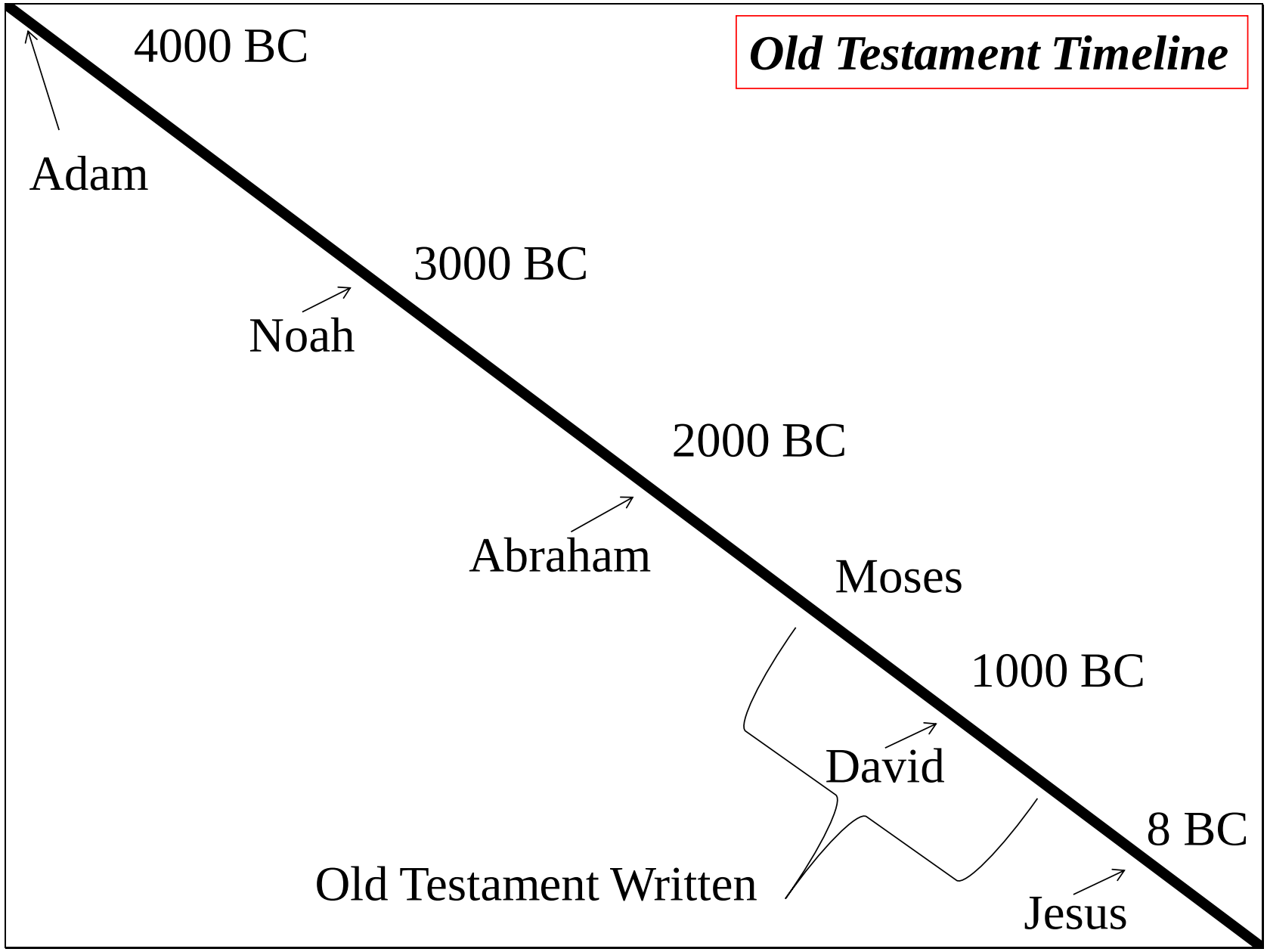
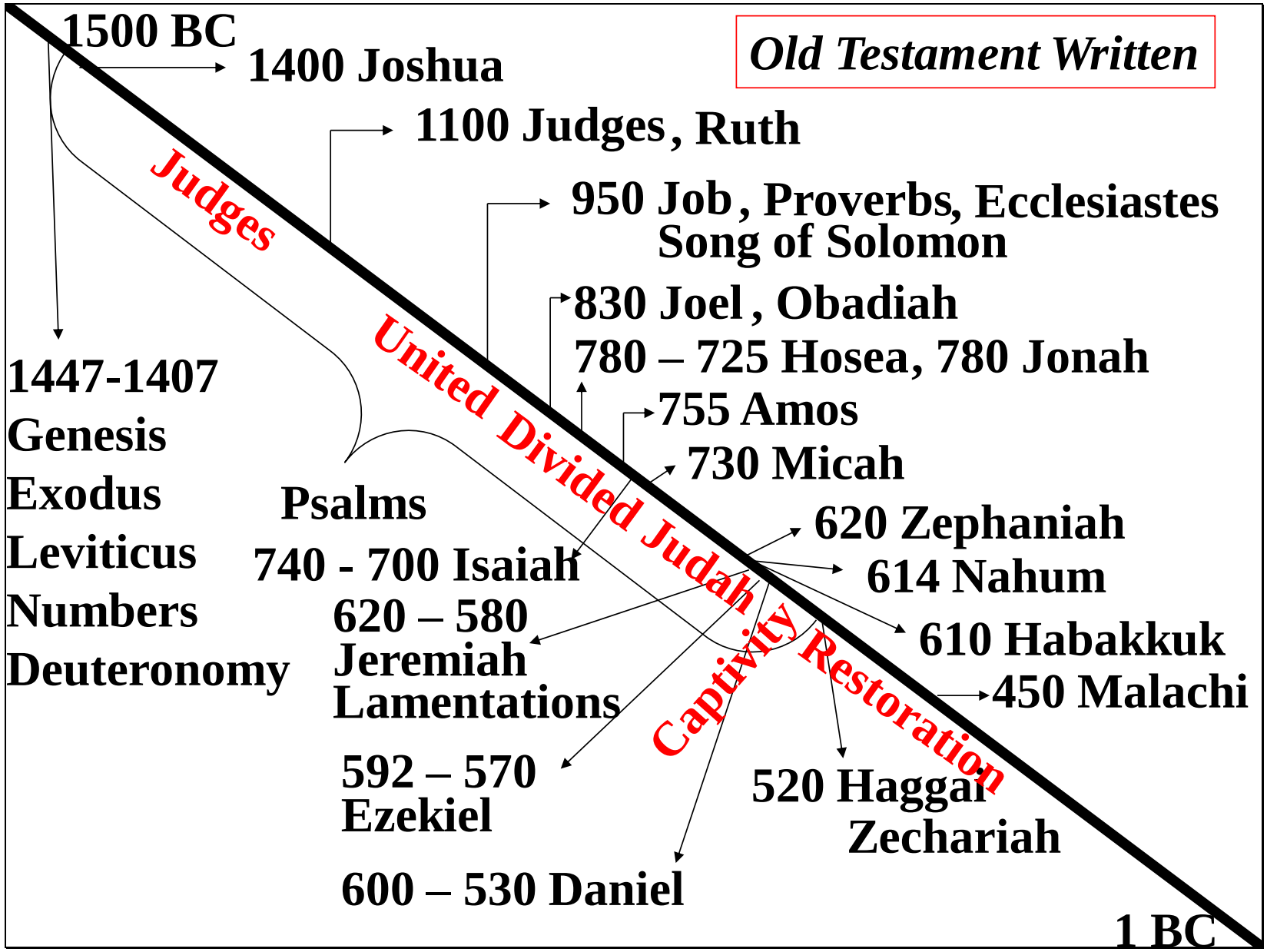
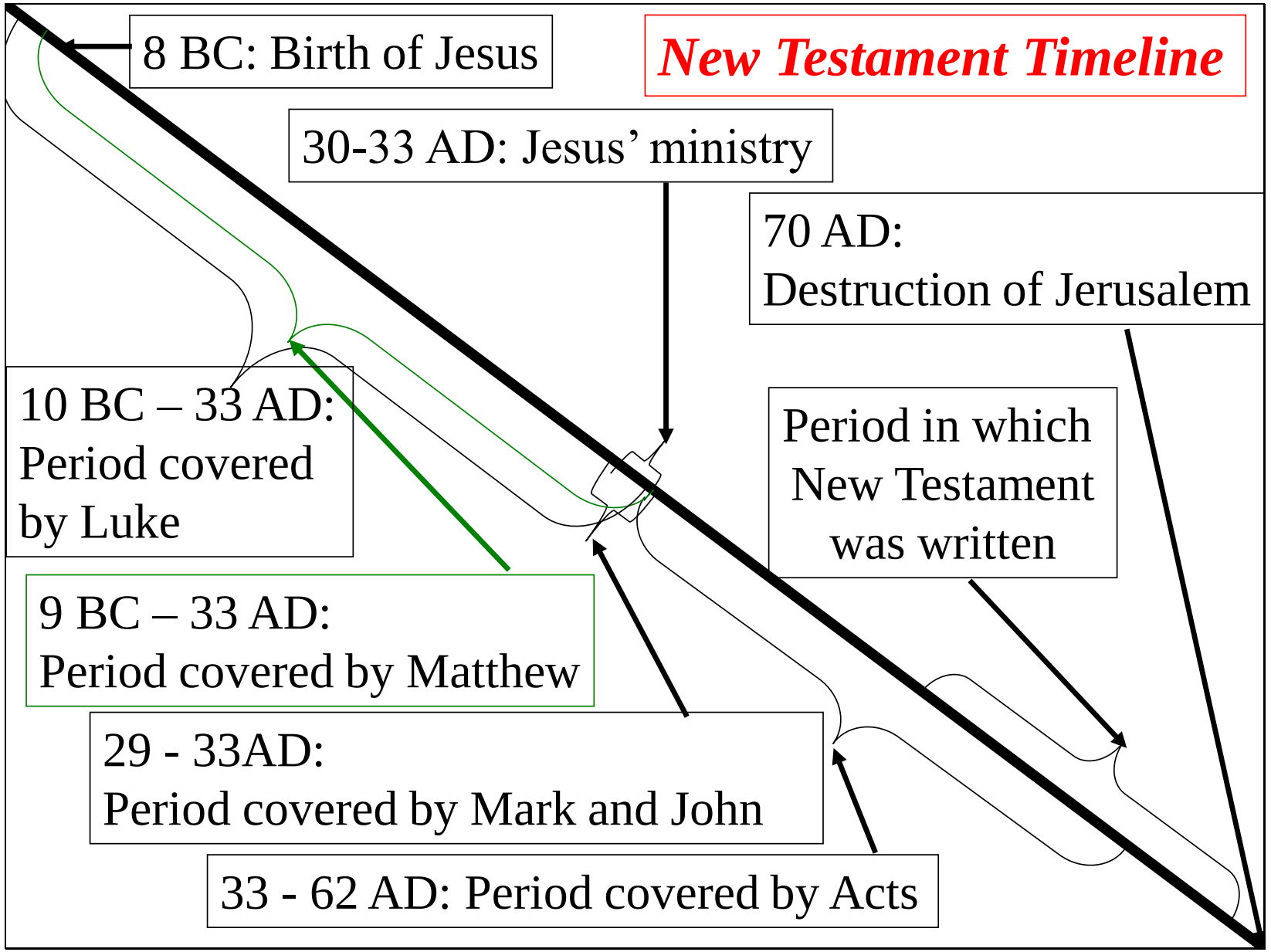
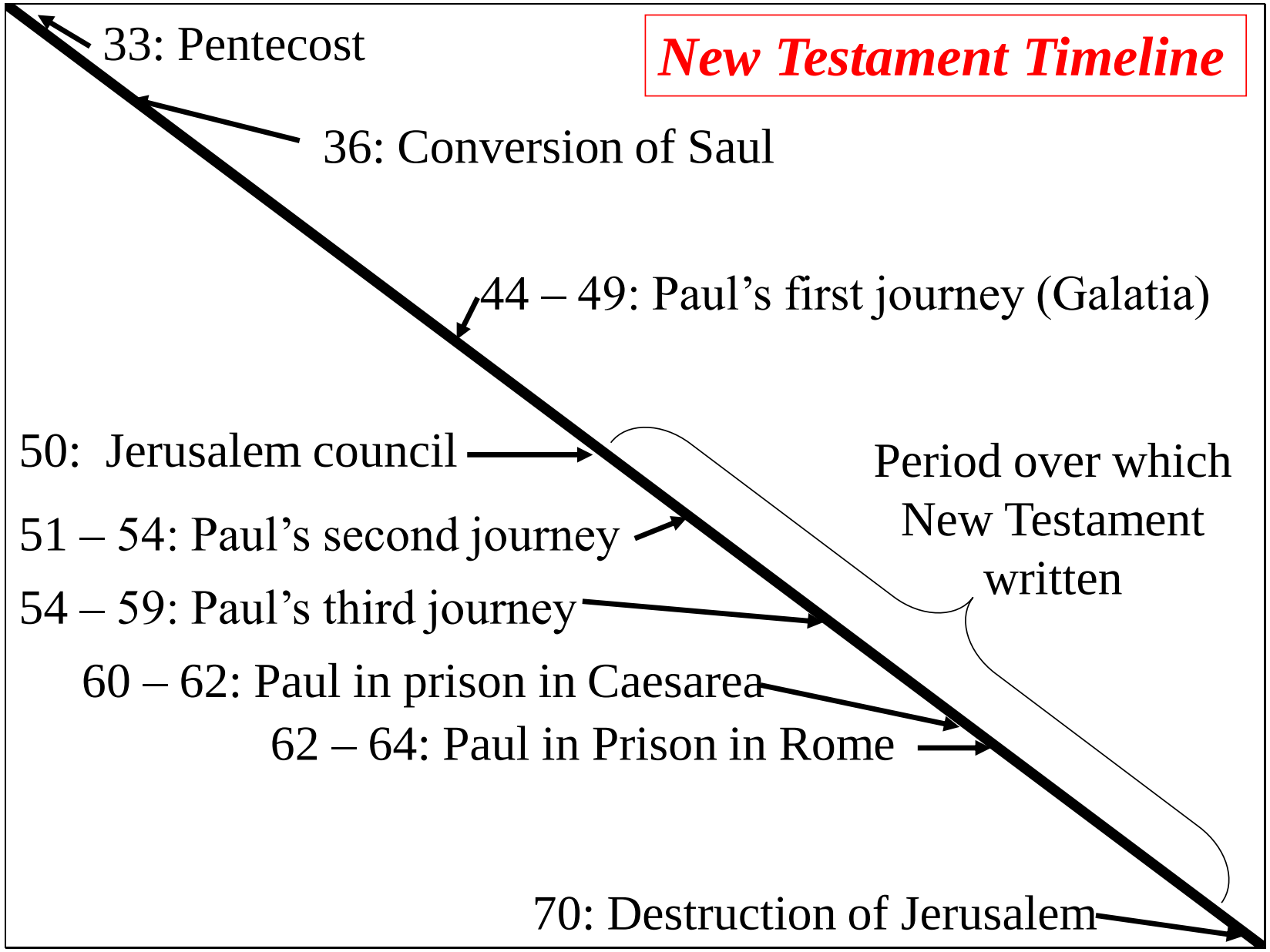
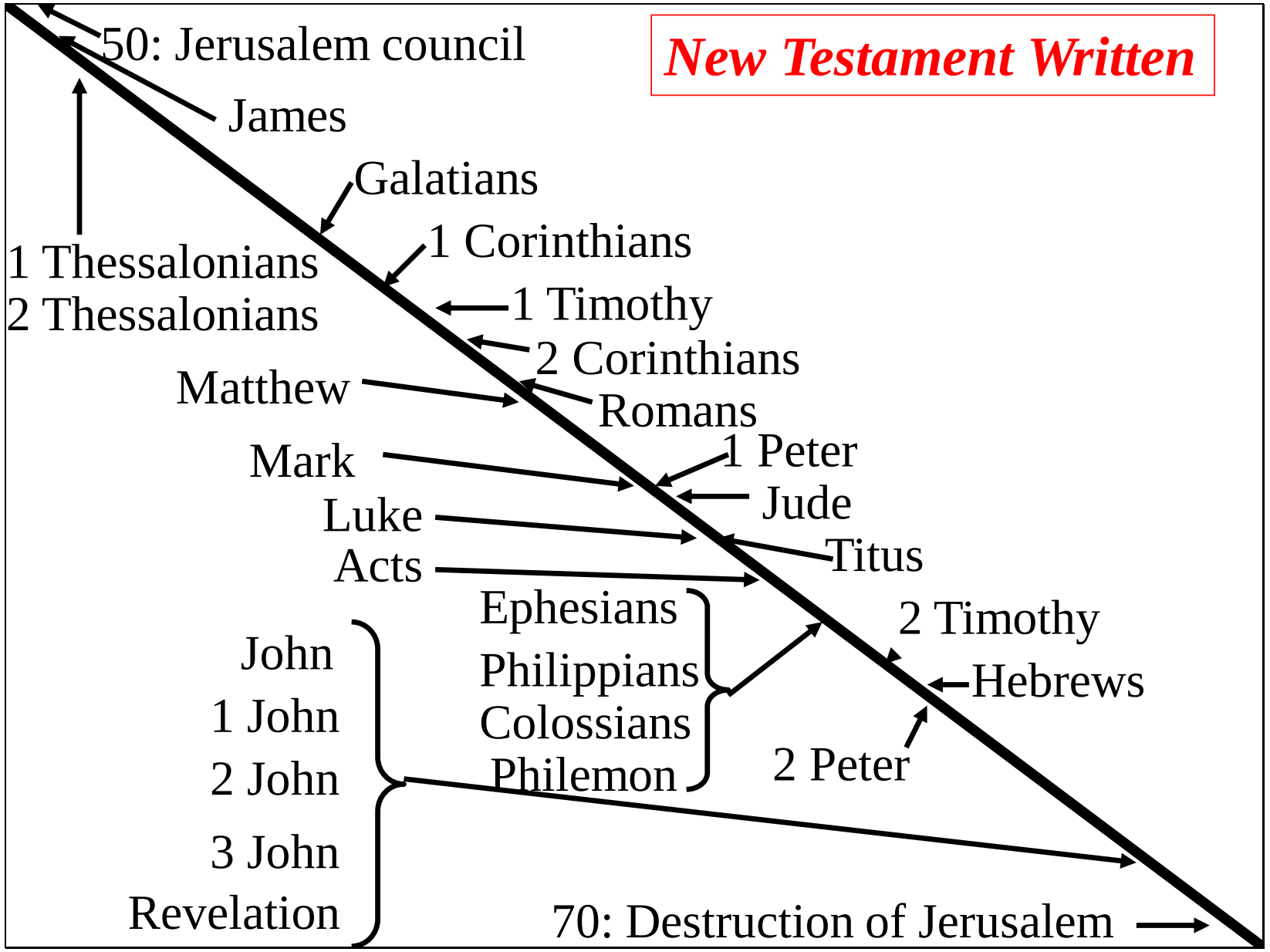

