CHAPTER 3. CHRONOLOGIES OF GENESIS AND AGE OF THE EARTH

Genesis 5:27. And all the days of Methuselah were nine hundred and sixty nine years.

In Chapter 2 we discussed the traditional position of the Christian church that Creation took six literal days. In this chapter we will discuss the traditional church view that the planet Earth (and entire universe) are only 6000 years old. How does church tradition come up with a 6000-year age for the Earth? It assumes a six-day Creation, and then it tallies up all of the patriarchal generations (since Adam) and reigns of kings recorded in Genesis and the rest of the Bible to arrive at a figure of approximately 6000 years.

There have been a number of attempts to determine the date for Adam and Eve and the creation of the world using a chronologies method.¹ One of the first attempts was that of Jose Ben Halafta in the second century A.D., who calculated that Adam was created in 3761 B.C. This date of ~3760 B.C. has become part of orthodox Jewish tradition and is the basis for the Jewish calendar. Most famous of these “literal” chronologies, and the one most cited, is Bishop Ussher’s age for the world published in 1654. Ussher was the Anglican archbishop of Armagh, Ireland and one of the most formidable scholars of his time. The exact date he calculated for the creation of the Earth and universe was Sunday, October 23, 4004 B.C. The results of these (and other) dates vary partly because three of the earliest Old Testament manuscripts (Masoretic, Samarian, and Septugint) contain different numbers for the patriarchal ages, and partly because scholars disagree on when to begin counting backwards from the beginning of the Christian era.

There are two main problems with this traditional “literal” view, both of which are major stumbling blocks to faith for millions of people:
(1) The incredibly long life spans of the patriarchs such as Methuselah, who supposedly lived for 969 years (Gen. 5:27), are in direct conflict with the known life spans of people living today or with those living in the past according to the archeological record. As stated by Hugh Ross in his book *The Genesis Question*: “When readers encounter the long life spans in Genesis, they become convinced that the book is fictional, or legendary at best, whether in part or in whole.”

(2) The 6000-year age is in direct conflict with the science of geology that emphatically maintains that the Earth is 4.5-4.6 billion years old.

In this chapter we will discuss problem (1) first because whether the numbers in the biblical chronologies are real or symbolic is crucial for judging the viability of the claim that the Earth is 6000 years old. Then we will cover problem (2) by presenting the geologic evidence for an old Earth.

**Two Christian Views on the Age of the Earth**

*Creationism* is the theological position that the universe and Earth were deliberately planned and made by a creator. It is the position held by all Christians, regardless of their viewpoint on the age of the Earth. But under this general creationist position, there is a division between Christians as to the age of the Earth. Christians who believe that God formed the universe and Earth approximately 6000 years ago are called *Young Earth Creationists*. Their position follows from a belief that the opening chapters of the book of Genesis provide an exact chronology of events in the creation of the cosmos over a period of six solar days, and the time since creation follows the genealogies presented in Genesis Chapters 5 and 11. Christians who believe that God formed the universe and Earth over a long period of time are called *Old Earth*
Creationists. The foundation of Old Earth Creationism rests on the bedrock of science, most notably on two centuries worth of astronomical and geological observations. The cumulative findings of these studies strongly support a 13-14 billion year-old age for the universe and a 4.6 billion year-old age for planet Earth.

<table>
<thead>
<tr>
<th>TWO CHRISTIAN VIEWS</th>
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<tbody>
<tr>
<td><strong>Young Earth Creationist</strong></td>
<td><strong>Old Earth Creationist</strong></td>
</tr>
<tr>
<td>From the chronologies of Genesis 5 &amp; 11, the age of creation and the planet Earth can be set at ~6000 years (~10,000 years maximum).</td>
<td>From the scientific evidence (mainly geology), the age of the Earth can be set at ~4.6 billion years.</td>
</tr>
</tbody>
</table>

Prior Explanations for Long Patriarchal Life Spans

A number of attempts have been made over the centuries to explain the long life spans of the patriarchs. By the word “patriarch” it is meant any of the biblical personages regarded as the fathers of the human race or Israelites; that is, from Adam down to Abraham, or “the book of the history of Adam” specifically outlined in Chapters 5 and 11 of Genesis. In other words, the term “patriarch” in this chapter will refer to generations of people rather than in the specific sense of Abraham, Isaac, Jacob, and Joseph, as was done in Chapter 2.

1. Year-month-season explanation. This theory proposes that perhaps a “year” to the people of the ancient Near East had a different meaning than it does today. Instead of being marked by the orbit of the sun, a “year” then marked the orbit of the moon (a month) or a season (three months). Among the Greeks, years were sometimes called “seasons” (“horoi”), and so some ancient authors such as Pliny and Augustine thought that a “year” in Genesis might be equivalent to a one-month or three-month time period.

However, this theory is nonsensical if one looks at the “begetting” ages of the patriarchs. If the ages of Adam and Enoch are divided by twelve (1 year = 1 month), then Adam would have
fathered Seth at age eleven and Enoch would have been only five when he fathered Methuselah. Enoch’s age (65; Gen. 5:21) divided by four (1 year = 1 season) would result in an age of sixteen, which is biologically possible. But if 500 – Noah’s age when his first son(s) were born (Gen. 5:32) – is divided by the same number four, then the age of “begetting” would have been 125 years, another unlikely possibility.

2. Astronomical explanations. Astronomical explanations have also been proposed to explain the incredibly long patriarchal ages. Perhaps the rotation period of the Earth has changed, so that the days then were not equivalent to those we have now. Or, perhaps a supernova could have damaged the Earth’s ozone layer, thus increasing ultraviolet radiation and systematically decreasing the age of humans. The problem with such astronomical explanations is the complete absence of supporting evidence. There have been no known supernova explosions within the last 10,000 years that could account for the long ages of the patriarchs.

3. Tribal, dynasty, or “clan” explanation. Another explanation is that, when the Bible makes a statement like “Adam was the ‘father’ of Seth,” it means that the Adam “clan” had exercised dominion for 130 years (the age of Adam when Seth was born). In this view, Seth would be a direct-line descendent of Adam (grandson, great-grandson, etc.), but not the immediate son of Adam. Then, Seth’s “son” descendents would become part of the Seth dynasty or tribe. While this theory has merit, it does not account for the personal encounters that the “fathers” reportedly had with their “sons”; e.g., Noah was 500 years when his son(s) were born (Gen. 5:32), yet he coexisted with them on the ark (Gen. 7:13).

4. Canopy theory explanation. Other people have tried to explain the long ages of the patriarchs by creating a “different world” for pre-Flood humans. Before Noah’s Flood a vapor canopy supposedly shielded Earth from harmful radiation so that people could live to a very old
After the Flood, harmful radiation slowly increased so that the patriarchs’ ages exhibit a slow and steady decline to the biblical life span of 70 years mentioned in Psalm 90:10.

The problem with the vapor canopy hypothesis is that there is no physical or geological evidence to support it (refer to the discussion in Chapter 5). In addition, there is no archaeological evidence that substantiates incredibly long ages for people in the past – either in Mesopotamia or anywhere else. It is known that humans living in the Bronze Age (which time span includes most of the patriarchs; Table 7.1) had an average life span of about 40 years, based on human skeletons and legal documents of the time.\(^5\) If infants and children are included in this life-span average, it would be even lower. Examination of skeletons in a number of graves at al’Ubaid (one of the oldest known archaeological sites in Mesopotamia; Table 7.2) has indicated that some people lived to be over sixty – a great age at that time.

