The dates we give are those derived from radiometric dating and are not to be considered absolute but rather the best present estimates based on a variety of scientific measurement techniques. At the end of the paper is a chart showing the six creative periods, the events occurring in each, and the approximate dates.

First Period—Formation of the Solar System (Abraham 4:1–5)

Several things occur during this first period: the organization and formation of the solar system—the sun and its associated planets, asteroids, comets, meteorites, and sundry dust and gas. In this primeval state, darkness “reigned upon the face of the deep, and the Spirit of the gods was brooding upon the face of the waters” (Abraham 4:2). What is happening here? Abraham is describing what he sees in his vision using a vocabulary that lacks the specialized scientific words we now use. According to the present theory of the formation of our solar system, some 4.7 billion years ago there was a large cloud of gas and dust, which, perhaps initiated by the shock wave of a nearby supernova, began to rotate and collapse upon itself due to the mutual gravitational attraction of the constituent gas molecules and dust particles. Since approximately 75 percent of all the matter in the universe is hydrogen, this was a major component of the cloud. Abraham perhaps used the term “waters” to describe this cloud consisting predominantly of hydrogen (the word hydrogen means “water source” in Greek). As the cloud of gas and dust began to collapse, it became denser and began to block out light; hence the darkness. There are regions in our galaxy where we see these dark clouds (the Horsehead Nebula in Orion is perhaps the most well known), in which infrared observations show new stars forming.³⁸

As this cloud continued to collapse, regions of higher density formed within it. At the center, in particular, the density became particularly high, and as the gravitational potential energy was converted to heat, the center got progressively hotter until the density and temperature were high enough for nuclear fusion of hydrogen into helium. The smaller regions of higher density further from the center of the cloud eventually formed the nine planets, the asteroids, and the comets of our solar system. Close to the sun the temperature was higher, which only allowed the formation of small, rocky planets like the earth. Further out, the lower temperatures allowed the formation of the larger, gaseous planets like Jupiter.³⁹

Once fusion started in the core of the proto-sun, the light pressure began to blow off the remaining dust and gas. Stars in this stage of development, i.e., pre-main sequence, stars surrounded by dark clouds of gas and dust, have been observed and are called T-Tauri stars.⁴⁰ Naked T-Tauri stars are the next stage in which the cloud has mostly been dispersed.⁴¹ Thus, the creation of light during the first

38. Zeilik et al., *Introductory Astronomy*, 387–90.

39. *Ibid.*, 141–45.

40. *Ibid.*, 341.

41. *Ibid.*, 391.

period seems to refer to the ignition of nuclear fusion in the core of the sun. It is not, however, until the fourth period that the various “lights” in the heavens become visible, because it takes some time for the light pressure of the sun to disperse the dark cloud in which the solar system was formed.

Let’s turn now to the continuing formation of the earth. Abraham 4:2 says “the earth, after it was formed, was empty and desolate.” The earth began to be formed by the accretion of rocky bodies formed within the cloud. This accretion as well as the decay of radioactive elements produced a rapid internal heating, which drove off the initial atmosphere of hydrogen and inert gases and melted the planet. Lighter materials rose to the surface to ultimately form the crust of the earth, and the denser material sank to form the molten nickel-iron core. The earth began to cool, and by “about 3.7 billion years ago, the first continents appeared and plate tectonics began.”⁴²

The events of the first period took place roughly between 4.6 and 3.6 billion years ago, according to the most recent scientific dating techniques.

Second Period—Formation of the Atmosphere (Abraham 4:6–8)

In the second creative period, the gods form an “expanse” in the midst of the “waters” to divide the waters above from the waters below (Abraham 4:6). This seems to be describing the formation of the earth’s atmosphere. About four billion years ago, “volcanic activity caused by interior heating created the second atmosphere, containing outgassed water, methane, ammonia, sulfur dioxide, and carbon dioxide. An infall of large objects continued, fracturing the [earth’s] crust.”⁴³ The scars of this bombardment have been weathered away on the earth but are still clearly visible on the moon. Ocean basins were formed by this bombardment, and “the Earth’s surface cooled enough for rain to fall and begin filling the basins.”⁴⁴