Old Testament Timeline
4000 BC
Adam
3000 BC
Noah
2000 BC
Abraham
Moses
1000 BC
David
8 BC
Old Testament Written
Jesus

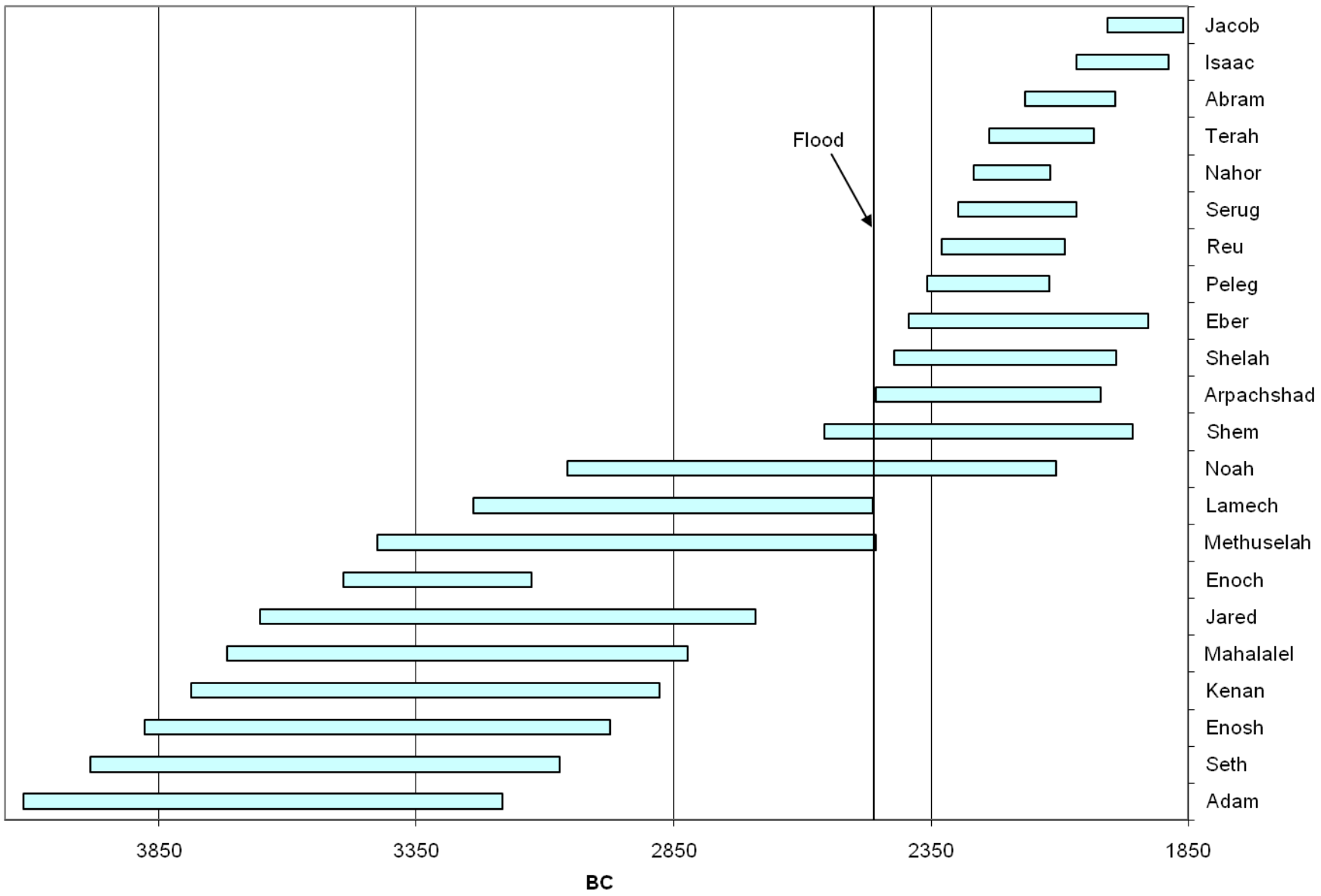

1500 BC
1400 Joshua
1100 Judges, Ruth
950 Job, Proverbs, Ecclesiastes
Song of Solomon
830 Joel, Obadiah
780 – 725 Hosea, 780 Jonah
755 Amos
730 Micah
620 Zephaniah
614 Nahum
610 Habakkuk
450 Malachi
520 Haggai
Zechariah
600 – 530 Daniel
592 – 570
Ezekiel
620 – 580
Jeremiah
Lamentations
740 - 700 Isaiah
Psalms
1447-1407
Genesis
Exodus
Leviticus
Numbers
Deuteronomy
Judges
United Divided Judah
Captivity
Restoration
1 BC
Old Testament Written


8 BC: Birth of Jesus
New Testament Timeline
30-33 AD: Jesus' ministry
70 AD:
Destruction of Jerusalem
10 BC – 33 AD:
Period covered
by Luke
Period in which
New Testament
was written
9 BC – 33 AD:
Period covered by Matthew
29 - 33AD:
Period covered by Mark and John
33 - 62 AD: Period covered by Acts


New Testament Timeline
33: Pentecost
36: Conversion of Saul
44 – 49: Paul's first journey (Galatia)
50: Jerusalem council
51 – 54: Paul's second journey
54 – 59: Paul's third journey
60 – 62: Paul in prison in Caesarea
62 – 64: Paul in Prison in Rome
70: Destruction of Jerusalem
Period over which New Testament written


New Testament Written
50: Jerusalem council
James
Galatians
1 Thessalonians
1 Corinthians
2 Thessalonians
1 Timothy
2 Corinthians
Matthew
Romans
Mark
1 Peter
Jude
Luke
Titus
Acts
Ephesians
2 Timothy
John
Philippians
Hebrews
1 John
Colossians
2 Peter
2 John
Philemon
3 John
Revelation
70: Destruction of Jerusalem

Name	Birth year (A.C.)	Age when father	Father year (A.C.)	Age at death	Death year (A.C.)	Tolerance (+ or -)	Tolerance (+ or -)	Birth Year BC	
Adam	0	130	130	930	930	0.5	0.5	4113	Gen 5:3-5
Seth	130	105	235	912	1042	0.7	1.0	3983	Gen 5:6-8
Enosh	235	90	325	905	1140	0.9	1.5	3878	Gen 5:9-11
Kenan	325	70	395	910	1235	1.0	2.0	3788	Gen 5:12-14
Mahalalel	395	65	460	895	1290	1.1	2.5	3718	Gen 5:15-17
Jared	460	162	622	962	1422	1.2	3.0	3653	Gen 5:18-20
Enoch	622	65	687	365	987	1.3	3.5	3491	Gen 5:21-24
Methuselah	687	187	874	969	1656	1.4	4.0	3426	Gen 5:25-27
Lamech	874	182	1056	777	1651	1.5	4.5	3239	Gen 5:28-31
Noah	1056	500	1556	950		1.6	5.0	3057	Gen 5:32, 9:29
Flood in Noah's 600th year					1656	1.7	5.5	2457	
Assuming that Shem was Noah's first child...ages are not given for the others.									
Shem became a father 2 (3?) years after the flood, so the total must be corrected.									Gen 8:13, 11:10
Shem	1556	100	1656	600	2156	1.7	5.5	2557	Gen 11:10-11
Arpachshad	1656	35	1691	438	2094	1.7	6.0	2457	Gen 11:12-13
Shelah	1691	30	1721	433	2124	1.8	6.5	2422	Gen 11:14-15
Eber	1721	34	1755	464	2185	1.9	7.0	2392	Gen 11:16-17
Peleg	1755	30	1785	239	1994	1.9	7.5	2358	Gen 11:18-19
Reu	1785	32	1817	239	2024	2.0	8.0	2328	Gen 11:20-21
Serug	1817	30	1847	230	2047	2.1	8.5	2296	Gen 11:22-23
Nahor	1847	29	1876	148	1995	2.1	9.0	2266	Gen 11:24-25
Terah	1876	70	1946	205	2081	2.2	9.5	2237	Gen 11:26-32
Abram	1946	100	2046	175	2121	2.2	10.0	2167	Gen 21:5 25:7
Abram was 75 when he left for Canaan; Terah died in Haran					2021	2.3	10.5		Gen 12:4, 11:32
Isaac	2046	60	2106	180	2226	2.3	11.0	2067	Gen 25:26, 35:28
Jacob	2106			147	2253	2.4	11.5	2007	Gen 47:28
Jacob lived 17 years in Egypt					2236	2.4	12.0		Gen 47:28
Exodus was 430 years after arrival					2666	2.5	12.5		Ex 12:40-41
The temple was dedicated 480 years after the Exodus					3146	2.5	13.0		1Kg 6:1
The best date for the Exodus is 1447 BC									
This places creation in		4113	BC			2.5	13.0		