How then can the long lives of the patriarchs and other problematic numbers of Genesis be explained? Does one have to construct a fantastical world based on incredulous ages in order to come up with an adequate explanation? The answer is actually quite simple – if one considers the worldview or “mind-set” of the people living in the age of the patriarchs; that is, the Mesopotamians (the people who lived in what is now mostly Iraq) and the Israelites in Palestine who were descended from the Mesopotamians. This worldview includes both the religious ideas of these people and the numerical system used by them.

The Mesopotamians’ Worldview of Numbers

The Mesopotamians were the first people to develop writing, astronomy, mathematics (algebra and geometry), a calendar, and a system of weights and measures, accounting, and money. Even as early as the Ubaid Period (~3800-5500 B.C.; Table 7.2), Mesopotamian
architects were familiar with geometric principles such as 1:2, 1:4, 3:5, 3:4:5 and 5:12:13 triangles for laying out buildings. By around 3000 B.C. scribes were working with very large and small numbers. The Mesopotamians were the first to arrive at logarithms and exponents from their calculations of compound interest, they knew how to solve systems of linear and quadratic equations in two or more unknowns, and they calculated the value of pi (π) to an accuracy of 0.6%. The so-called Pythagorean Theorem was invented by the Mesopotamians more than 1000 years before Pythagoras lived, and was known not only for special cases, but in full generality. In other words, the Mesopotamians were the world’s first accomplished mathematicians.⁶

**Sexagesimal Numbers**

The mathematical texts of the Sumerians or Babylonians (people who lived in southern Mesopotamia) show that these people were regularly using a *sexagesimal* (base 60) numbering system at least by Uruk time (~3100 B.C.; Table. 7.2).⁷ Along with the numbers sixty and ten on which their combined sexagesimal-decimal system was based, the number six was also used in a special bi-sexagesimal system. Examples of the Mesopotamian sexagesimal system are still with us today in the form of the 360° circle, with 60-minute degrees and 60-second minutes, and with respect to time, the 60-minute hour and 60-second minute. The Mesopotamians’ sexagesimal basis for time is also reflected in their 360-day (60 x 6) year, where a thirteenth month was added every sixth year to make up for the days in an actual 365-day solar year. The Sumerians wrote their numbers in cuneiform – a series of wedged marks impressed onto clay tablets (Fig. 3.1).
Sacred or Symbolic Numbers

The Mesopotamians incorporated two concepts of numbers into their worldview: (1) numbers could have real values, and (2) numbers could be symbolic descriptions of the sacred. “Real” numbers were used in the everyday administrative and economic matters of accounting and commerce (receipts, loans, allotment of goods, weights and measures, etc.), construction (architecture), military affairs, and taxation. But certain numbers of the sexagesimal system, such as sossos (60), neros (600), and saros (3600) occupied a special place in Babylonian mathematics and astronomy. Also, the major gods of Mesopotamia were assigned numbers according to their position in the divine hierarchy. For example, Anu, the head of the Mesopotamians’ pantheon of gods, was assigned sixty, the most perfect number in the hierarchy. In addition, the Mesopotamians sometimes used numbers cryptographically; e.g., names could have a corresponding numerical value. For example, during the construction of his palace at Khorsubad, Sargon II stated: “I built the circumference of the city wall 16,283 cubits, the number
of my name”. In the genealogy of Genesis 5, Lamech is assigned a lifespan of 777 years, the sum of the numerical value of his name.

The Purpose of Symbolic Numbers

The Mesopotamians (and other ancient peoples) had a totally different concept of numbers than we have today. To us a number is just a number, and one number is no better than another number. But to the ancients numbers had intrinsic meaning beyond their being numbers. Just as a name held a special significance to the ancients (e.g., Noah, Gen. 5:29), a number could also have significance in and of itself. That is, the purpose of numbers in ancient religious texts could be numerological rather than numerical. Numerologically, a number’s symbolic value was the basis and purpose for its use, not its secular value in a system of counting. One of the religious considerations of the ancients involved in numbers was to make certain that any numbering scheme worked out numerologically; i.e., that it used, and added up to, the right numbers symbolically. This is distinctively different from a secular use of numbers in which the overriding concern is that numbers add up to the correct total arithmetically. Another way of looking at it is that the sacred numbers used by the Mesopotamians had honorific value, which gave a type of religious dignity or respect to important persons or to a literary text.

Preferred or Figurative Numbers

Besides the “sacred” exaggerated sexagesimal (base-60) numbers used in the early chapters of Genesis, the rest of the Bible often uses “preferred” or “figurative” numbers. These numbers were preferred by the biblical authors because they had spiritual (figurative) meaning rather than a strict numerical meaning. Even a cursory reading of the Bible will reveal that
certain numbers are used over and over again. Among these preferred numbers are three, seven, twelve, and forty.

Three. Three is the number of emphasis in the Bible; e.g., “holy, holy, holy” signified that God was being especially hallowed. Jesus often repeated himself three times to emphasize a point, or things were done three times for emphasis (e.g., Jn. 21:15-17). Three as a number also symbolized completeness; e.g., as when Jesus rose from the dead in 3 days, his mission was complete. Jonah was in the whale 3 days and 3 nights, in 3 days the temple will be raised, etc.

The preferred number three is also used symmetrically in the geneologies of Genesis: three sons are named for Adam, Noah, and Terah, even though these men may have had more than three sons (e.g., Gen. 5:4). Three men, Esau, Jacob, and Ishmael, each had twelve sons, etc.

Seven. The number seven was especially sacred to the Jews because of the Sabbath, the seventh day of their week. As the last day of the week it signified contentment and peace. It is a recurrent biblical symbol of fullness and perfection. For example, in Genesis 4:24, “sevenfold” means in perfect measure, and “seventy-sevenfold” means in overflowing measure. The number seven is used ubiquitously throughout both the Old and New Testaments: 7 golden candlesticks, 7 spirits, 7 words of praise, 7 churches, 70 (7 x 10) nations, 70 (7 x 10) elders, forgive 70 x 7 times, Terah’s age of 70 (7 x 10), Lamech’s age of 777, etc.

The number seventy (7 x 10) is also used symbolically in the Bible. Seventy may not represent an exact number, but this was unimportant to the ancients. The number seventy symbolized a numerical ideal, not a numerical reality. Thus, in Chapter 10 of Genesis seventy nations are mentioned – which number was symbolic among the Israelites for any family blessed with fertility (e.g., the 70 “sons” of Jacob who went down to Egypt in Gen. 46:27).
Twelve. Another number that is repeated over and over in the Bible is twelve. There are 12 pillars, 12 wells, 12 springs, 12 precious stones, 12 silver bowls, 12 golden spoons, 12 bullocks, rams, lambs, and goats, 12 cakes, 12 fruits, 12 pearls, 12 tribes of Israel, 12 tribes of Ishamael, 12 tribes of Esau, 12 tribes of Nahor, 12 districts of Solomon, 12 gates of the New Jerusalem, 12 disciples of Jesus, 12,000 horsemen, 144,000 (12 x 12 x 1000) remnant of Israel, etc. The preferred use of the number twelve may have had its foundation in the Mesopotamian sexagesimal system (6 x 2).

Forty. The number 40 also occurs many times in the Bible in different contexts, and it can be taken either literally or figuratively (for a long period of time). The Flood lasted 40 days and 40 nights, Moses fasted 40 days and 40 nights, Jesus fasted 40 days and 40 nights. The Israelites were in the wilderness for 40 years, Jesus was seen by his disciples after his resurrection for 40 days, Jonah preached to Nineveh for 40 days, Solomon, David, and Saul are each credited with a reign of 40 years, Eli judged Israel for 40 years, Goliath presented himself 40 days, the 480 (12 x 40) years of 1 Kings 6:1, etc.