Beginning about 3.5 billion years ago, photosynthesis by blue-green algae (primitive one-celled organisms without a distinct nucleus) began to release oxygen into the atmosphere.⁴⁵ However, prior to two billion years ago, there was very little free oxygen in the atmosphere. It was a reducing atmosphere (one without any free oxygen). Large deposits of reduced minerals such as banded iron chert, detrital pyrite, and uranite could not have formed if even 0.1 percent of the atmosphere had been oxygen. Sometime between 2.0 and 1.5 billion years ago, levels of oxygen increased, due to the biologic activity of the blue-green algae. From this time on, no more reduced minerals are laid down, and now oxidized minerals are found.⁴⁶ About 1.5 billion years ago, green algae, the first eukaryotes (organisms with nuclei in their cells) began to appear. “Green algae are efficient photosynthesizers. They added more oxygen to the atmosphere until, about 800 million years ago, the oxygen level reached 5 percent of the present value.”⁴⁷

Another important element of the atmosphere also formed during this period—the ozone layer. Energetic ultraviolet photons began to dissociate water molecules in the atmosphere. The hydrogen escaped into space and the oxygen atom was left behind. The oxygen in turn combined

42. Ibid., 76.

43. Ibid.

44. Ibid.

45. Shu, *Physical Universe*, 494.

46. Rich et al., *Fossil Book*, 79.

47. Emiliani, *Scientific Companion*, 156.

to form molecular oxygen (O₂) and other molecules. As O₂ accumulated in the upper atmosphere, it was again dissociated into free oxygen atoms, which in turn combined with other O₂ molecules to form ozone. The dissociation-association process eventually stabilized, forming the ozone layer. This filtered out the harmful ultraviolet light, which not only prevented any further dissociation of water, but also allowed life to flourish.⁴⁸ Ultraviolet light is lethal to most living organisms.

The proper mixture of gases in the atmosphere is critically important for sustaining life on the earth. For example, although carbon dioxide and water vapor make up only a very small part of the atmosphere, without them “the average temperature of the earth would be -40° C.”⁴⁹ It seems clear that God at various stages of the creative process arranged for modifications in the earth’s atmosphere to ultimately provide one suited to the animal and plant life now found here.

The earth’s magnetic field, produced by its rotating liquid nickel-iron core, also helps protect life upon the earth’s surface. This field deflects the potentially harmful stream of charged particles coming from the sun, called the solar wind, and forms the well-known Van Allen radiation belts.⁵⁰

The events of the second period, in which the present atmosphere of the earth was formed, seem to have occurred from around 4.0 billion to 600 million years ago, thus overlapping with both the first and third periods.

Third Period—Formation of Oceans and Continents, Plant Life (Abraham 4:9–13)

During this creative period the seas were formed and dry land appeared. As indicated above, the water that forms the seas and other bodies of water on the earth came from the volcanic out-gassing of water vapor, which condensed as rain and began to fill the low-lying areas. Also, with the cooling of the crust of the earth around 3.7 billion years ago, the major continental plates formed and the process known as plate tectonics began.⁵¹ As the various continental plates collided with each other, mountain ranges began to form, a process that continues up to the present time. The weathering of the earth by rain and wind also caused major changes over time.

Next the gods prepared the earth for plant life. When the earth was first formed, it was far from being a favorable environment for life. It had an atmosphere of carbon dioxide, hydrogen, sulfur, methane, etc., but lacked any free oxygen. Plants would be the obvious thing to first place on the earth. Their ability to convert carbon dioxide into oxygen would in turn prepare the earth for animal life. The oldest fossils are those of blue-green algae (sometimes called cyanobacteria) dating back some 3.5 billion years, and they remained the dominant form of life until about 1.5 billion years ago,⁵² although in Precambrian rocks found in South Africa there are also fossil remains of tiny rod-shaped forms resembling living bacteria in their cell-wall structure.⁵³ This means that life appeared on the earth very soon after the crust solidified. There is some genetic evidence that perhaps archaeobacteria preceded the blue-green algae, but there is no fossil evidence to support this.⁵⁴

48. Shu, *Physical Universe*, 492.

49. Emiliani, *The Scientific Companion*, 157.

50. Zeilik et al., *Introductory Astronomy*, 72–74.

51. *Ibid.*, 76.