Jacob
Isaac
Abram
Terah
Nahor
Serug
Reu
Peleg
Eber
Shelah
Arpachshad
Shem
Noah
Lamech
Methuselah
Enoch
Jared
Mahalalel
Kenan
Enosh
Seth
Adam
Flood
3850
3350
2850
2350
1850
BC

PERIODS OF BIBLE HISTORY

Period	Dates	Books	Major Events
Antedeluvian	~4113 – ~2457	Genesis 1-5	Creation to the Flood
Postdeluvian	2457 – 2100	Genesis 6-11	Noah to Abraham
Patriarchal	2100 – 1900	Genesis 12-50	Abraham, Isaac, Jacob, Joseph
Bondage	1900 – 1447	Exodus 1-14	Moses to crossing the Red Sea
Wanderings	1447 – 1407	Exodus 15-40 Leviticus, Numbers Deuteronomy	Mt. Sinai to the Plains of Moab
Conquest	1410 – 1370	Joshua	Crossing the Jordan River to the death of Joshua.
Judges	1380 – 1050	Judges Ruth 1 Samuel 1-10	The Judges to the anointing of Saul to be king
United Kingdom	1050 – 931	1 Samuel 11-31 2 Samuel, 1 Kings 1-11 1 Chronicles 2 Chronicles 1-10 some of Psalms Proverbs, Ecclesiastes Song of Solomon	Kings Saul, David, Solomon
Divided Kingdom	931 – 721	1 Kings 12-22 2 Kings 1-20 2 Chronicles 1-10 some of Psalms Isaiah (740-700), Hosea Joel, Amos, Jonah, Micah	Division of the kingdom after Solomon until Samaria fell to Assyria
Judah Alone	721 – 586	2 Kings 21-25 2 Chronicles 33-36 some of Psalms Jeremiah, Obadiah Nahum, Lamentations Habakkuk, Zephaniah	Exile of the Northern Kingdom to the destruction of Solomon's Temple
Captivity	606 – 536	2 Kings 25, Ezekiel Daniel, some of Psalms	Period of servitude to and exile to Babylon
Restoration	536 – 400	Ezra, Nehemiah, Haggai Zechariah, Malachi, Esther	Return under Zerubbabel until Malachi

ARCHEOLOGY

Until 1825 AD, the only sources of information about ancient history were the classical historians, who wrote in the period around 500 BC, and the Bible. Many major discoveries have been made since then that have revolutionized the science of history. Consistently, the historical and geo-political references in the Bible have been corroborated. Some of the more significant finds are listed here:

1798 – The Rosetta Stone was discovered by Boussard, an artillery officer in Napoleon's Expeditionary Force in Egypt. This stone has the same message written on it three times in three languages: Greek, Demotic (the common script of Egypt), and Hieroglyphic. Finally deciphered in 1822, this historically insignificant text became the key to being able to read the writing of the monuments of ancient Egypt.

1835 – The Behistun Rock inscription was copied by Rawlinson. This is a monumental carved message and picture, 345 feet up a sheer cliff, declaring the greatness of Darius I of Persia. The inscription is in Persian, Elamite, and Akkadian. Over the next several years, the cuneiform writing of ancient Mesopotamia was finally decoded, making readable monuments and tablets from 1000 to 2000 BC.

1843 – The Palace of Sargon was excavated by Botta, proving the existence of this ancient Assyrian king, previously believed by many to be a myth.

1849 – The ancient Assyrian city of Nineveh, along with the Palace of Sennacherib, was excavated by Layard. Nineveh and Sennacherib were thought by some to be myths. Sennacherib's library contains a detailed account of his campaign in Israel.

1890 – Modern methods of stratigraphic excavation were developed. Previous discoveries were plundered almost aimlessly, destroying much subtle evidence. Since this time, methods have improved steadily so that excavations can be reproduced on paper to detect that which was preciously overlooked.

1901 – The Code of Hammurabi was unearthed in Babylon, showing that the people of the 17th century BC had detailed and organized law codes which were publicly displayed on stone columns for all to read.

1906 – The capital of the ancient Hittite civilization was excavated by Winckler at Boghzkoy. The Hittites were believed by many to be a mythical people.

1930 – Some papyri were purchased in an Egyptian flea market by Chester Beatty. They turned out to be the oldest existing copies at that time of the writing of Paul, coming from the 100's AD. They contained Romans, 1 Corinthians, 2 Corinthians, Galatians, Ephesians, Philippians, Colossians, 1 Thessalonians and Hebrews. Eighty-six of the original 104 pages were recovered. Previously, the oldest such copies had been from 325 AD. No significant differences can be noted between these texts and the ones previously relied upon.

1947 – The Dead Sea Scrolls were discovered by an Arab goatherd. This find yielded the oldest (3rd century BC) manuscripts of the Old Testament currently known. There were no significant differences between these and the next oldest manuscripts, from the 10th century AD. These scrolls had been hidden by the Qumran Essenes when their community was about to be destroyed by the Roman army in 132 AD, during the Bar Cochba revolt.

1948 – The library of papyri discovered at Nag Hammadi in Egypt were the complete works of Gnostic scholars of the second century AD, giving a priceless inside look at one of the first Christian heretical sects.

1975 – The national archives of the Ebla Empire filled a large gap in the history of the third millennium BC. Uncovered quite by accident by a Syrian farmer plowing his field, this military library preserved thousands of documents describing life long before Abraham.

METHODS OF ASSIGNING A DATE TO AN ARTIFACT

Assigning an age to an artifact is a difficult task. Calendars today are numbered from the traditional year of Jesus' birth. They have not always been so well synchronized. Not having a monumental date from which to count, ancient civilizations recorded years by marking the time since the current dynasty began, or some other political event. But since political events are only important in the arena of that body politic, the dates of different societies have nothing to coordinate them. Occasionally, writing from two civilizations will refer to the same event, especially if the two groups fought each other. But, such documents would be between 2500 and 4000 years old. Understandably, many of them have not survived. The following are some of the more popular methods used today to assign a date to an artifact:

Manetho's Chronicle, written about 250 BC by a Greek historian in Egypt, lists 31 dynasties of Egypt, from 3100 BC to his own time. He assembled his data from the famous library in Alexandria. Modern Egyptologists are aware of errors in his reckoning, but his basic data is very useful.

The Sothic Cycle is a 1460 year period based on the coincidence of the rising of the Nile River (which happened on the same day every year for over 5000 years until the Aswan Dam was built) with the rising of the star, Sothis. Many ancient Egyptians dated events by the number of years since the last such coincidence.

The Khordabad List, written about 800 BC, chronicled the names of Assyrian kings back to about 3000 BC. An eclipse at Nineveh is included in the list. Since astronomers can calculate when that event would have occurred according to our calendar, an exact dating can be made for kings in Assyria who lived within a few hundred years of that event.

Pottery chronology judges dates according to the type and style of pottery found in the ruins. Some reputable archeologists claim to be able to date a site to within 50 years using this method. However, this assumes that everyone used the same pottery at the same time, that there were no "backward" people or preferences according to aesthetic appeal. Further, this method assumes that the broken pottery rests at the same level as other artifacts of the period and was not buried in something like our landfills.

Stratification judges dates by how deep the artifact is buried in the earth. It is assumed to be the same age as other items at that depth. Again, this presupposes that artifacts were never buried, but simply lay where they fell until covered by debris.

Carbon-14 and fluorine dating analyze the decay of radioactivity in formerly-living material. A certain amount of all the carbon and fluorine in the world is radioactive. A living plant contains approximately the same proportion of radioactive material as the rest of the environment. When the plant dies, its carbon and fluorine are trapped in the dead plant. If the decaying plant is not turned into fertilizer, but rather becomes a part of something else (such as a piece of lumber or papyrus), the element is trapped, and the radioactivity slowly decays, but is not replaced. By measuring the remaining radioactivity, the age of the material may be calculated. The theory is sound, but in practice, the method has fallen into disrepute. It is too easy for the radioactivity of the plant material to have been altered somewhere over the course of a few thousand years by the leeching of erosion, a fire, or even exposure to the sun. And, sometimes the method is applied to materials that are too young to have a meaningful loss.

Dendrochronology dates events by counting tree rings. Since all the trees in a region receive about the same rainfall each year, wood from that area will have a pattern of narrow and wide grain lines that can identify exactly when the tree lived. This works well only in forested areas.

BOOKS OF THE BIBLE – OLD TESTAMENT

Book	Author	Date	Period	Content/Theme
Genesis	Moses	1446	Antedeluvian Postdeluvian Patriarchal Bondage	History: Creation through Joseph
Exodus	Moses	1446	Bondage Wanderings	History: Moses to Mt. Sinai
Leviticus	Moses	1446	Wanderings	Law of Moses
Numbers	Moses	1407	Wanderings	History: Mt. Sinai to Jordan
Deuteronomy	Moses	1407	Wanderings	History: Exodus to Jordan
Joshua	Joshua	1400	Conquest	History: Conquest of Canaan
Judges	Samuel(?)	1050	Judges	History: Time of the Judges
Ruth		950	Judges	Love story from the Judges
1 Samuel		900	Judges United Kingdom	History: Eli to Saul
2 Samuel		900	United Kingdom	History: David
1 Kings		500	United Kingdom Divided Kingdom	History: Solomon – Elijah
2 Kings		500	Divided Kingdom Judah Alone	History: Elisha – Captivity
1 Chronicles		450	United Kingdom	History: David
2 Chronicles		450	United Kingdom Divided Kingdom Judah Alone	History: Solomon – Captivity
Ezra		450	Restoration	History: Restoring worship
Nehemiah		400	Restoration	History: Rebuilding Temple
Esther		400	Restoration	Of Jews who stayed in Persia
Job		2000	Restoration	The problem of suffering
Psalms	Moses David, Solomon Temple Singers Captives in Babylon			Old Testament Song Books from all periods
Proverbs	Solomon	950	United Kingdom	Wise Sayings

Ecclesiastes	Solomon	950	United Kingdom	Observations on life
Song of Solomon	Solomon	950	United Kingdom	Marriage Song
Isaiah	Isaiah	740-700	Divided Kingdom Judah Alone	Messianic Prophet
Jeremiah	Jeremiah	626-581	Judah Only	Weeping Prophet
Lamentations	Jeremiah	586	Judah Only	Mourning over Jerusalem
Ezekiel	Ezekiel	597-570	Captivity	Beginning the exile
Daniel	Daniel	606-536	Captivity	Ending the exile
Hosea	Hosea	750	Divided Kingdom	The unfaithful wife (North)
Joel	Joel	830	Divided Kingdom	Judgment by invasion (South)
Amos	Amos	755	Divided Kingdom	Doom despite wealth (North)
Obadiah	Obadiah	586	Judah Alone	Against Edom
Jonah	Jonah	780	Divided Kingdom	Against Nineveh
Micah	Micah	730	Divided Kingdom	Comfort to the poor (South)
Nahum	Nahum	614	Judah Alone	Against Nineveh
Habakkuk	Habakkuk	610	Judah Alone	Problem of justice (South)
Zephaniah	Zephaniah	625	Judah Alone	The Day of Jehovah
Haggai	Haggai	520	Restoration	Rebuild the Temple
Zechariah	Zechariah	516	Restoration	Visions and oracles
Malachi	Malachi	444	Restoration	Against hypocrisy

CHRONOLOGY OF THE OLD TESTAMENT

2500 BC

Ebla controlled Syria, Palestine and northern Mesopotamia. Upon conquering an opposing city-state, their custom was to massacre all the inhabitants and the livestock, burn the city, and divert the local river to run over the site. They were so hated by their neighbors that, when Ebla finally fell, the conquerors tried to remove all references to them. Thus, the existence of this powerful empire was unknown until its military archives, buried in a well-hidden vault, were accidentally discovered in Syria in 1975.

Egypt was in the Old Kingdom period, covering the Third to Sixth Dynasties. The Great Pyramid, the largest structure ever made by man, was completed in this period, along with many monumental buildings that can be visited today.