In addition to these preferred numbers, figurative ages are used for certain important people. An example of this is found in Deuteronomy 34:7: *And Moses was an hundred and twenty years old when he died; his eye was not dim, nor his natural force abated.* The number 120 (60 x 2) is first mentioned in Genesis 6:3: *yet his days shall be an hundred and twenty years.* This number has also been mentioned in a similar context in a cuneiform text found at Emar:

“One hundred twenty years (are) the years of mankind – verily it is their bane.” This is the only known extra-biblical parallel to Genesis 6:3. The figure 120, shared by Genesis 6:3 and the Emar text, is to be regarded as a maximal and ideal figure, which in the worldview of that time could be reached only by extremely virtuous individuals. Indeed, in the Bible there is only one person
to whom this life-span was attributed – namely Moses. Similarly, Joseph and Joshua were each recorded as dying at age 110, a number considered “perfect” by the Egyptians. In ancient Egyptian doctrine, the phrase “he died aged 110” was actually an epitaph commemorating a life that had been lived selflessly and had resulted in outstanding social and moral benefit for others. And so for both Joseph and Joshua, who came out of the Egyptian culture, quoting this age was actually a tribute to their character, but bore no necessary relationship to an individual’s actual life span.

In the case of all of these preferred and figurative numbers, which are to be considered “literal” (exact numerical numbers)? How such symbolic numbers were meant at the time of writing is something that we may only guess at today, and if a specific principle ever underlay such numbers, it is no longer readily apparent. Unless we assume that God prefers certain numbers over other numbers, and somehow passed that preference down to the biblical authors, we must acknowledge that in many cases where preferred numbers are used in the Bible, they are to be taken symbolically or figuratively. Furthermore, we must acknowledge that the Jews (including Jesus) sometimes purposely used preferred numbers just because of their historical and/or spiritual meaning. The symbolic reading of numbers does not mean that the Bible is not to be taken literally. It just means that the biblical author was trying to impart a spiritual or historical truth to the text – one that surpassed the meaning of purely rational numbers.

How the Concept of Numbers Has Changed Over Time

Today we don’t consider certain numbers to be sacred or special (at least we in the West don’t – in some parts of the Near East and East this worldview is still prevalent). So, how did the concept of numbers used in sacred texts change over time from numerological to numerical?
Scholars in biblical and Mesopotamian studies have tried over the years to show the common traditions of both cultures, including the Creation and Flood stories and the numbers contained in Genesis. The ancient Akkadian (northern Mesopotamia), Sumerian (southern Mesopotamia), and Egyptian cultures all had exaggerated “long reigns” for their gods and kings, and this seems to have been a common religious tradition for peoples of the ancient Near East. A number of scholars have specifically attempted to mathematically determine a numerical connection between the long-life spans in the Sumerian King List and the long ages of the patriarchs in Genesis, but despite these attempts, only a superficial similarity has been established.13

What has emerged from such comparative studies, however, is that the numbers used in the early chapters of Genesis are definitely sexagesimal in nature and thus point to Mesopotamian roots for the basic stories in these chapters (Table 3.1). Abraham, when he lived in Ur in southern Mesopotamia, would undoubtedly have used a sexagesimal numbering system. However, when Abraham left Ur he and his descendents came in contact with other Semitic peoples who were using the decimal system. Thus, gradually the decimal system replaced the sexagesimal system in the Israelite’s numerical worldview as they moved from Mesopotamia to Haran to Palestine to Egypt and back to Palestine (Table 3.1).14 Along with slowly acquiring the decimal system came a loss of the sacredness of numbers that was formerly attached to the sexagesimal system.

<table>
<thead>
<tr>
<th>&gt;2000 BC</th>
<th>~1500 BC</th>
<th>~1000 BC</th>
<th>1st Century AD</th>
<th>Middle Ages</th>
<th>Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesopotamia</td>
<td>Egypt</td>
<td>Palestine</td>
<td>Palestine</td>
<td>Europe</td>
<td>Western World</td>
</tr>
<tr>
<td>Sexagesimal, exaggerated, <em>sacred</em> numbers (60, 7); Genesis up to Abraham</td>
<td>Decimal numbers</td>
<td>Decimal numbers</td>
<td>Time of Christ; real numbers, use of preferred numbers wan</td>
<td>Real numbers only; concept of Mesopotamian sacred numbers completely lost</td>
<td>Cuneiform tablets found; concept of sacred numbers rediscovered</td>
</tr>
<tr>
<td></td>
<td>Joseph-Joshua-Moses; preferred &amp; figurative numbers (40, 12, 7, 3)</td>
<td>Solomon-David; real numbers, but religious use of preferred numbers</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

*Table 3.1. How the concept of numbers has changed over time.*
It seems certain that a sound and really historical chronology had become established in Israel by the time of David (~900 B.C.), as two hundred or so chronological dates in the books of Samuel, Kings, and Chronicles are, with a few exceptions, of remarkable consistency. But even then, and long after, preferred or figurative numbers continued to be used throughout both the Old and New Testaments.

During the Middle Ages in Europe the concept of “sacred” numbers was lost, and it was not until the discovery and publication of the Babylonian mathematical cuneiform texts in the second quarter of the 20th Century that the numerological nature of the patriarchal ages was rediscovered.

Long Lives of the Patriarchs

Having discussed the Mesopotamians’ concept of sacred and secular numbers, with their dual numerological and numerical meanings, we can now tackle the difficult problem of the long lives of the patriarchs. A list of the patriarchs from Adam to Abraham, containing their ages when their first son was born, their remaining years of life, and total years, is shown in Table 3.2. These ages are then “deciphered” into their common components with respect to the sexagesimal (sacred) numbers of the Mesopotamians or preferred numbers of the Hebrews.

The first thing to notice in Table 3.2 is that most of the numbers listed in the Genesis chronologies are based on the sexagesimal (60) system and can be placed into one of two groups: (1) multiples of five; that is, numbers exactly divisible by five, whose last digit is 5 or 0; and (2) multiples of five with the addition of seven (or two sevens). The significance of the number five is that 5 years = 60 months, and combinations or multiples of 60 years + 5 years
Table 3.2. The chronologies of Genesis: age of patriarchs and corresponding sexagesimal and preferred numbers. All age-numbers (30 in all) from Adam to Noah are some combination of the sacred numbers 60 (years and months) and 7. No numbers end in 1, 3, 4, 6, or 8 – a chance probability of one in a billion. Thirteen numbers end in 0 (some multiple or combination of 60), 8 numbers end in 5 (5 years = 60 months), 3 numbers end in 7, 5 numbers end in 2 (5 yrs + 7 yrs = 12), and 1 number ends in 9 (5 yrs + 7 yrs + 7 yrs = 19). All of this cannot be coincidental. The Mesopotamians were using sacred numbers, not real numbers. Therefore, these numbers should not be interpreted as real numbers.