52. Emiliani, *Scientific Companion*, 151.

53. Rich et al., *The Fossil Book*, 91.

54. Emiliani, *Scientific Companion*, 150.

It is interesting that scientists have proposed terraforming the planet Venus (converting it to an earthlike environment) by seeding its clouds with blue-green algae, which would convert the predominantly carbon dioxide atmosphere to oxygen. The reduction of carbon dioxide would in turn reduce the greenhouse effect, and the temperature would drop. Eventually, water vapor in the atmosphere (which contains enough water to cover the entire surface of Venus with 100 inches of water) would condense and fall as rain. Over time the surface temperature of Venus would drop to 70 to 80 degrees Fahrenheit, with oceans forming in the depressions.⁵⁵ This is, in essence, the process God seems to have used in preparing our earth for more advanced life forms.

Land plants appeared much later during the Middle Silurian period, some 420 million years ago, and did not become common until near the end of the Devonian, about 360 million years ago.⁵⁶ The first appearance of flowering plants (angiosperms) was not until about 120 million years ago.⁵⁷ Grasses are not found until around 57 million years ago.⁵⁸

The progressive appearance of plant life⁵⁹ on the earth thus stretched over an enormous period of time—from about 3.5 billion years to 57 million years ago, when the variety of plant life was much like what we now have on the earth.

Fourth Period—Appearance of Sun, Moon, and Stars (Abraham 4:14–19)

During this phase of the creation, the gods organized the various “lights” in the heavens—the sun, moon, and stars. As stated in the section in the first period, once hydrogen fusion had started in the sun, light pressure would have progressively blown out the remaining gas and dust of the original cloud out of which the solar system formed, thus progressively making these various heavenly bodies visible. Organizing the lights for seasons, days, and years can also have reference to the setting of the orbital and rotational periods of the earth and moon, a year being the time it takes the earth to orbit once around the sun. A month originally was the time period from one new moon to another, which is based upon the orbital period of the moon about the earth. A day is the time it takes the earth to rotate once upon its axis. The seasons too can be determined by which constellations are visible at a given period during the year. Moreover, the various seasons—winter, summer, spring, and fall—are a consequence of the tilt of the earth’s axis with respect to its orbital plane, as well as the eccentricity of its orbit about the sun. All these various aspects of the motion of the earth and moon had to be fine-tuned to produce the times and seasons we now have.

55. Adrian Berry, *The Next Ten Thousand Years: A Vision of Man’s Future in the Universe* (New York: The New American Library, 1974), 90–93. Carl Sagan first suggested the idea in “The Planet Venus,” *Science* 133 (24 March 1961), 849–58.

56. Rich et al., *Fossil Book*, 67.

57. *Ibid.*, 33–35.

58. *Ibid.*

59. In classifying blue-green and green algae as plants, we recognize that this is not in accordance with modern biological classification schemes, which now recognize five kingdoms. But as was stated above, the scriptures are not meant as textbooks of geology, biology, etc. The algae perform the same function as more complex plant life in that they convert carbon dioxide to free oxygen.

Fifth Period—Sea Animals and Birds (Abraham 4:20–23)

In agreement with the scriptural accounts of creation, both plant and animal life first appeared in the ocean. Only in rocks less than 1.5 billion years old are microfossils of eukaryotic cellular organisms much more complicated than the prokaryotic blue-green algae.⁶⁰ It was only when oxygen levels reached about 5 percent of the present value, some 800 million years ago, that more complex multicellular life (metazoa) began to appear.⁶¹

About 600 million years ago, at the beginning of the Cambrian period, there was a rapid increase in the variety of higher life forms.⁶² Around 590 million years ago, exoskeletal animals such as trilobites, brachiopods, and shelled mollusks appeared. By 550 million years ago, the first vertebrates, such as jawless fish and graptolites, appeared.⁶³

It was not until 145 million years ago that birds first appeared. Why birds are included with sea animals rather than land animals is not clear, but as we stated before, the separation into periods is in a sense artificial, since the creative process was a continuous one.