Ur controlled southern Mesopotamia. The homes of the upper class had indoor plumbing and a well-engineered sewer system, constantly flushed by the river. Civil engineering was a well applied science, shown in their irrigation, sewer, flood control and civic planning systems. The Ziggurat of Ur is perhaps its most famous monument. Its gold artifacts from the tombs of the wealthy show considerable metallurgical and artistic abilities.

2400 BC

Sargon of Akkad is the first known empire builder. Although Akkad has not been identified, it must have been in the region where the Tigris and Euphrates join. This Semitic culture dominated the land from India to Turkey.

2300 BC

The first dynasty in China, Yü, was established. At least five emperors of all China reigned before Yu, but he was the first to establish an inherited throne in that nation.

2200 BC

The Admonitions of Ipuwer, an address to the Pharaoh from an unknown individual, perhaps a treasury official, attempted to make the king aware of problems in the empire that had been concealed: “Lies are told to thee.” This was from a chaotic period in Egyptian history, immediately after the collapse of the Old Kingdom. Ipuwer tell of unrestrained bandits in the countryside, poor faming habits, and an unfavorable balance of trade.

2100 BC

Ugarit was located on the Mediterranean coast in northern Syria only 50 nautical miles from Cyprus. Prospering because of the copper trade from Cyprus to Mesopotamia, centers of art and culture were able to develop. A library at Ras Shamra has preserved epic tales in many languages, reflecting the culture of the time just before Abraham.

After the decline of Akkad, Ur re-established itself as the dominant force in Mesopotamia. Known to us as the Third Dynasty of Ur, this Sumerian power reached from the Mediterranean to the Persian Gulf. The city of Ur grew to a half million people by the time of Abraham. The gigantic Ziggurat of Ur was constructed by Un Nammu in this century. He also wrote and published the earliest known codified body of civil law.

2000 BC

A law code nearly contemporary with Ur Nammu's was that from Esh Nunna, a city 50 miles northeast of Baghdad. It deals with many civil problems of the day: the prices of commodities, the hire of wagons and boats, the wages of laborers, marriages, divorce, adultery, assault and battery, and liability for damages if your ox gores the neighbor.

By this time, Egypt had re-organized. Several more monumental temples were begun at Thebes. Egypt controlled most of North Africa, as far south as Nubia (Ethiopia), and northeast as far as the southern part of Palestine.

Abraham was born in a city of 500,000 people with planned neighborhoods and sewers. In his travels, he saw the capitals of three empires: Ur, Mari, and Thebes. In Egypt, he marveled at the 500-year-old pyramids and socialized with the Pharaoh.

1900 BC

The Gilgamesh Epic, recorded on eleven tablets, is the story of the Babylonian king, Gilgamesh, in his quest for immortality. He crossed the waters of death to meet Utnapishtim, who, along with his family, survived the Flood in a large reed boat. Gilgamesh failed to pass three tests to become immortal. He was unable to stay awake for six days and nights, he did not drink from the fountain of youthful life (although he bathed in it), and he lost the "plant of life" to a snake.

The Enuma Elish, another Babylonian epic of the period, was written in praise of their god, Marduk. It recounts a colorful but violent description of creation, culminating with Marduk cutting the god, Tiamat, in two, the halves of whom became heaven and earth. The blood of another slain god, Kingu, when mixed with clay, became man.

The Tombs of Beni Hassan, 170 miles south of Cairo, are adorned with some of the finest examples of Egyptian art from the Middle Kingdom period. One tomb depicts the arrival of 37 Semites coming to Egypt with merchandise for trade. While the people depicted are not otherwise known, the painting gives the authentic depiction of the dress among Semitic tribesmen in the time of Isaac and Jacob.

Lipit-Ishtar, king of Babylon from 1864 to 1854 BC, published his law code on steles at intersections of his empire. The surviving laws deal with the hiring of boats, treatment of slaves, the possession of real estate, tax defaults, inheritances, and marriage.

1800 BC

The Hittites, the result of an Indo-European migration around 2000 BC, became an empire in Asia Minor by the mid 1700's BC. Hittites were encountered by Abraham near Hebron. Esau married a Hittite woman, which greatly disappointed his mother, Rebekah. On of David's mighty men was Uriah, the Hittite, Bathsheba's first husband. Libraries of the Hittite Empire have since been unearthed to reveal a large and powerful empire stretching from Egypt to Babylon to Greece.

The Hyksos were Semitic people who infiltrated from the other side of the Mediterranean, probably because they had been slowly squeezed out of Asia Minor by the Hittites. Eventually, the Hyksos became numerous enough to overpower the Egyptians for several centuries. It has been speculated that the Hyksos were newly in power when Joseph came to Egypt as a slave. This would help to explain the favor extended to Jacob and his family when they moved to Egypt. The Hyksos were expelled within 100 years after that, which could explain the line, "There arose a new king over Egypt who knew not Joseph" (Exodus 1:8).

Hammurabi (1728-1686 BC) was one of the great kings of Babylon, extending his influence from the Mediterranean to the Persian Gulf. One of the great administrators of the ancient world, he had his code of 282 laws incised all around the black diorite stone nearly eight feet tall and six feet in circumference. The original was placed in the Temple of Marduk, with copies distributed to all major cities of the empire.

Mari, located on the Syria-Iraq border, rose and fell as an empire several times between 2500 and 1700 BC. The most significant discovery there has been the 15-acre, 300-room palace of the last king. The royal archives yielded about 20,000 tablets, including correspondence with Hammurabi. The texts mention the Habiru (Hebrew) people and several cities also mentioned in the Bible, such as Hazor, Nahor, Terah, and Serug. These tablets give a glimpse into the life and customs of the time between Genesis and Exodus.

1700 BC

Excavations at Nuzi have yielded more than 20,000 tablets from this period. They reveal life in northern Mesopotamia during the Bondage period and down to the time of the Judges. There are several Biblical parallels. For example, a barren wife must provide her husband with a slave girl through whom to have children. Further, the slave girl and her children were accorded certain rights within the family. The laws show that the actions of Sarah and Hagar, Rachel and Bilhah, and Leah and Zilpah were not unusual for the time.

1600 BC

The culture which produced the Minotaur, the Labyrinth, and Minos was located on Crete, flourishing until about 1400 BC when it was destroyed by the Mycenaens from the Greek mainland. Until Sir Arthur Evans discovered its remains in the early 20th century, this civilization was largely thought to be mythological.

1500 BC

The Exodus, the giving of the Law of Moses, and the Wilderness Wandering period all occurred in this century. The Torah, the first 5 books of the Old Testament, was first recorded at this time. Many people date the Exodus in the 13th century BC with Pharaoh Ramses. That is impossible. The Amarna letters place the Conquest under Joshua during the reign of Akhenaton and Nefertiti. And, as recorded on the Mernepthah Stele, Ramses' son fought against Hebrew people in Palestine. If the Exodus were under Ramses, the Israelites would still be in the wilderness during the reign of his son. Finally, 1 Kings 6:1 gives an exact number of years (480) between the Exodus and the dedication of the Temple in the fourth year of Solomon's reign (967 BC), which is not likely to be 200 years off.

1400 BC

Akenaton, the only Pharaoh to abandon the traditional Egyptian pantheon, converted the country by force to the worship of one god, Aton, the sun. His skills were in philosophy and religion, not affairs of state, so the empire fragmented. His son-in-law, Tutankamon (King Tut), reversed his religious efforts. The power of the empire was restored to some degree after King Tut. Future generations so hated Akhenaton for his rigorous monotheism that they attempted to remove all trace of him from the country.

Amarna, the city built by Akhenaton and his beautiful wife, Nefertiti, yielded a cache of tablets that were the military correspondence to the Pharaoh from several of his allies in Palestine. The most significant of these letters is from the king of Jerusalem reporting the invasion of the Habiru (Hebrew) people and begging for military support.

1300 BC

Raamses was the great temple builder of Egypt. His monumental statues of himself had to be moved to avoid being submerged in Lake Nassar behind the Aswan Dam. Although a city named Raamses was built by

Hebrew slaves (Exodus 1:11), it cannot be named for this person. He was not the first Raamses to be Pharaoh of Egypt, nor the last. And, the city need not have been named for the Pharaoh. The other city built by Hebrew slaves was Pithom. Further, there was no general decline in the economic or military might of the country to coincide with the departure of a substantial part of the labor force.

Raames' son, Mernepthah, ruled from 1224 to 1214 BC. He waged several military campaigns in Palestine, Libya, and Nubia. His monument to his victories includes the people of Israel, which would have been during the period of the Judges.

The Trojan Wars occurred in about this period.

1200 BC

The Veda, the collection of ancient sacred literature of Hinduism, was first organized in this century. The four Vedas were written by Aryan invaders of India.

Eli and Samuel, the protagonists of 1 Samuel 1 – 10, lived in this century. Their primary enemies, the Philistines, were known in other civilizations as the Sea People. They migrated from Sardinia into Asia Minor as the Hittite Empire collapsed, then across to Crete and Cyprus, finally invading Egypt during the time of Mernepthah. The Egyptians were able to push them back up the coast to southwestern Palestine. The Philistines knowledge of iron working was a national defense secret (1 Samuel 13:19 – 23). They gained rapid control over almost all of Palestine.

1100 BC

Saul (1 Samuel 9 – 31, 1 Chronicles 9 – 10) reigned 40 years , according to Acts 13:21, approximately 1055 – 1015 BC. While Saul is associated with the United Kingdom period, the beginning years of his reign were far from united. When the people demanded of God to have a king like their neighbors, he was the one chosen in the casting of lots conducted by Samuel. In retrospect, we can mark Saul's reign from 1 Samuel 10. But, it was not for several more years, after several victories over the Ammonites and Philistines, that all the tribes took him seriously. At the beginning of his reign, Israel controlled only a small section of the hill country in the center of Palestine, having lost Transjordan to the Ammonites and all the coastal and rich valley lands to the Philistines. The latter half of Saul's reign was spent in and out of fits of rage and jealousy, chasing David. During his reign, two high priests developed: one with David and his men (Zadok) and one with the tabernacle (Abiathar). These two continued as high priests jointly until the reign of Solomon.

David played a big part in the saga of Saul (1 Samuel 16 – 31), and then has a story of his own (all of 2 Samuel, 1 Chronicles 11 – 29). David did not replace Saul immediately as king over all the tribes. Ishbosheth, Saul's son, was crowned by Abner, Saul's surviving general. The northern tribes followed Ishbosheth, albeit somewhat loosely, for two years. Civil war ensued, on and off, for the next several years. Eventually, Abner usurped Ishbosheth's power. Finally, both were assassinated.

David headed Judah from his capital in Hebron for seven and one-half years. The other tribes finally turned to David to head the whole confederation. At that point, David led a campaign against Jerusalem and took it from the remaining Canaanites of Palestine, making it his new capital. He reigned there thirty-three and one-half years, for a total of forty (1014 – 973 BC) David brought the tabernacle to Jerusalem and restored the Ark of the Covenant to its place in it. (The Ark had been displaced from the tabernacle before the days of Saul.) David spread the borders of Israel to the Sinai peninsula and to the Euphrates River. He also stockpiled building materials for the Temple. David survived several insurrections, some headed by his own sons.

1000 BC

Hiram, King of Tyre, affected Biblical history and world events for several generations. He was the supplier of the materials and skilled labor for the building of both the royal palace and the Temple in Jerusalem. A strong alliance was made between the two countries. Solomon probably married one of Hiram's daughters. Hiram's granddaughter, Jezebel, married King Ahab of the Northern Kingdom. Their daughter, Athaliah, married King Jehoram of Judah. Athaliah became ruler of Judah through an assassination scheme. Hiram's sons founded Carthage, Gibraltar, and Nice, among others. During this period, Hiram's descendants governed a loosely knit confederation which controlled virtually all sea trade from the Atlantic to the Indian Ocean.

Solomon reigned forty years like Saul and David (972 – 932 BC). His reign is described in 2 Samuel 1 – 11 and 1 Chronicles 29 through 2 Chronicles 9. Solomon did not enjoy an easy transfer of power upon the death of his father. He had to defeat his older brother, Adonijah, in a brief civil war. Using the stockpiles left by his father, Solomon built the Temple, known as one of the marvels of its time. He also fortified many cities, remains of which are being excavated to this day. However, since he did not expand the borders, he had no spoils of war such as made his father rich. By the end of his reign, the kingdom was nearly bankrupt and in a period of excessive taxation.

The Temple was dedicated in the four hundred and eightieth year after the Exodus, in the fourth year of Solomon (1 Kings 6:1). Literally, tons of gold went into the ornamentation, not to mention the silver and bronze. The interior of the Most Holy Place was shingled with gold plate on all sides. On special occasions, the Temple guards carried gold shields. Part of Solomon's foundation of the Temple Mount has been excavated. As a testament to the engineering skill of the time, the massive blocks are still precisely in line after nearly 3000 years, although they are neither cemented nor keyed together. One of the secrets was discovered only in the last 70 years. The Temple esplanade is supported by a huge retaining wall all around. Everyone assumed that the space under the esplanade and behind the retaining walls had been filled with earth and rubble, as have been other massive platforms. But Solomon's engineers used arches instead. Layers of arches connect the retaining walls back to the bedrock of the hill upon which the Temple was built. Earth fill applies a wedging pressure at the base of the retaining wall, eventually kicking it out. On the Temple Mount, the arches support the huge stones of the esplanade. There is very little outward pressure on the retaining walls. The arches transmit most of the force straight down to the bedrock. What pressure that remains on the wall is evenly distributed down the height of the wall, rather than being concentrated at the bottom.