<table>
<thead>
<tr>
<th>Patriarch</th>
<th>Age (yrs) when first son born</th>
<th>Sexagesimal and Preferred Numbers</th>
<th>Remaining years of life</th>
<th>Sexagesimal and Preferred Numbers</th>
<th>Total years</th>
<th>Sexagesimal and Preferred Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>130</td>
<td>60x2yrs + 60x2mos</td>
<td>800</td>
<td>60x10x10mos + 60x60mos</td>
<td>930</td>
<td>60x3x5yrs(60mos) + 6x5yrs(60mos)</td>
</tr>
<tr>
<td>Seth</td>
<td>105</td>
<td>60x10x2mos + 60mos</td>
<td>807</td>
<td>60x10x10mos + 60x60mos + 7yrs</td>
<td>912</td>
<td>60x3x5yrs(60mos) + 5yrs(60mos) + 7yrs</td>
</tr>
<tr>
<td>Enoch</td>
<td>90</td>
<td>(6+6+6) x 60mos</td>
<td>815</td>
<td>60x10x10mos + 60x60mos + 60x3mos</td>
<td>906</td>
<td>60x3x5yrs(60mos) + 5yrs(60mos)</td>
</tr>
<tr>
<td>Kanon</td>
<td>70</td>
<td>7x2x5yrs(60mos)</td>
<td>840</td>
<td>60x10x10mos + 60x60mos + 6x8mos</td>
<td>910</td>
<td>60x3x5yrs(60mos) + 2x5yrs(60mos)</td>
</tr>
<tr>
<td>Mahalalel</td>
<td>65</td>
<td>60yrs + 5yrs(60mos)</td>
<td>830</td>
<td>60x10x10mos + 60x60mos + 60x6mos</td>
<td>895</td>
<td>60x3x5yrs(60mos) - 5yrs(60mos)</td>
</tr>
<tr>
<td>Jared</td>
<td>162</td>
<td>60x6x5mos + 5yrs(60mos) + 7yrs</td>
<td>800</td>
<td>60x10x10mos + 60x60mos</td>
<td>962</td>
<td>(60+60+60+6+6)x60mos - 5yrs(60mos) + 7yrs</td>
</tr>
<tr>
<td>Enoch</td>
<td>65</td>
<td>60yrs + 5yrs(60mos)</td>
<td>300</td>
<td>80x5yrs(60mos)</td>
<td>365</td>
<td>60x6yrs + 5yrs(60mos) = 1 solar year</td>
</tr>
<tr>
<td>Methuselah</td>
<td>187</td>
<td>60x3yrs + 7yrs</td>
<td>782</td>
<td>60x10x10mos + 60x60mos - 6x3yrs</td>
<td>969</td>
<td>(60+60+60+6+6)x60mos - 5yrs(60mos) + 7yrs + 7yrs</td>
</tr>
<tr>
<td>Lamech</td>
<td>182</td>
<td>60x7x5mos + 7yrs</td>
<td>595</td>
<td>60x10yrs - 5yrs(60mos)</td>
<td>777</td>
<td>7x10x10 + 7x10 + 7yrs</td>
</tr>
<tr>
<td>Noah</td>
<td>500</td>
<td>60x10x10mos</td>
<td>450</td>
<td>40x2x5yrs(60mos) + 10x5yrs(60mos)</td>
<td>950</td>
<td>60x3x5yrs(60mos) + 10x5yrs(60mos)</td>
</tr>
</tbody>
</table>

Flood:

| Shem      | 100                           | 60x10x2mos                      | 500                    | 60x10x10mos                      | 600         | 60x10yrs                         |
| Arphaxad  | 35                            | 7x5yrs(60mos)                   | 403                    | 40x2x5yrs(60mos) + 3yrs (6x6mos) | 438         | 40x2x5yrs(60mos) + 60x6 + 6x6mos |
| Shelah    | 30                            | 60x6mos                        | 403                    | 40x2x5yrs(60mos) + 3yrs (6x6mos) | 433         | 40x2x5yrs(60mos) + 6x(60+6)mos   |
| Eber      | 34                            | 60x6mos + 6x8mos               | 430                    | 40x2x5yrs(60mos) + 6x6mos        | 404         | 40x2x5yrs(60mos) + 60yrs + 6x8mos |
| Peleg     | 30                            | 60x6mos                        | 209                    | 40x5yrs(60mos) + 5yrs(60mos) + 6x8mos | 239         | 40x5yrs(60mos) + 6x5yrs + 6x6mos |
| Reu       | 32                            | 60x8mos + 6x4mos               | 207                    | 40x5yrs(60mos) + 5yrs(60mos) + 6x8mos | 239         | 40x5yrs(60mos) + 6x5yrs + 6x6mos |
| Serug     | 30                            | 60x8mos                        | 200                    | 40x5yrs(60mos)                   | 230         | 40x5yrs(60mos) + 60x6mos         |
| Nahor     | 29                            | 60x8mos - 6x2mos               | 119                    | 60x2yrs - 6x2mos                 | 148         | 60x10x2mos + 6x8yrs              |
| Terah     | 70                            | 7x2x5yrs(60mos)                | 135                    | 60x2yrs + 60x2mos + 5yrs(60mos)  | 205         | 40x5yrs(60mos) + 5yrs(60mos)     |
| Abraham   | 100                           | 60x10x2mos                     | 75                     | 5yrs(60mos) x 3x5yrs(60mos)      | 175         | 60x10x2mos + 15x5yrs(60mos)      |
(60 months) are basic to Table 3.2. Note that for the 30 numbers listed for the antediluvian patriarchs up to the Flood (from Adam to Noah), all of the ages end in 0, 5, 7, 2 (5 + 7 = 12), or 9 (5 + 7 + 7 = 19) – a chance probability of one in a billion! For the entire 60-number list (antediluvian and postdiluvial) none of the ages end in 1 or 6 – a chance probability of about one in a half million.

Such mathematical improbabilities also continue for the generations between Adam and Moses, as shown in Table 3.3. If one includes the six generations from Abraham to Moses (Isaac, Jacob, Levi, Kohath, Amran, Moses), then the total number of years for these men becomes 12,600 (70 x 180), which total reflects both the sexagesimal (base 60) system of Mesopotamia and the Mesopotamian-Hebrew preferred number 7 (or 70). The ages in the first Genesis 5 column add up to 8575 (25 x 7 x 7 x 7) and the 7 ages in the third column add up to 1029 (3 x 7 x 7 x 7). The 17 ages of the first and third column combined add up to 9604 (4 x 7 x 7 x 7); the middle age for these two columns is that of Lamech (777), and remarkably the 7 ages on either side of Lamech add up to a total of 7777!

<table>
<thead>
<tr>
<th>Genesis 5</th>
<th>Genesis 11</th>
<th>Abraham to Moses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>930</td>
<td>Shem</td>
</tr>
<tr>
<td>Seth</td>
<td>912</td>
<td>Arpachshad</td>
</tr>
<tr>
<td>Enosh</td>
<td>905</td>
<td>Shelah</td>
</tr>
<tr>
<td>Kenan</td>
<td>910</td>
<td>Eber</td>
</tr>
<tr>
<td>Mahalalel</td>
<td>895</td>
<td>Peleg</td>
</tr>
<tr>
<td>Jared</td>
<td>962</td>
<td>Reu</td>
</tr>
<tr>
<td>Enoch</td>
<td>365</td>
<td>Serug</td>
</tr>
<tr>
<td>Methuselah</td>
<td>969</td>
<td>Nahor</td>
</tr>
<tr>
<td>Lamech</td>
<td>777</td>
<td>Terah</td>
</tr>
<tr>
<td>Noah</td>
<td>950</td>
<td></td>
</tr>
</tbody>
</table>

*Table 3.3*. The 26 generations between Adam and Moses and total years of each person’s life span.
It is inconceivable that all of this should be accidental! Surely, if all of the ages listed in Tables 3.2 and 3.3 are statistically random numbers, as would be expected for real ages, such numerical improbabilities would not exist. These numbers were purposely contrived by a person or persons knowing mathematics, and were incorporated into the text by the biblical author(s) because they held some sacred significance. What could this significance have been? Are these sacred ages somehow mathematically connected to the real ages of the patriarchs? Could they be cryptographic (gematria) numbers, where numerical values were assigned to different letters of the patriarchs’ names? Why do the “begetting” ages of the patriarchs decrease over time? Is it because successive biblical authors gradually lost their concept of sacred exaggerated sexagesimal numbers over time? Were these numbers “assigned” to the patriarchs on the basis of their character, accomplishments, or relationship with God? For example, in the generally decreasing age trend, there is an enormous jump in the “begetting” age of Noah, which may signify an attempt by the biblical author to favor the more righteous, or those who “stand out” from the rest due to their prominence in the unfolding story (i.e., Noah, the hero of the Flood). Whatever the specific intent of the biblical author(s) for each of these patriarchal ages, it does seem apparent that at least one main purpose of the text was to preserve numerical harmony.