Sixth Period—Land Animals and Man (Abraham 4:24–31)

The sixth and final period of creation includes the placing of land animals and man upon the earth. About 370 million years ago, amphibians first appeared in the fossil record. By 340 million years ago the earliest reptiles (cotylosaurs) were present, and by 320 million years ago mammal-like reptiles (pelycosaurs) were found. Winged insects appeared around 310 million years ago, and dinosaurs came on the scene about 240 million years ago. By 220 million years ago, there were a large variety of mammal-like reptiles, but it was not until about 90 million years ago that marsupials and placentals appeared.⁶⁴

Around 65 million years ago, at the end of the Cretaceous period, there was a period of mass extinction, in which dinosaurs and many other kinds of life disappeared. This may have been caused by a giant asteroidal impact. The fossil record also shows other major extinction events, such as the Permian, around 250 million years ago.⁶⁵

The first primates appeared 62 million years ago, and by 60 million years ago there was a great diversity of mammal types. Rodents first arrived on the scene about 45 million years ago, and hominids (manlike creatures) about 19 million years ago.⁶⁶

The first appearance of fossils of *Homo sapiens sapiens* and *Homo sapiens neanderthalensis* seems to have been about 125,000 years ago, when fossils of both are found, at about the temperature maximum of the last interglacial period. By 18,000 years ago, the last ice age reached its maximum with glaciers covering large areas of northern Europe and North America.⁶⁷ About 11,600 years ago, there

60. Shu, *Physical Universe*, 495.

61. Emiliani, *Scientific Companion*, 159.

62. Shu, *Physical Universe*, 497.

63. Rich et al., *Fossil Book*, 33–35.

64. *Ibid.*

65. *Ibid.*, 247, 483.

66. *Ibid.*, 33–35.

67. Emiliani, *Scientific Companion*, 195.

was a rapid warming, and the ice sheets melted, producing catastrophic floods down the Mississippi valley and other places.⁶⁸ Could this have been the cause of the biblical flood?

This final phase of the creation thus seems to have covered a period from about 370 million years ago to the point when Adam was first placed on the earth.

Seventh Period

The seventh period is actually not part of the creation but is the rest period after the work was done. We have no information as to how long it lasted.

Summary

As we have examined the astronomy and creation accounts of the Book of Abraham, we have found a remarkable agreement with modern scientific understanding. This is especially notable since most of our present scientific knowledge has been discovered during this century and indeed during the latter part of this century—a century and a half after it was revealed through Joseph Smith. The Book of Abraham stands as a proof of Joseph's prophetic calling for the entire world to see. It is also a confirmation that true science and true religion will be in harmony with each other.

Note that the dates here are those derived using various radiometric dating techniques. They are not meant to be the final word but are science's best estimate at this time.

68. Ibid., Rich et al., *Fossil Book*, 617.

Tentative Chronology of the Events of Creation

Period	Activity	Details	Years before present
First	Formation of solar system	Earliest meteorites formed Solar system formed Oldest lunar rocks Oldest terrestrial rocks	4.7 billion 4.6 billion 4.2 billion 3.8 billion
Second	Formation of atmosphere	First (original) atmosphere Volcanic activity formed 2nd atmosphere Blue-green algae begin to produce O ₂ in atmosphere Oxygen level reaches 5% of present value	4.0 billion 4.0 billion 3.5 billion 800 million
Third	Formation of continents and ocean, plant life	Plate tectonics begins Blue-green algae Green algae Land plants Flowering plants Grasses	3.7 billion 3.5 billion 1.5 billion 420 million 120 million 57 million
Fourth	Appearance of sun, moon, and stars	Light pressure from the sun clears out residual gas and dust	4.5 to 4.4 billion
Fifth	Appearance of sea animals and birds	Cambrian explosion of complex life forms Exoskeletal animals Vertebrates Birds	600 million 590 million 550 million 150 million
Sixth	Appearance of land animals	Amphibians Reptiles Mammal-like reptiles Marsupials and placentals Primates Rodents Hominids	370 million 340 million 320 million 90 million 62 million 45 million 19 million