Homer lived sometime between 1200 and 850 BC. (The Trojan Wars of which he wrote were around 1200 BC.) His epics, the Illiad and the Odessy, are approximately contemporaneous with the building of the Temple.

The Kingdom of Israel divided about 931 BC in a tax revolt. Solomon's son, Rehoboam, ignored the counsel of the elder advisors and raised taxes once too often. Judah and Benjamin remained loyal to the throne of David, while the northern majority followed the general, Jeroboam. To keep the people from running off to Jerusalem four times a year (Yom Kippur, Passover, Pentecost, and Tabernacles), Jeroboam convinced the masses, who apparently were not too familiar with the Scriptures, that the calf worship of the Wilderness period was the true ancient ancestral practice. He built two temples for that purpose. He kept his religious and political loyalties on the same side of the border, and prevented a very unfavorable balance of trade due to tourism and the half-shekel temple tax. Although not specifically mentioned, the tribes of Simeon and Levi remained loyal to David's throne, also. Simeon had been absorbed into Judah centuries earlier. The northern Levites slowly migrated south after the division in order to be available for Temple service. Some theologically bankrupt Levites stayed in the north to run the calf worship temples built by Jeroboam, although the calf-worship priests could be from any tribe.

900 BC

The Moabite Stone was a monument made by Mesha, King of Moab, to commemorate his victories resulting in the liberation of his nation from Israelite domination. Omri and his son, Ahab, are named on the stone as the Kings of Israel who had had power over Moab. 2 Kings 1:1 says that Moab revolted when Ahab died. Mesha is named as the King of Moab in 2 Kings 3:4. Ahab's son (Jehoram), King Jehoshaphat of Judah, and the vassal

king of Edom formed an alliance to try to bring Moab back under control. In the resulting war, Mesha lost many soldiers and much spoil, but retained his country by sacrificing his eldest son upon the wall of his last city, Kir-hareseth (2 Kings 3:27). The allies retired, probably because the many pagan soldiers among the attackers refused to fight after this extreme sacrifice was performed against them.

Assyria rose to world dominance in the Neo-Assyrian Period, 900 – 612 BC. The booty from their early conquests mostly went to rebuilding the capital of Calah. Their advance to the Mediterranean was temporarily halted by a coalition of "twelve kings of the seacoast, "including Ahab the Israelite. King Ben-Hadad II of Syria headed the successful resistance. However, after his assassination (2 Kings 8:15), Hazael was not so able. King Shalmanezer of Assyria received tribute from King Jehu of the Northern Kingdom, as depicted on his Black Obelisk.

Ashurbanipal reigned from 672 to 631 BC in Assyria. His library is listed here because it provides a fantastic collection of literature and science reaching back to the time of the Flood. It is the primary source of data concerning the beginning of the Assyrian Empire.

Joel drew upon a drought and locust plague and the resulting fires as an illustration of a stronger and more severe judgment to come, an invading army to be sent by God. The book was an appeal from God to the people to seek Him through repentance. Out of this repentance would come material blessings followed by spiritual blessings. Either Syria or Assyria could have been the threatened invader.

800 BC

Jonah played an important role in the reign of Jeroboam II (2 Kings 14:23 – 35). From the time of the division of the kingdom until Jonah, Israel was shrinking; Syria and Assyria were growing. Syria usually was busy fighting Assyria, but turned on Israel whenever possible. The assassination of Ben-Hadad took away one adversary for Israel. A period of non-aggression in Assyria took care of Israel's other problem. Jonah's trip to Nineveh coincided with this sudden pacifistic turn in Assyrian national policy. Between the death of Shalmanezer in 824 BC and the ascension of Tiglath-Pileser III in 745 BC, Assyria was ruled by a series of ineffective kings and was torn by internal strife. In that period, Jeroboam II extended the borders of Israel to the same extent as had David and Solomon.

Amos prophesied near the end of the reign of Jeroboam II. The Northern Kingdom had expanded rapidly. Luxury was commonplace due to the spoils of war and tribute from vassal states. But Assyria was about to be resurrected as a world power. Amos told of a coming destruction for a people who had forgotten the God who had given them their nation. The Northern Kingdom went into a steady decline for the next 50 years, ending in its destruction and exile.

Hosea prophesied slightly after Amos, but in the same general period, predicting the fall of the country. While Amos was much more stern in his condemnation of the Israelites, Hosea focused more on the lovingkindness of God, and how they had forsaken it.

As Tiglth-Pileser (known as Pul in 2 Kings 15:19) approached Israel, Uzziah of Judah send an army against him. Judeans are named in the Assyrian records as among those captured. Menahem of the Northern Kingdom promised a large payment of tribute if Pul would back his bid for the throne. He did. This allowed Pul to turn his attention to the east, expanding his empire into Elam and Media. He then returned to finish off an alliance of Syrian and Phoenician kings. Ahaz, King of Judah, appealed for Assyrian aid against Syria and Phoenicia (2 Kings 16:7 – 14). Pul consented and captured Damascus, ending the siege of Jerusalem by Syria. In the process, Pul wrote that he placed a new vassal on the throne of the Northern Kingdom, Hoshea.

Shalmanezer V succeeded his father, Pul, and is most famous for his conquest and deportation of the Northern Kingdom. He destroyed the country in retaliation for Hoshea's attempt to make an alliance with Egypt and to withhold the agreed tribute money (2 Kings 17:4). Shalmanezer captured and destroyed the capital of the Northern Kingdom, Samaria, after a three year siege, ending in 721 BC. He settled the people of the Northern

Kingdom in Halah on the Habor, a river of Gozan, in the cities of the Medes (2 Kings 17:6). Shalmanezer died before Samaria fell, but his son, Sargon, finished the task.

The next king of Assyria, Sennacherib, invaded Palestine again, capturing all the towns of Judah and laying siege to Jerusalem. The Taylor Prism contains Sennecherib's account of the campaign. The siege was suddenly lifted and Sennecherib went home. The Bible attributes the sudden departure to the angel of the Lord killing 185,000 Assyrian soldiers in one night (2 Kings 19:35). The Egyptians, against whom he was fighting at the same time, attributed the defeat to a divine plague of rats that ate the Assyrians bowstrings and sandal thongs. The Assyrian records are curiously silent. Sennecherib's reign was in turmoil from that time forward, ending in his assassination by his sons.

The inhabitants of Jerusalem were able to endure the siege by Sennacherib partly due to the engineering expertise available to Hezekiah. He had all the springs near Jerusalem stopped up so the enemy could not use them (2 Chromicles32:3). He disconnected the two aqueducts that ran from the Gihon Spring to the Lower Pool so the enemy could not poison them. Then, a serpentine, 1750-foot-long tunnel was cut through solid rock, 150 feet under one of the hills upon which Jerusalem sits, to connect the concealed spring with a reservoir inside the city walls. So well constructed and concealed was this water system that, although it provides water to the city to this day. The source of the water coming into the Pool of Siloam was not re-discovered until 1838 AD. The total fall in elevation across its length is only seven feet two inches. Crews worked six or seven months from both ends. They met very nearly in the middle, with an error in elevation of about 1 foot.

Micah lived at the same time as Isaiah, but he was the prophet to the common man while Isaiah associated with kings.

Isaiah had much to say about the Messiah. But that was not all. As personal advisor to four kings (Uzziah, Jotham, Ahaz, and Hezekiah), he had a direct effect on the course of national affairs. He told of the Assyrian invasion 20 years before it came (Isaiah 6:26 – 30). He calmed Ahaz when Syria and the Northern Kingdom formed an alliance to conquer him, telling him that in less than two years his enemies would collapse (Isaiah 7). And he told at least two kings not to worry about the Assyrians. He calmed Hezekiah with a prophecy as the Assyrians began their siege of the last city left under his control, that they would be defeated without a battle (Isaiah 37). He chastised Hezekiah for showing off the Temple treasury to Babylonian ambassadors, predicting 150 years before the event that, although Assyria was prevented from conquering Jerusalem, it would be Babylon that would destroy it (Isaiah 39). Further, he predicted the return of the exiles under the Persians who would conquer Babylon, and that the Persian king's name would be Cyrus (Isaiah 44:28, 45:1). Many have tried to break Isaiah into two books, the second half being of a much later period. However, there is no evidence to support this position and much archeological evidence to refute it.

700 BC

Ashurbanipal lived in the middle of this century, assembling his great library. In the course of his conquests, he put down a rebellion in Elam and Babylon. Consistent with the Assyrian practice of deportation, he moved the people of that area into the vacant territory of the Northern Kingdom (2 Kings 17:24 – 41). Of course, not all the Israelites of the north were captured; many had had the sense to move out of the country before the war. And, because productive land does not stay vacant for long, some people in border areas to Israel had moved in to claim it. So, mixed with the imported Elamites and Babylonians were Syrians, Phoenicians, and some returning Israelites. This mixture became the Samaritans so hated by the Jews of Jesus' day. Ashurbanipal is also believed to be the king who released King Manasseh from imprisonment to return and govern Judah (2 Chronicles 33:1 – 20).

Manasseh, Hezekiah's son, reversed the godly trend in Judah, rebuilding the pagan temples and idols that had been demolished by his father. He was listed as a vassal in the chronicles of Esarhaddon, the father of Ashurbanipal. After spending time in an Assyrian prison, he had a change of heart about serving God. Upon his return, he tried to reverse his previous course. His son, Amon, reigned only two years and was assassinated. Amon's eight-year-old son Josiah, came to the throne.

Josiah was the last decent king of Judah, of which there were not very many. When he was 16, he began a religious reform. But to illustrate how far the people had gone away from God, in the eighteenth year of Josiah's reign, during renovations to the Temple, the scroll of the Law was re-discovered. It had been "lost" for nearly 60 years. From that point, reform began in earnest. But, the prophet Jeremiah was unimpressed, saying that the new-found religion of the people was only skin deep (Jeremiah 3:10).

Zephaniah began his career at the same time as Jeremiah, shortly after Josiah came to the throne. Described by some as "the hottest book in the Old Testament," Zephaniah paints vivid pictures of judgment. The judgment being brought in this time was one of military invasion. Most of the evidence points to that threat being the rising Babylonian power.

Nahum prophesied about the fall of the capital of Assyrian, Nineveh. As the power of Assyria waned in the last part of the century, due in large part to the loss of the main battle group at the walls of Jerusalem, Babylon and Media formed an alliance to throw off the yoke of their master. The city wall of Nineveh was over six miles long, 60 feet thick, and about 100 feet high. After besieging for two years with no effect, the allies finally re-directed the river that ran by the wall so that it beat against it. In another year, the wall was undermined and a section collapsed, allowing the invaders a point of entry. Nahum's prediction ran along similar lines. Nineveh fell in 614. The final battle of the empire was not fought until 612 at Carchemish.

Habakkuk wrote after Babylon had conquered Assyria (and after Josiah was killed), but before Babylon came to put Judah under its control. Habakkuk's subject was justice. He was complaining to God that, while he acknowledged the sins of the people of Israel, he could not understand why God would use a people to chastise them who were worse than they.

After Nineveh fell, as the remains of the Assyrian army fled west, the Egyptians decided to join in. They wanted to come to the aid of Assyria not so much out of loyalty, for they had none, but rather to prevent Babylon from becoming invincible. Josiah knew of the plan and decided to head off the Egyptians. Pharaoh Neco knew that he would have a hard fight if he came by land through Israel, so he went by sea to Acco, then inland through the Valley of Esdraelon. Josiah tried to cut him off at the narrow point of the valley, occupying the hill of Megiddo. The Anglicized version of the name of that hill is Armageddon. Josiah was mortally wounded in the battle and the Israelite forces were decimated. Everyone knew that this marked the beginning of the end of Judah. Just as Napoleon made Waterloo synonymous with the end of an era, Josiah made Armageddon the most famous cliché in Israel. Masada replaced Megiddo as the historical watchword of Israel after the Jewish Revolt of 70 AD. Sadly for Josiah, Pharaoh Neco was a year late coming to Assyria's aid. The last battle of the Assyrian army was long over when he arrived at Carchemish. Josiah's attempt to slow Neco would not have made a difference even if successful. After the long trip and no battle, the Egyptian army passed back through Judah in 609 BC. Neco took the new king, Jehoahaz, prisoner, and set Jehoahaz's brother, Jehoiakim, on the throne of Judah as a puppet.

600 BC

Judah served Egypt from 609 to 606 BC, until Nebuchadnezzar and the Babylonian army regrouped and invaded Palestine. After a brief siege, Jehoiakim surrendered, becoming the vassal of Babylon. The 70 years of service to Babylon predicted by Jeremiah (Jeremiah 25:11) began at that time. Some of the royal family and some other important people were taken as exiles. Daniel and his friends were taken to Babylon to begin their training to enter the service of the king of Babylon. But, three years after that, Jehoiakim tried to withhold tax money, and Nebuchadnezzar sent mercenaries to harass him back into submission. It worked for a time, but he tried it again after six years. This time Nebuchadnezzar brought the whole army and besieged Jerusalem. Jehoiakim had the good timing to die just as they arrived. His son, Jehoiachin, was king for three months and surrendered, going into exile also. Many others of the royal and priestly service were taken to Babylon as well, one of whom was Ezekiel. Nebuchadnezzar put Jehoiachin's uncle, Zedekiah, on the throne. He submitted well for almost ten years. Then he, too, rebelled. Nebuchadnezzar came back a third time, this time destroying Jerusalem and taking anyone he could catch as a captive. This was the end of Solomon's Temple.