**Numerical Symmetry and Harmony**

As emphasized in Chapter 2, there is a symmetry and regularity to the whole of Genesis that cannot be accidental. Rather, there seems to have been an intentional attempt to impart religious harmony and prosaic beauty to the text commensurate with the style of literature of that time. This same symmetry and regularity also applies to numbers. For example, each genealogy presented in Chapters 5 and 11 of Genesis includes ten names. Adam to Noah contains ten names...
and Shem to Abraham contains ten names (Table 3.2). To break a text into a ten-generational pattern was common for many Near Eastern people-groups of that time, and reflected an overall sense of numerical importance and harmony (ten was the base of the decimal numbering system for most of these peoples, including the Egyptians and Hebrews). In addition, the description of each of these ten generations ends with a father having three sons; e.g., in Genesis 5:32, Noah begot Shem, Ham and Japeth, and in Genesis 11:26, Terah begot Abram, Nahor and Haran. This is likewise the case for the Canaanite genealogy with respect to Jabal, Jubal and Zillah (Gen. 4:20-22). By ending each of these sections with three sons, an overall symmetry was established in Genesis using the preferred number three for emphasis. Thus, it appears that the symmetry of the Genesis text is artificial rather than natural. This is not to say that Noah or Terah or Cain did not have three (or more) sons, or that these sons were not real historical people. It is to say that the biblical author mentioned only these sons so that the text was made numerically symmetrical and harmonious within the overall framework of religious intent.

**Genealogies and Chronologies**

**Condensed Genealogies and “Gaps” in Chronology**

The matter of obtaining a creation date from the patriarchal ages is not that simple if one looks carefully at the whole genealogical record of the Bible. Genealogies in the Bible are frequently abbreviated by the omission of unimportant names. In fact, abridgment was the general rule for biblical authors who did not want to encumber their texts with more names than necessary for their intended purpose. Numerous examples of abridgment exist, the most notable example being the genealogy of our Lord in Matthew 1:8 where Uzziah was not the son but the great-great grandson of Joram (3 names have been dropped). The tradition of breaking down
long genealogical lists into a ten-generational pattern also suggests that only the most important
ten persons were retained. Since a number of names have been omitted from biblical
genealogies, it is logical to conclude that these genealogies should be used in a broad sense to
indicate overall descent (“X fathered the line culminating in Y”) rather than a direct father-to-son
relationship (“X fathered Y”). Furthermore, the fact that each member of a series is said to
“beget” the next succeeding member is not evidence in itself that some genealogical links have
not been omitted. For example, in Genesis 46:16-18, the children born to Jacob by Zilpah
actually includes not only their sons (Gad, Asher), but their grandsons and great-grandsons.
Thus, the word “beget” in the Bible does not always refer to a literal biological father-to-son
relationship. Sometimes “beget” does not even apply to people. It can also refer to geography
(e.g., Elishah, Tarshish, Gen. 10:4 and 1 Chr. 1:2), to cities (e.g., Sidon, Gen. 10:15), to people
groups or tribes (e.g., Kittim and Dodanim, Gen. 10:4 and 1 Chr. 1:17), and even to nations (e.g.,
Canaan, the grandson of Noah is said to have begotten the Jebusites, Ammonites, etc.; Gen.
10:16-18).

Other evidence suggesting that there could be gaps in the Genesis chronologies is the
“overlap” of patriarchal life spans. If the genealogies in Genesis 5 and 11 are both literal and
complete, then the death of Adam has to be dated to the generation of Noah’s father Lamech.
Shem, Arphaxad, Shelah, and Eber would have outlived all of the generations following as far
and including Terah, the father of Abraham. Noah would have been the contemporary of
Abraham for 58 years and Shem (Noah’s son) would have survived Abraham by 35 years. But
where does the Bible indicate that any of these men were coeval? They are spoken of as
respected ancestors, not as contemporaries that interacted with them. Concluding that the ages
for the patriarchs are literal is contrary to the spirit of the record that presupposes gaps between
the lines of Adam and Noah and between Noah and Abraham.¹⁸

These gaps and overlap in people, and the flexibility of the word “beget”, must be
considered in the interpretation of the stated ages of the patriarchs. When it is said, for example,
in Genesis 5:9: And Enosh lived ninety years, and begot Kenan, how do we know that “beget”
means that Kenan was the immediate son of Enosh or if he was in the descendent line of Enosh?
Perhaps Enosh was ninety years old when his grandson Kenan or great-grandson Kenan was
born.

**Biblical Chronologies and the Worldview Approach**

What then is to be made of the Genesis chronologies? From the perspective of the
numerological worldview of the Mesopotamians, the patriarchal ages do not represent real
numbers – they represent sacred symbolic numbers. Therefore, it is concluded that the
genealogies of Genesis cannot be used for the construction of a chronology on an absolute time
scale. It is forcing a purpose for the biblical chronologies that was never intended. Biblical
chronologies were intended by the biblical author(s) to confirm a specific line of descent for the
Jews in the Old Testament, from Adam down to Jesus in the New Testament – not to set an
absolute date for the creation of the world.¹⁹

However, does the conclusion that the Genesis numbers are not “real” also imply that the
people mentioned in these chronologies are not “real”? If it does imply this, then why does the
Bible go to such great lengths to establish the genealogies of Genesis, Chronicles, Ezra-
Nehemiah, Matthew, and Luke. First Chronicles begins with nine chapters of “begots”. If these
genealogies are not real then where do the mythological people end and the real people begin?
Do real people start with Abraham, which lineage Matthew 1 says leads to Christ? The so-called “critical scholars” would say no – Abraham and the patriarchs were invented by scribes during the Israelite monarchy or exile (see discussion in Chapter 2). What about Moses and the Exodus from Egypt? Archeology has found no evidence for this event, so was Moses also “invented”? Mark 9:4 has Elijah and Moses talking to Jesus, so were these people – if not historically real – only a figment of Jesus’ and the disciples’ imaginations? What about Solomon and David? Is the whole history of Israel to be denied – the history that Jesus attests to many times in the New Testament?

To answer these questions from a worldview approach, let’s go back to the basic premise of the worldview approach stated in Chapter 1: The Bible in its original (autograph) text accurately records historical events, viewed within the culture (worldview) of that time. For the Bible to be historically accurate, the people, places, and events mentioned in it must be real. However, the description of these people, places, and events are necessarily colored by the culture and worldview of the authors who wrote the text. To “beget” someone necessitates a physical act – either it happened or it didn’t. But a sacred, non-numerical use of numbers is a cultural act that stems from a particular worldview. Therefore, the worldview approach considers Adam and Eve, the Garden of Eden, Noah and the Flood, Abraham, etc. to be real people, places, and events, but as stories told from the cultural perspective of the biblical author(s). There must be a basic historical core that underlies all of the Bible, otherwise the integrity of the Bible is compromised.

Biblical Evidence for an Old Earth
In addition to a worldview approach to the Genesis chronologies, which concludes that patriarchal ages cannot be used in an absolute time scale for the age of the Earth, certain verses in the Bible also seem to indicate that the Earth is old. Habakkuk 3:6 talks about the “everlasting mountains and perpetual hills”. The Hebrew word for “everlasting” is ‘ad. This is exactly the same word as used in Isaiah 9:6: “The everlasting Father, the Prince of Peace”. The word means: “of advanced duration, in perpetuity, old, perpetually, or without end”. The Hebrew word for “perpetual” is olâm meaning “time out of mind (either past or future), ancient, lasting, of old”.