During his final invasion of Judah, Nebuchadnezzar took the cities one by one, leaving Jerusalem for last. The second to last was Lachish. The signal fires of Lachish could be seen from Jerusalem. Military correspondence directed to the commander of Lachish during this time has been found in the ruins. Since they were written on the note paper of the day, pieces of broken pottery (ostraca), they are called the Lachish Ostraca.

Jeremiah began to prophesy in the reign of Josiah, and continued to do so until several years after the destruction of Jerusalem and the Temple in 586 BC. After that destruction, he prophesied to a band of Jews who had left their decimated land for Egypt – against the direct orders of God. There, they were overrun again by the Babylonians. Jeremiah's most famous prediction was declaring that Israel would serve Babylon 70 years (Jeremiah 25:11). Daniel was familiar with that prophecy and counted the years to its expiration (Daniel 9:2). Jeremiah was a thorn in the consciences of several kings. Several people tried to kill him, or at lest have him imprisoned. Nebuchadnezzar had heard of this prophet who preached surrender to Judah. He gave orders that Jeremiah should not be harmed when Jerusalem fell. Jeremiah was given the choice of where to go. He chose to stay with the few poor people left in the land. After 40 years of preaching, he had no conversions. In grief over the destruction of Jerusalem and the Temple, he wrote Lamentations. Baruch was his scribe through much of his career.

Ezekiel was taken as a captive to Babylon in 587 BC. He prophesied from 592 to 570 BC, overlapping Daniel, Jeremiah, and Obadiah. Ezekiel referred to Daniel twice (14:14, 28:3). Some contend that he means another Daniel, perhaps Dan'el, a Canaanite epic hero from Ugarit. However, Dan'el would hardly qualify as an example of righteousness for Israelites. Also, when Ezekiel wrote, Daniel had been governor for 10 years of the province in which Ezekiel lived. The righteousness of the prophet Daniel was already legendary. Ezekiel was the prophet to the exiles, with much competition from prophets telling the people that their captivity would be short, that God would rescue them very soon. Ezekiel told them to build homes and settle down because they were going to be in Babylon for quite a while.

Obadiah, the prophet with the shortest book, prophesied against Edom for the part that they played in the fall of Jerusalem. Despite being distant relatives of the Israelites (Edomites were the descendents of Jacob's twin brother Esau), the Edomites assisted the Babylonians during the siege and after the fall of Jerusalem by capturing Israelite refugees and delivering them to the Babylonians for a price.

Daniel's book is a collection of events and visions that occurred during his life, but that were not published until he was very elderly. Several of the visions and explanations he kept to himself for many years (e.g., 7:28). Daniel was taken as a captive to Babylon in 606 BC, among the first of the exiles. He was a young man then, taken for training to enter the service of the king, Nebuchadnezzar. In his second year, he distinguished himself by relating not only the interpretation of the king's dream, but also the dream itself. The king made Daniel governor of Babylon immediately (604 BC), a post that he kept until his retirement. Daniel was brought out of retirement by Nebuchadnezzar's grandson in 536 BC to interpret the "handwriting on the wall." When the Persians conquered the city that same night, they retained Daniel as governor, knowing that a good civil servant is hard to find. Many tales of Daniel's adventures exist outside the canonical book of Daniel. Several stories are included in the deuterocanonical books of the Roman Catholic canon. Several others circulate, but are called apocryphal. The Hebrew scholars of about 250 BC rejected most of the stories as uninspired and included only what we have as the canonical Daniel (12 chapters as we count it today).

Zoroaster (d. 541 BC), founder of one of the world's major religions, lived in Persia during the time of the captivity. While many attribute major shifts in Jewish thought to his influence, it is more reasonable, historically, that is was Zoroaster who was influenced by the exiles. Monotheism was introduced to the region of his birth a hundred years before him by the captives of the Northern Kingdom, deported there by the Assyrians. While he was growing up, Daniel was a major political figure, whose God was being proclaimed (off and on) by the current world ruler, Nebuchadnezzar. Darius the Mede and Cyrus of Persia, both served by Daniel, were Zoroastrians, which may explain some of Daniel's immediate acceptance by the conquerors.

The Captivity continued until 536 BC when the Persians conquered Babylon. As one of his first acts as the new emperor, Cyrus issued a decree that all captives (of Assyria or Babylon) could go back to their ancestral lands (*cf.*, Ezra 1:1 – 11, 2 Chronicles 36:22 – 23). The decree was distributed across the empire. As with many royal edicts that had to be copied many times, a rolling pin was carved with the message in mirror image. This was rolled

against a table that was covered with damp clay, which was then allowed to harden. The plate was then broken between copies and the pieces carried to many destinations. This forerunner of the Xerox machine is preserved in the British Museum, known as the Cyrus Cylinder. Not all, or even a majority, of the Jews returned. They had been living in Mesopotamia for between 50 and 186 years. Obviously, many called Mesopotamia home. Only those dedicated to the ancestral traditions were willing to return to destroyed cities to face those who had had possession of the land for nearly as long as the Israelites had been gone.

The restoration of the nation of Israel began with a migration under the supervision of Ezra in about 532 BC. The prophets of the time were Haggai and Zechariah. All three urged the people not to give up and to keep working. When the foundation of the Temple was re-laid, the younger ones cheered; the older one cried because they remembered how much larger had been Solomon's Temple. The Persians gave some help with advantageous laws and the return of the Temple vessels. But those who had occupied Palestine for the previous 50 years did not want to leave peacefully.

500 BC

Confucius (551 to 479 BC) and Sidhartha Gautama, the original Buddha (563 to 483 BC) lived during the time of the restoration of Israel. It is unlikely that either was influenced by the Jewish religion directly. However, the possibility exists that relocated Jews came through their territories.

The Persian emperor, Darius I, had his exploits carved on a sheer cliff face 345 feet above a spring, 100 feet above the highest point a man could climb, so that the inscriptions could not be defaced by those who came later. Those traveling the main trade route into Tehran must face it for several miles. The significance of this monument to us is that it has the same long account in three languages: Persians, Elamite, and Akkadian (Babylonian). This unlocked the code of Akkadian cuneiform writing.

The battle of Marathon at which Darius I was defeated by the Athenians was fought in 490 BC.

The book of Esther is set in the reign of Xerxes I (486 to 465 BC), the son of Darius I of Persia.

Nehemiah was cupbearer to the son of Xerxes, Artaxerxes, King of Persia. His missions to Jerusalem to govern and rebuild the walls of the city occurred between 446 and 423 BC. Malachi, the last of the writing prophets, probably was a contemporary of Nehemiah.

Socrates (470 to 399 BC) received the death penalty (a cup of hemlock) as a result of a charge of neglecting the gods of the state and introducing new divinities.

Plato (427 to 347 BC) founded his academy in Athens in 387 BC.

400 BC

Aristotle (384 to 322 BC) was a student of Plato, and became the teacher of Alexander the Great.

Epicurus (341 BC to 270 BC) taught what can be best characterized as "eat and drink, for tomorrow we die."

Alexander the Great ruled form 336 BC to 323 BC, in which period he spread his borders to include Egypt, Babylon, and Persia. He was preparing to invade India when he succumbed to disease. His generals quarreled over how to divide the empire. Four carved out sections for themselves, as predicted by Daniel (in chapter 8).

Manetho, a priest at Hieropolis, wrote a history of Egypt from its earliest times to 323 BC when Ptolemy, one of Alexander's generals, assumed control. Although modern chroniclers are aware of errors in Manatheo's

reckoning, they still find his schematic view of Egypt's history useful. Manetho's thirty dynasties form the basis for all modern discussions of the history of Egypt.

300 BC

Zeno, founder of the Stoic philosophy, was a Phoenecian who taught in Athens around 300 BC.

The central book of Taoism, Tao Te Ching, was written in the middle of the third century BC. Contrary to Confucianism, which taught submission of the individual to the common good, Taoism taught the supremacy of the individual.

Of the four generals who took power after Alexander died, only two were successful in maintaining a large empire: Ptolemy in Egypt and Selucus in Syria. Their constant border wars in Palestine were chronicled in advance by Daniel (chapter 11).

Greek culture was absorbed into the Jewish people and their religion. One group, the Hasidim (pious ones) resisted this trend. They appear several times, albeit briefly, in Jewish history, usually in times of national distress. They aided the Maccabees in the 167 BC revolution. They probably spawned the Pharisees and the Essenes. Their line can be traced forward to a body of rigorously orthodox Jews who go by the same name today.

Ptolemy II Philadelphus (285 to 246 BC) ordered the translation of the Hebrew Scriptures into Greek, the international language. Many Jews in his empire had never learned Hebrew.

200 BC

In 198 BC, the Selucids finally subjugated the Ptolemies (per Daniel 8). The worst of the line, Antiochus Epiphanes (175 to 163 BC), had himself officially crowned King of Egypt. On the 25th of Chislev (mid December) of 167 BC, he deliberately insulted the vassal Jewish state by sacrificing a pig on the altar in the Temple. This triggered the Maccabean Revolt (or the Hasmonean Revolt). After three years of hard fighting and intense persecution, on the 25th of Chislev of 164 BC, the Temple was rededicated with an eight-day festival that has become Hanukah.

After 20 years of sporadic fighting with Syria, Israel became truly autonomous, in 142 BC. Rome was beginning to exert some influence in the area, so Syria and Egypt were too busy to contest Israel's independence.

In the period of independence, the parties of the Pharisees, Sadducees, and Essenes were officially formed. Eventually, the Essenes withdrew from society to avoid its corruption, establishing the community of Qumran near the northern end of the Dead Sea.

100 BC

Rome continued to gain territory. The instability created by a rising world power caused several short-lived invasions and kingdoms in the Middle East, including the Parthians, the Nabateans, and the Armenians. In 63 BC, the Roman general Pompey took Jerusalem. Israel came under Roman domination. A series of petty kings over parts of Palestine arose, all under Roman authority.

The period between 63 and 29 BC was a stormy one in Roman history. Julius, Antony, Cleopatra, and Octavian all fought for control with huge armies and navies while the empire stood and watched. Finally, Octavian, named Augustus, came out on top, restoring some stability to government.

GEOGRAPHY

LANDS (Designated on maps as L1, L2, etc.)

1.	Ammon	Northeast of the Dead Sea. Land of the descendants of Lot's son Ammon. Driven back into the foothills by Canaanites before Joshua. Today: Jordan
2.	Arabia	Desert between Red Sea and Persian Gulf. Impassible, waterless, inhabited by fierce nomads. No army has crossed it successfully in all of history.
3.	Assyria	Northern Mesopotamia. Capital: Nineveh. Jonah went to Nineveh about 780. Nahum prophesied against Nineveh about 614. Nineveh was destroyed by Babylon in 612. Final battle of the empire at Carchemish in 609. Today: Iraq/Turkey.
4.	Babylonia	Southern Mesopotamia. Capital: Babylon. Other empires centered here: Sumer, Akkad, Ur. Today: Iraq.
5.	Bashan	East of the Sea of Galilee and parts North. Known for its fat cows. Today: Golan Heights.
6.	Canaan	Coastal strip west of the Jordan River. Today: Israel.
7.	Edom	South of the Dead Sea. Land of the descendants of Esau. Edom means red, as was Esau and as is the soil. Cities: Petra, Dedan, Teman. Overrun by Arabs in 6th century BC. Today: Israel.
8.	Egypt	Along the Nile. Calendar based on the rising of the Nile and the locusts (Sothic cycle.)
9.	Elam	Foothills between Babylon and Persia. Constantly overrun. Today: Iran.
10.	Gilead	East of the Jordan River, between the Sea of Galilee and the Dead Sea. Known for its healing salve, the balm of Gilead. Today: Jordan.
11.	Media	Northern Persia; south of Caspian Sea. Today: Iran.
12.	Midian	Both sides of the Gulf of Aqaba.
13.	Moab	East of the Dead Sea. Land of the descendants of Lot's son Moab. Today: Jordan.
14.	Persia	Mountainous area northeast of Mesopotamia. Today: Iran.
15.	Philistia	Coastal plain of southern Canaan. Cities: Gaza, Gath, Ashkelon, Ashdod, Ekron. Mass migration into this area in 2500 BC and 1500 BC. Today: Israel and Gaza Strip.
16.	Phoenicia	Coastal strip north of Canaan. Cities: Tyre and Sidon. Ancient sailors. Today: Lebanon.
17.	Syria	East of Assyria, north of Canaan. Capital: Damascus. Also called Aramea.

HILLS (designated H-1, H-2, etc.)

1.	Carmel	Forms the only natural port of the Palestinian coast. Site of Elijah's encounter with the prophets of Baal.
2.	Hermon	North of the Sea of Galilee. Headwaters of the Jordan. Over 9000 feet above sea level. Snow-capped.
3.	Megiddo	In the Valley of Esdralon, the site of many strategic battles. It was the Waterloo of the last good king, Josiah.
4.	Nebo	Northeast corner of the Dead Sea. Moses viewed the Promised Land from the peak called Pisgah. He also died here.
5.	Sinai	Southern part of the Sinai Peninsula, also called Horeb.
6.	Hor	South-southeast of the Dead Sea, which the Israelites circled for 38 years, and where Aaron died.