Another verse in the Bible that suggests the Earth is old is Deuteronomy 33:15: “And for the chief things of the ancient mountains, and for the precious things of the lasting hills”. The Hebrew word for “ancient” is gêdmâh, meaning “antiquity, aforetime, ancient time, old.” “Lasting” is the same as perpetual (olâm). All of these words seem to indicate that the Bible is saying that the mountains (and thus the rocks that make them up) are very ancient, older than just a few thousand years.

**Geologic Evidence for an Old Earth**

The worldview perspective on the numbers and chronologies of Genesis being symbolic and non-absolute is important because it proposes that the biblical author(s) never meant to imply a 6000 year-old age for planet Earth. Therefore, the scientific evidence for an old Earth, which we will be discussing in this section, is not contrary to the Bible. There are many independent lines of evidence for the claim that the Earth is 4.5-4.6 billion years old, but we will only discuss a few of them. In this chapter we will cover only those geologic topics related to the age of the Earth, whereas in the next two chapters we will cover the topic of Noah’s Flood with respect to the worldview approach.
The “discovery of time” was a slow, painful, and in many cases heart-wrenching process because long-time periods for geologic processes to occur challenged traditional church doctrine that proclaimed the Earth was young. It was only gradually, mainly over the last 150 years, that the great age of the Earth has become established. The process started just after the time of Galileo, at the very beginning of the Age of Enlightenment.

Relative Time: The Geologic Column

The history of geologic time begins in the mid-1600s with the-then rampant debate as to the origin of fossils and how seashells could have become embedded in rocks on the tops of mountains. The most prevalent theory at that time was that fossils grew within the rock itself and only mimicked living organisms. Entering into this debate was Nicolaus Steno (1638-1686), the diminutive, soft-spoken, anatomist-scientist from Denmark, who was to become the founder of modern geology. By carefully examining the fossils, rock, and strata in many parts of central and southern Europe, Steno proposed three of the most basic principles of geology in his book *De solidio*, published in 1669 in Florence, Italy:

1. *The Principle of Superposition.* Given that sedimentary layers are arranged one on top of another, and given that sediments deposit out of water (usually the ocean), the layer on the bottom must be deposited first and the layer on top must be deposited last. Thus, a sequence of bedrock layers comprises a *relative* chronology of geologic events over time.

2. *The Principle of Original Horizontality.* When superimposed sediments deposit out of water they will do so in roughly horizontal layers. Thus, any tilting or folding of these originally horizontal layers must be the consequence of later events.
The Principle of Lateral Continuity. When sediments deposit out of water they do so in laterally continuous layers. Thus, corresponding horizontal strata on opposite sides of a valley must have originally formed as continuous layers that were later cut by the valley. Steno was the first person to draw an actual geologic cross-section of how land forms change with time, having constructed his diagram from observing the rock layers of Tuscany (Fig. 3.2).

Figure 3.2. The first geologic cross sections, made by Nicolaus Steno in 1669 and included in his book *De solida*. Steno’s cross-section is of Tuscany, showing the six different stages of its development. The sequence begins with diagram 25 (lower right) and ends with diagram 20 (upper left). Steno envisioned two cycles; in each, sedimentary strata are laid down, then undermined by the growth of caverns, so as to finally collapse to create mountains and valleys. Steno’s interpretation of the role of caverns was incorrect (actually faults are involved), but his idea of the relative sequence of sedimentary strata was correct. Courtesy of History of Science Collections, University of Oklahoma Libraries. NEED PERMISSION.

These three basic geological principles seem commonsensical to us today, but in the 1600s the implications were too shocking to be believed. The implication of Steno’s observations was that the world was significantly older than the 6000 years supposed from a literal reading of the Genesis chronologies because it took time for sediments to form many layers, turn into rock, and be subsequently cut by valleys.

This general unbelief in long periods of time needed for geologic processes to occur continued until the early 1800s when an English surveyor and civil engineer named William Smith (1769-1839) became intrigued by the relationships he saw in the rock strata of England
and Wales. As Smith “walked out” these strata from place to place in the countryside, he noticed that many of the beds he was surveying contained fossils in them. Furthermore, he observed that (no matter where found) some rock layers contained identical fossils, whereas the fossils in rock layers above or below contained different characteristic fossil assemblages. Because Smith was a surveyor mapping the rock units in order to construct canals, he began to note which layers had which fossils in them. Eventually Smith became so skillful that, confronted with a fossil he had not collected, he could identify the rock unit from which the fossil had come. Smith then used Steno’s Principle of Superposition to determine which of these rock layers (with their characteristic fossils) were relatively older or younger than other rock layers containing their own characteristic fossils. Smith was thus the first to recognize the Principle of Faunal Succession, which states that successive layers of rock contain different assemblages of fossils and that increasingly complex life forms are found in successively younger strata.

By visiting and correlating hundreds of sites over many years, Smith was able to create a map depicting a vertical sequence of relatively older to younger rock layers. Smith’s work led to the publication of the first modern geologic map in 1815 (Fig. 3.3) and also to the first geologic column. At about the same time as Smith’s work, other geologists started to break the rock sequence into successive systems of strata; i.e., the Cambrian, Ordovician, Silurian, Devonian, etc., named for various places where rocks of a certain type and fossil content were found (e.g., the Devonian is named for Devon, England). The time intervals during which similar rock-fossil types were deposited were named geologic periods, and smaller divisions within these periods were named epochs. As this system of rock identification spread to other countries and continents, periods and epochs were combined into larger time units (eras and eons). Eventually
this system was extended to rock strata around the world. Today’s geologic column, in contrast to Smith’s first one of Great Britain, encompasses almost all of the rock strata on planet Earth (Fig. 3.4).

Figure 3.3. The first geologic map ever constructed, by William Smith in 1815 of England, Wales, and parts of Scotland.22 In the archives of the British Geological Survey (?CK). NEED PERMISSION.
Figure 3.4. The geologic column, showing the main eons, eras, periods, and epochs of geologic time.

The geologic column that we have today was originally based on relative time (where strata are older or younger relative to each other). However, within the last fifty years or so...
geologists have been able to assign *absolute* ages to these strata by using the process of radiometric dating of igneous rocks (igneous rocks are those that solidify from melted material, rather than being deposited from water; Box 5.2, Chapter 5). Igneous rocks often crosscut or intrude sedimentary rock, and when this happens the igneous rock must be *younger* than the sedimentary rock it cuts across. This is called the *Principle of Crosscutting Relationships*. Sedimentary rock can thus be assigned approximate absolute ages relative to dated igneous rock, and it is in this manner that all of the dates listed in the geologic column of Figure 3.4 were determined.

The most important thing to realize about absolute dates is that they fit into the relative time scale that had been developed over the previous one hundred years. In other words, rocks placed in the Jurassic Period by relative time don’t radioactively date to, say, the Devonian – they date to the Jurassic (Fig. 3.4). This correspondence and consistency with relative time provides an independent check on the reliability of radioactive dates in absolute time.

**Absolute Time: Radioactive and Non-Radioactive Dating Methods**

The absolute ages of rocks can be determined by using both radioactive and non-radioactive dating techniques. Radioactive dating is a method by which time is measured based on the rates of decay of certain elements (such as carbon) into other elements (such as nitrogen). The element that decays is called the “parent”, while the new element produced from the decay is called the “daughter”. A “half-life” is the length of time it takes for half of a group of atoms in a given radioactive element to decay into another element. The measured half-lives of radioactive elements never change, and range from extremely short durations (seconds) to extremely long durations (in the billions of years).
The process behind radioactive dating is too involved to include here in this brief overview discussion of the age of the Earth, and the reader is referred to the excellent website of geophysicist Roger Wiens for a more lengthy coverage of this subject. What will be mentioned here are some of the different kinds of dating methods (both radioactive and non-radioactive) and how they independently substantiate each other.