ISLANDS (designated I-1, I-2, etc.)

1.	Crete	South of Greece, where Titus was to appoint elders.
2.	Cyprus	South of Asia Minot. Paul and Barnabas passed through.
3.	Malta	South of Sicily, where Paul was shipwrecked.
4.	Patmos	Off southwest corner of Asia Minor. John was imprisoned on the Devil's Island of the first century.

RIVERS (designated R-1, R-2, etc.)

1.	Arnon	East side of the Dead Sea. Northern border of Moab.
2.	Euphrates	The western river of Mesopotamia.
3.	Jabbok	Into the Jordan River between the Sea of Galilee and the Dead Sea.
4.	Jordan	Entirely below sea level from Galilee to the Dead Sea.
5.	Kishon	Flows out past Mt. Carmel.
6.	Nile	Egypt.
7.	Orontes	Antioch of Syria is on the Orontes.
8.	Tigris	The eastern river of Mesopotamia.
9.	Yarmuk	Into the Jordan River just below the Sea of Galilee.

MOUNTAIN RANGES (designated M-1, M-2, etc.)

1.	Ararat	North of Assyria. If the name is the same, this is the resting place of Noah's ark. Today: On the border of Turkey, Iraq and the Soviet Union.
2.	Lebanon	Parallel coastal ranges of Phoenicia. Forms today's Bekaa Valley.
3.	Zagros	Between Babylon and Persia.

CITIES (designated C-1, C-2, etc.)

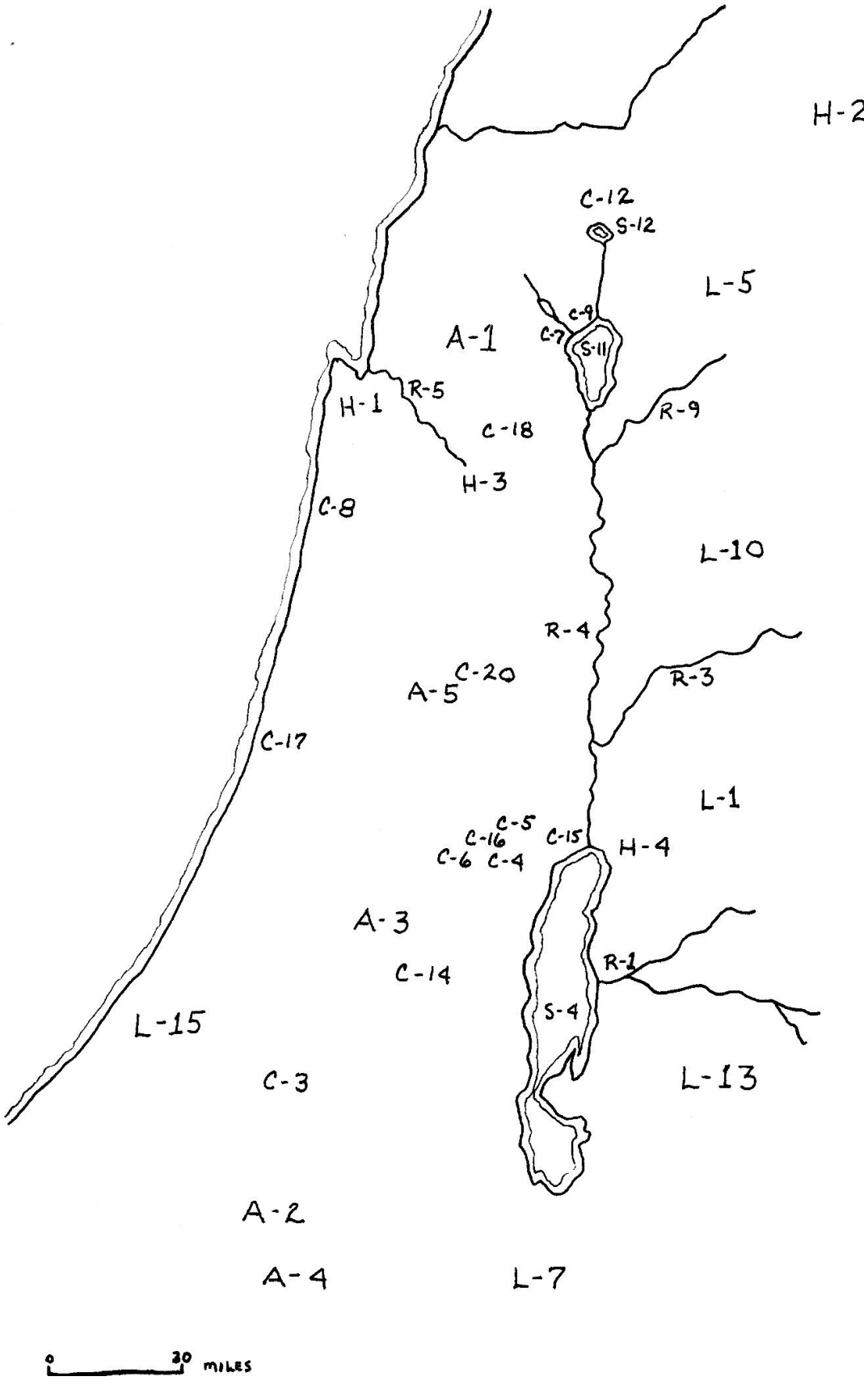
1.	Antioch	Cyprus 'points' to Antioch. Capital of Selucid empire.
2.	Athens	50 miles east of Corinth.
3.	Beersheba	Opposite the narrow spot in the Dead Sea, half way to the Mediterranean. Southern limit of traditional Israel.
4.	Bethany	3 miles southeast of Jerusalem. Lazarus' home.
5.	Bethel	9 miles northeast of Jerusalem. Calf-worship temple. Southern limit of the Northern Kingdom.
6.	Bethlehem	6 miles south-southwest of Jerusalem.
7.	Bethsaida	Just south of Capurnaum, on the Sea of Galilee.
8.	Caesarea	25 miles south of Mt. Carmel. Port built by Herod the Great.
9.	Capurnaum	Northwest corner of the Sea of Galilee.
10.	Corinth	At the narrow spot of Greece.
11.	Damascus	East of Hermon. Oldest continuously occupied city in the world.
12.	Dan	North of the Waters of Merom. Calf-worship temple. Northern limit of traditional Israel.
13.	Ephesus	West Coast, somewhat south, of Asia Minor.
14.	Hebron	20 miles south of Jerusalem. Tomb of Abraham.
15.	Jericho	West of the Jordan, at the top of the Dead Sea.
16.	Jerusalem	20 miles west of the top of the Dead Sea.
17.	Joppa	Half way down the Palestinian coast. Poor port.
18.	Nazareth	Half way between Mt. Carmel and the Sea of Galilee.
19.	Philippi	Top of the Aegean, on the Grecian side.
20.	Shechem	In the middle of Samaria. First site of tabernacle.

BODIES OF WATER (designated S-1, S-2, etc.)

1.	Aegean Sea	East of Greece.
2.	Black Sea	North of Asia Minor.
3.	Caspian Sea	North of Media.
4.	Dead Sea	No outlet. Probably hides Sodom, Gomorrah and Zoar.
5.	Gulf of Aqaba	East of Sinai Peninsula. Solomon's southern sea outlet.
6.	Gulf of Suez	West of Sinai Peninsula.
7.	Ionian Sea	Under the boot of Italy.
8.	Mediterranean	Also called the Great Sea.
9.	Persian Gulf	Where the Euphrates empties into the sea.
10.	Red Sea	South of the Sinai Peninsula, including the two gulfs.
11.	Sea of Galilee	In a deep cup of hills, causing sudden, fierce winds.
12.	Waters of Merom	Flows into the Sea of Galilee.

AREAS (designated A-1, A-2, etc.)

1.	Galilee	West of the Sea of Galilee. Today: Israel
2.	Idumea	South of Judea, west of the Dead Sea, occupied by the remnant of the Edomites, mixed with the Nabateans. Today: Israel.
3.	Judea	West of the Dead Sea.
4.	Negev	Desert to the south of Judea, north of the Sinai peninsula.
5.	Samaria	West of the Jordan River, between the Dead Sea and the Sea of Galilee. After conquest by Assyria, repopulated by exiles from other nation who adopted a form of Israelite worship. Today: Occupied West Bank.


H-2
C-12
S-12
L-5
C-9
C-7
A-1
S-11
R-5
H-1
R-9
C-18
H-3
C-8
L-10
R-4
R-3
A-5
C-20
C-17
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C-16
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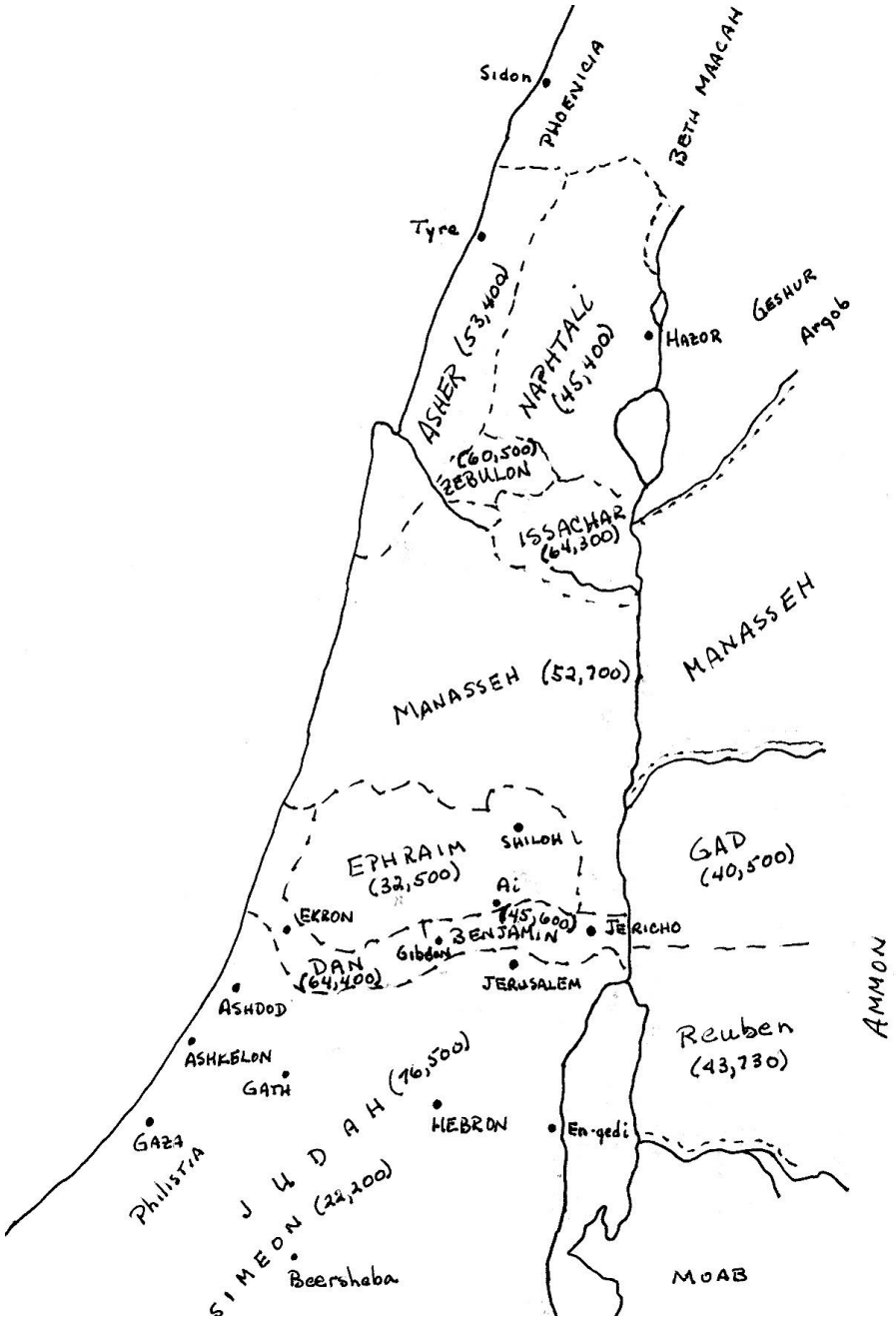
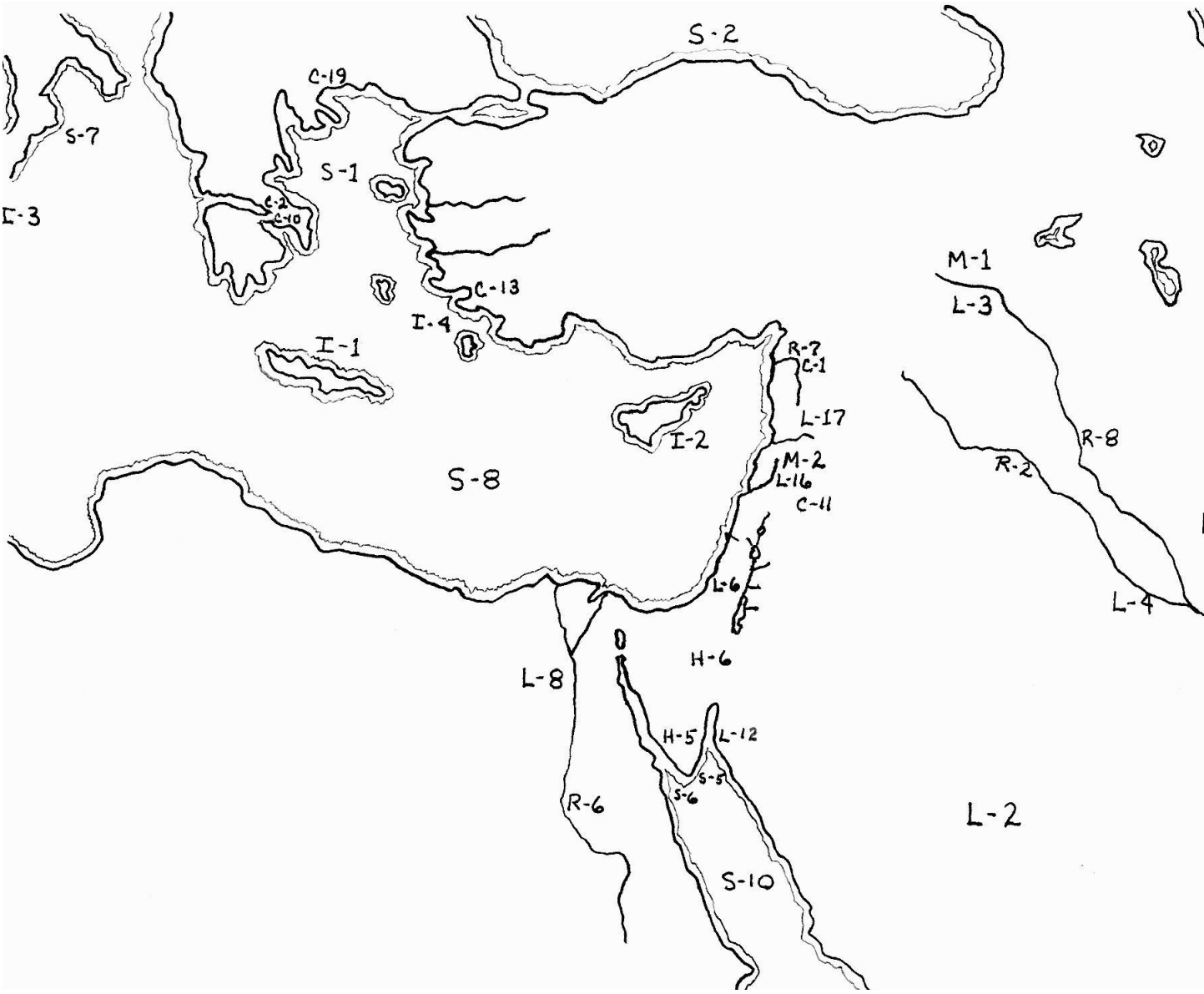
30 MILES