**Carbon-14 radioactive dating.** It is the common misconception of many Christians that rocks are dated by the Carbon-14 method because much of the Young Earth Creationist literature has focused on criticizing this method. Rocks are *never* dated by the Carbon-14 method because the half-life decay of Carbon-14 to nitrogen is only 5730 years. Therefore this method can only be used to date material younger than about 40,000 years. Since the majority of rocks are much older than this, the Carbon-14 method is mainly used by archaeologists on carbon-rich materials such as wood, bone, parchment, and ash from ancient fires. For example, the Dead Sea Scrolls have been dated at 1900 C-14 years, corresponding to about 100 B.C.

While the Carbon-14 method is often portrayed as being unreliable by Young-Earth Creationists, it is actually a well-proven method of dating. This is because Carbon-14 dates can be calibrated with dendrochronology – the study of tree rings, especially rings of the ancient bristlecone pine. When Carbon-14 dates are compared with the number of tree rings (a tree grows one ring per year), many Carbon-14 dates come out a bit too young. The Carbon-14 dating method has now been correlated with bristlecone tree-ring records going back to about 12,000 years before the present.

**Other radioactive dating methods.** There are over 40 different radioactive dating techniques; the most frequently used ones are listed in Table 3.4. Radioactive dating techniques usually used to date rocks are the rubidium-strontium (Rb-Sr), the potassium-argon (K-Ar), and
the argon-argon (Ar-Ar) methods. All dating methods have inherent problems, and the idiosyncrasies of these techniques must be understood and corrected for by geochronologists. For example, the potassium-argon method is especially susceptible to problems involving “parentless” argon. When Mt. Saint Helens erupted 25 years ago, potassium-argon dates on these brand-new ash flows gave dates of about 300,000 years. This was because some “old” argon within the Mt. Saint Helens volcano had been included within the ash flows when they erupted and thus these ash layers gave anomalously old ages. As geochronologists have known for over 20 years, igneous rocks younger than a few million years cannot be dated by the potassium-argon (K-Ar) method: the argon-argon (Ar-Ar) method must be used instead. For example, the argon-argon method has been used to very accurately date lavas produced in historical times, such as the eruption of Mount Vesuvius some 2000 years ago.

<table>
<thead>
<tr>
<th>Dating Techniques</th>
<th>Time Span Covered by Technique (Ga = billion years ago, Ma = million years ago; Ka = thousand years ago)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radioactive Techniques</td>
<td></td>
</tr>
<tr>
<td>Uranium-lead dating</td>
<td>4.5 by → 1 Ma</td>
</tr>
<tr>
<td>Rubidium-strontium dating</td>
<td>4.5 by → 60 Ma</td>
</tr>
<tr>
<td>Potassium-argon dating</td>
<td>3 by → 3 Ma</td>
</tr>
<tr>
<td>Argon-argon dating</td>
<td>3 by → 10,000 Ka</td>
</tr>
<tr>
<td>Uranium series dating</td>
<td>400,000 → 0 Ka</td>
</tr>
<tr>
<td>Carbon-14 dating</td>
<td>40,000 → 0 Ka</td>
</tr>
<tr>
<td>Non-Radioactive Techniques</td>
<td></td>
</tr>
<tr>
<td>Fission track dating</td>
<td>1 by-500,000 Ka</td>
</tr>
<tr>
<td>Thermoluminescence dating</td>
<td>500,000 → 0 YBP</td>
</tr>
<tr>
<td>Electron spin resonance dating</td>
<td>1 Ma →1000 YBP</td>
</tr>
<tr>
<td>Amino acid racemization</td>
<td>300,000 →500 YBP</td>
</tr>
<tr>
<td>Dendrochronology</td>
<td>12,000 → 0 Ka</td>
</tr>
</tbody>
</table>

Table 3.4. The main radioactive and non-radioactive dating techniques. All of these (and other) techniques are age-consistent with each other.
Since the advent of radiometric dating in the 1950’s, hundreds of thousands of rocks collected from all over the world have been radioactively dated. The oldest rocks on Earth have been discovered in western Australia, and have been dated to approximately 4.1-4.2 billion years ago, with tiny zircons in these rocks dating to approximately 4.4 billion years ago.

Non-radioactive dating techniques. Some Young Earth Creationists claim that the half-lives involved in radiometric dating are not constant and therefore radiometric dates cannot be trusted. However, there are also many non-radioactive dating techniques, some of which are shown in Table 3.4. The important thing to realize is that when both radioactive and non-radioactive techniques are used on the same samples, the ages derived are consistent with each other. This is independent evidence that the dates derived from radioactive dating are reliable.

Geologic Processes Take Time

Before absolute ages were assigned to the geologic column, geologists knew that the Earth was old – they just didn’t know how old. Even as early as the 1800s geologists could see that ancient rocks had formed like their modern volcanic and sedimentary counterparts, and so they tried to estimate how long processes relating to this geology took to happen. Some of the first geological calculations for an old Earth were contained in a paper by Charles Lyell (1779-1875), read before the Royal Society of London in 1853. Lyell estimated the volume of sediment that had been deposited in the Gulf of Mexico, and then calculated that it would have taken more than two million years for the Mississippi River to convey this amount of solid matter to the Gulf based on measured erosion rates. Such calculations of millions of years for the Earth’s age grew to hundreds of millions of years by the end of the 19th Century. Arthur Holmes in his 1927 classic book Age of the Earth\textsuperscript{24} estimated that the Earth was somewhere between 1.6 and 3.0
billion years based on erosion rates, the relative relationship of different rock strata, and Earth
heat-loss considerations.

Sedimentary Rock

To understand how geologists estimate the age of the Earth, we will briefly cover some of
the ways in which this is done. One of the ways involves how rocks form, especially sedimentary
rocks. (Refer to Chapter 5, Box 5.2 for an overview on how the different rock types form). Some
types of rocks form very fast – for example, the volcanic rocks deposited during the Mount Saint
Helens eruption. However, other rocks, such as sedimentary rocks, form very slowly.
Sedimentary rocks are formed by the hardening of sediments, such as mud, sand, or lime,
through a process of compaction and cementation. When sediments are buried beneath other
sediments, they become hardened by the weight of compaction. Eventually, minerals grow
between the sediment particles and cement the sediment into hard rock. In this manner, clay
sediments turn into a rock called shale, sand sediments into sandstone, and limy-shelly
sediments into limestone.

How long does it take for sedimentary rock to form? It takes hundreds to thousands of
years for rock particles to be weathered and eroded from mountains, pounded and worn down
into rounded grains of sand and silt by streams and rivers, and eventually carried to the sea,
where they are dumped as sediment at the mouths of rivers. Even after tens of thousands of years
such sediment may lie only several feet below the seafloor. An example of sediment buried
offshore is the great Mississippi River delta of the Gulf of Mexico. Deep oil wells have
penetrated an accumulation of over 20,000 feet of sediment in the Gulf, and if it has taken tens of
thousands of years for only several feet of sediment to have accumulated, imagine the millions of
years required for 20,000 feet of sediment to have accumulated there. As it turns out, Lyell was much too conservative in his time estimate for sediment accumulation in the Gulf of Mexico because he didn’t know how deep the sediments extended beneath the Gulf.

**Plate Tectonics (Continental Drift)**

The recognition of plate tectonics has been the greatest advance in the geological sciences in the second half of the twentieth century. Plate tectonics successfully explains the origin of continents, ocean basins, mountain belts, zones of volcanic and earthquake activity, and many other geologic features of Earth. The premise of plate tectonics is that the lithosphere of the Earth (its solid crust and upper mantle) is not a single, continuous layer. Rather, the lithosphere is broken into irregular “plates,” as if the outer shell of the Earth were cracked (Fig. 3.6). These lithospheric plates are outlined by boundaries that correspond with the Earth’s most active volcanic and earthquake zones, and these plates have moved with respect to each other over time.

![Figure 3.6](image-url)

*Figure 3.6.* Six major lithospheric “plates” and several smaller ones cover the Earth’s surface and move over time in the direction shown by the arrows. Plates have three kinds of margins: (1) spreading centers delineated by mid-oceanic ridges; (2) subduction zones, delineated by seafloor trenches; and (3) transform faults (the zig-zag edges of the plates shown above). Note how the “horn” of South America would “fit” into the inset of Africa if the South American Plate and the African Plate would move back together instead of apart.\(^{25}\) NEED PERMISSION
Plate tectonics developed out of an earlier idea known as *continental drift*. Ever since maps were first made of the Atlantic Ocean, it was observed that the continents of South America and Africa could be made to fit together, like giant pieces of a jigsaw puzzle (Fig. 3.6). Alfred Wegener, a German scientist, during the years 1915 to 1930, championed the idea that the continents had drifted apart, and if put back together they would form an ancient supercontinent that he called *Pangea*. Wegener collected relevant rock and fossil data from continents around the southern Atlantic and Indian Oceans to support his drifting continent model. However, geologists of his day did not accept Wegener’s hypothesis of continental drift because he did not have a mechanism to drive continental movement.

Wegener’s theory of continental drift was not verified until geologists began to concentrate their research on the sea floor in the 1960s. This new research revealed high mountain chains (*mid-oceanic ridges*) rising up from flat areas (*abyssal plains*), long cracks (*transform faults*) in the ocean floor projecting at right angles away from these submerged mountains, and deep *ocean trenches* bordering the edges of continents (Fig. 3.6). The progressively older ages of rock outwards from mid-oceanic ridges verified that new material was welling up along the ridges and that sea-floor spreading was continually moving material away from the ridges.

Why are geologists so convinced that continental plates are moving and that the sea floor is spreading? Because they can measure this movement. The rate of plate movement is measured with the aid of satellite-based global positioning systems (GPS) and also with sophisticated measurements of distances between radio telescope stations on Earth relative to star positions. It is now known that the mid-Atlantic U.S. coast is moving away from Europe at a rate of about a half an inch per year, and that the coast of California is moving northward along the San Andreas
fault at a rate of about one inch per year relative to the rest of North America. The magnitude 9.0 earthquake that created the December, 2004 Indonesian tsunami disaster was caused by the Indian plate being forced beneath the Burma plate at an average subduction rate of about 2.5 inches per year. Some parts of the Pacific Ocean plate, where it is drifting towards East Asia, have measured rates of up to 3 inches per year (or about as fast as your toenails grow).

Importantly, all of this modern data verifying plate movement is consistent with ancient rock data. The age of the ocean crust just beyond the continental margin of eastern North America has been measured by radiometric dating at about 150 million years, while the age of rocks in the vicinity of the Mid-Atlantic Ridge are less than one million years (Fig. 3.6). The average distance between these two points in the western Atlantic Ocean is about 3000 miles. Dividing this distance by the time span yields a spreading rate of about a half an inch per year – or about the average rate of seafloor spreading that we can measure today. Thus, plate tectonics is another piece of evidence that the Earth’s land forms are far older than 6000 years.

Ice Core and Sedimentary Layers

There is other geologic evidence that the age of the Earth exceeds 6000 years. We have already mentioned the tree-ring sequence in bristlecone pines that records at least 12,000 years of time. We will now briefly mention two other (among many) pieces of evidence: annual layers in ice and annual layers in sedimentary rocks.

Every year in the winter when it snows on the thick ice sheets of the Arctic and Antarctic, a new thin layer of ice accumulates. Then in the summer part of this ice may melt and become hard or discolored with dust, so as to become distinguishable from the previous year's dust layer. Such annual layers have built up year after year in the Earth’s ice caps, thus preserving a record
of Earth’s climate. In Greenland, layers going back to more than 100,000 years have been obtained, while in the Antarctic layers going back to about 200,000 years have been obtained.

Certain kinds of sedimentary rocks can also display yearly layers, called “varves” by geologists. Varves are found in some types of shale, limestone, and evaporite deposits (sedimentary rocks that form from evaporite minerals such as gypsum or salt). One example of an evaporite varved sequence is the Castile Formation of West Texas. The yearly layers (laminations) of the Castile Formation represent a two-component (couplet) system of light-gray to yellowish gypsum and gray-brown to dark-gray to black limestone. From counting the number of varves, the total amount of time represented by the deposition of the Castile Formation is approximately 200,000 years.

Oil and Natural Gas

Only a few geologic environments favor the formation of petroleum (oil and natural gas). With very few exceptions, oil and natural gas are associated with sedimentary rocks of marine origin containing microscopic plant and algal organic material. As this organic-rich rock is buried deeper and deeper, it is exposed to higher subsurface temperatures and passes into what geologists call the "oil window." This occurs where temperatures exceed about 120 degrees Fahrenheit and burial depths of over one mile and up to three miles. Under even higher temperatures and depths, natural gas forms in the "gas window." Almost no oil exists in rocks younger than about 2 million years, so geologists know that it must have taken at least this long for oil to have formed, migrated, and accumulated in traps where commercial oil drillers find it today. Oil and natural gas deposits are further confirmation that Earth’s geologic processes take many millions of years.
Astronomy and the Age of the Earth

As already mentioned in Chapter 2, the universe is now considered by astronomers to be about 13-14 billion years old (Fig. 2.1). The time that our sun and solar system condensed out of the solar nebula is believed to have been approximately 4.5 to 4.6 billion years ago, based on the 4.54 billion year dates obtained on carbonaceous chondrite-type meteorites. Meteorites are rocks from space that are believed to be made from primitive material that condensed during the formation of our solar system. The oldest dates obtained for Moon rocks, collected by the astronauts when they were on the Moon, are approximately 4.2 billion years old. Thus, the Moon must have formed as a solid planetary body at least by this time. The oldest rocks/minerals found on Earth have been dated to about 3.8-4.4 billion years. A synthesis of all of this information places the original formation of the Earth as a planetary body in the solar system at about 4.5-4.6 billion years ago.

Is Genesis Mythological or Historical?

The fact that the numbers in Genesis may have been “contrived” by the biblical author(s) is difficult for many Christians to accept. Doesn’t this view compromise the integrity of the Bible and mean that it cannot be trusted? Doesn’t it imply that the Bible cannot be taken “literally”? No, it only means that the text must be approached from the worldview of the people who wrote it. We have to try and “get into the minds” of these ancient people and understand what made them tick – just like modern missionaries must try and understand the worldview of the people they are trying to evangelize. In the case of Genesis, we must try to understand the text from the
worldview of the ancient Near East. Peoples of the ancient Near East simply did not think along the same lines, or express themselves in the same manner, as we do today.

The important question to ask is: Is Genesis, and the record of the patriarchs from Adam to Abraham, to be considered mythological or historical? Ironically, by interpreting the numbers of Genesis “literally” many Christians have created a mythological world. But, if understood from the worldview of the ancient Mesopotamians, the Genesis record proves to be remarkably accurate, as I will try and show in the next two chapters on Noah’s Flood.

NOTES


22. For an excellent layperson’s explanation of the process of radiometric dating go to the website: http://www.asa3.org/ASA/resources/Wiens.html.