Populations from Nu 26-

-20 yr old and upward
-men-
total (Nu 26:51) 601,73


S-2
C-19
S-7
S-1
I-3
C-2
C-10
C-13
I-4
I-1
M-1
L-3
R-7
C-1
L-17
I-2
R-8
R-2
S-8
M-2
L-16
C-11
L-6
L-4
H-6
L-8
H-5
L-12
S-5
S-6
R-6
L-2
S-10

Statistical Analysis of Carbon Dating

The usual measure of the precision of a measurement is the standard deviation, which actually is a measure of probability based on what is often called the "bell curve" (Figure 1). The meaning of the term, standard deviation, is that the true value of the measurement will be within plus or minus one standard deviation of the mean (average) value 68% of the time, or within plus or minus two standard deviations 96% of the time, or within 3 standard deviations 99% of the time. So, a measurement of 6.1 ± 0.05 g means that the true value of the mass will be between 6.05 and 6.15 g 68% of the time. If you want to be more certain than your range brackets the true value, you need to make the interval wider, using a multiple of the standard deviation.

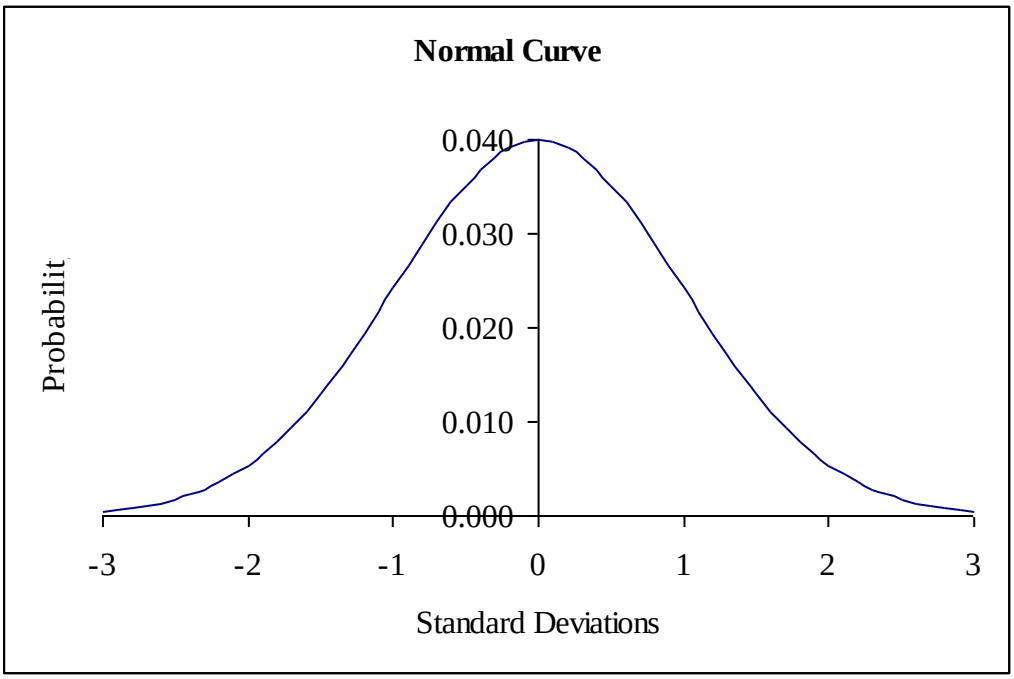


Figure 1. The normal curve

When more than one measurement is made and the measurements are combined mathematically to make a new number, the standard deviations must be combined, too. For example, if you measure the distance you traveled and the time it took to get there, and you wanted to report miles per hour, you would need to combine the standard deviations of the measurement of distance and the measurement of time in order to have a standard deviation for the value for speed.

The method to use for combining the standard deviations depends on the mathematical operation being performed. These methods of combination are based on probability, too. For example, if two lengths are to be added, the standard deviations are not added in the same way, because it is highly improbable that the true value of both measurements will be at the extreme edge of the standard deviation range. So, if two values are added, the standard deviations are combined as the square root of the sum of the squares. For example, 3.8 ± 0.5 ft plus 4.5 ± 0.7 ft = 7.7 ± 0.86 ft. ($\sqrt{(0.5^2 + 0.7^2)} = 0.86$) Notice that if the two values had been subtracted, the answer would be 0.7 ± 0.86 ft, which, in most cases, would be a meaningless value, since the

"window" for knowing the true value of the result even 68% of the time would be bigger than the value itself.

In the case of ^{14}C dating, several measurements are combined to obtain an estimate of the age of an article, and several assumptions are made. The tolerances inherent in the measurements must be combined in certain ways to determine the "window" in which the true value resides. Further, if any of these underlying assumptions are found to be unreliable, the entire calculation method becomes meaningless.

^{14}C is formed in the upper atmosphere by neutron bombardment of ^{14}N. The neutrons are a product of the nuclear reactions in the sun. The ^{14}C diffuses through the rest of the atmosphere and becomes incorporated into living things. In today's world, a gram of pure carbon will experience approximately 5 disintegrations of ^{14}C per minute. If an object containing carbon is sequestered in some way so as to prevent it from interacting with the environment freely, then the atoms of carbon cannot be exchanged with the environment any longer. ^{14}C will continue to disintegrate but will not be replenished from the surroundings. Therefore, the age of an object may be estimated from the amount of ^{14}C remaining in a sample as compared to the amount that would be there if it were free to equilibrate with the environment.

This process depends on several assumptions.

- **Assumption 1:** The rate at which ^{14}C is produced in the upper atmosphere is assumed to have been constant during the timescale of the experiment. So, if something is dated at 10,000 years, the assumption is made that the abundance of ^{14}C was the same then as it is now. This assumes that the solar flux of neutrons was the same then as it is now. This certainly is not true, since the sun has been diminishing in size as it uses up fuel, and the reaction rates of the nuclear events in the sun have changed measurably several times just in the last century.
- **Assumption 2:** The decay rate of ^{14}C is assumed to have been constant over that time. In the scientific world today, radioactive decay is assumed to occur at a constant rate governed by probability. These probabilities have been developed from measurements, so they are called empirical formulas. No one really knows why a nucleus decides to disintegrate when it does, or if that rate can be changed by as-yet-unknown forces. Many people have tried to change the decay rate with an external stimulus. Nothing has changed it so far. However, a reasonable possibility does exist that some stimulus will be found that causes a change. For example, the decay rate could depend on the proximity of other radioactive materials or could be stimulated by a "direct hit" by one of the many sub-atomic particles that pass through us every second, so their flux would influence the rate of decay. Our current model says that a radioactive nucleus decays at a random moment, the impetus for which we do not know. If we ever find what triggers it, then we will be able to alter the rate artificially.
- **Assumption 3:** It is further assumed that these constant decay rates are constant according the formulas we have developed. These rates have been measured for less than a century. As an example, the decay rate for ^{14}C in published literature has changed by 0.3% between the 1950's and the 1990's (from a half-life of 5730 years to a half-life of 5715 years). Another reputable reference gave the half-life of ^{14}C as 5568 years. This could be due to better measurement techniques in some places as compared to others. Or, it could be that the decay rates do not obey the model we have created for them. A change of 0.3% in 40

years seems insignificant. But, over a time span of 40,000 years, that rate could be very different.

- **Assumption 4:** The method assumes that the various isotopes of carbon (^{12}C, ^{13}C and ^{14}C) are incorporated into natural materials in proportions that match the atmospheric abundance. However, ^{14}C is 17% heavier than ^{12}C. So, it moves more slowly. In some natural tissues, the abundance of ^{14}C is significantly lower than in the environment.

Getting back to standard deviations, if we accept that all the assumptions are valid, ordinary statistical analysis sets a limit on the values that ^{14}C dating can produce. The formula for that dating is $\ln(N/N_0) = -\lambda t_a$. N_0 is the predicted original amount of radioactive material, in this case, ^{14}C. N is the amount of C^{14} that remains. λ is the decay constant for ^{14}C, which is assumed to be constant over all time spans. And t_a is time (or the age of the object, hence the variable name t_a) in years.

The predicted original amount of radioactive material, N_0, is not a very precise value. It is based on the mass of the carbon sample and the generally accepted natural abundance of ^{14}C. The generally accepted value of the abundance is based on the generally accepted measurement of 5 disintegrations of ^{14}C per minute per gram of pure carbon. In the professional literature, I have found values for the natural abundance of ^{14}C that differ by more than a factor of 2. Of course, if the relative standard deviation for that natural abundance were 100%, all future calculations would be meaningless. (The relative standard deviation is the standard deviation divided by the value with which it is associated, expressed as a percent. For example, if a value of 5 has a standard deviation of 0.5, then the relative standard deviation is 10%.)

But, since the best values for the abundance of ^{14}C in natural carbon are based on the measurement of about 5 disintegrations per minute per gram of carbon, the natural abundance can be assumed to be $4.34 \times 10^{-13} \pm 10\%$. The relative standard deviation of 10% came from the fact that the original calculation started with 5, which is an approximation meaning that the true value is between 4.5 and 5.5. For subsequent calculations, the 10% relative standard deviation will be used, although this value may be much higher and certainly is not lower.

The next variable to address is N, the amount of ^{14}C that remains. The abundance of ^{14}C in the sample when it was removed from free exchange with the environment thousands of years ago is assumed to have been at the same abundance as it is today, so that value is obtained by multiplying the natural abundance times the mass of carbon in the sample. The amount of ^{14}C that is present in the sample today (the value of N) is expected to be much less than the original amount (N_0). The value of N cannot be measured directly; rather, it is measured indirectly based on the number of ^{14}C that disintegrate during a test period that is relatively short. For the sake of convenience, we will call that value N_d (number of disintegrations). The value of N can be derived from the value of N_d using the same equation as before: $\ln(N_x/N) = -\lambda t_t$. N_x is the number of ^{14}C atoms that remain after the laboratory counting period, t_t, the testing time. Since $N = N_x + N_d$ (the total number of ^{14}C atoms at the beginning equals the number that remain plus the number that decayed), the formula can be rearranged to include the value that can be measured (N_d) in order to find the value that is needed (N):

$$\ln(N_x/N) = -\lambda t_t$$
becomes
$$\ln((N - N_d)/N) = -\lambda t_t$$
becomes

$$\ln(1 - N_d/N) = -\lambda t_t$$

N_d is the number of disintegrations measured by a beta spectrometer. Only whole numbers are possible. In other words, half of one disintegration cannot happen. It either disintegrates or it doesn't. So, N_d is called a counting value. By definition, its standard deviation is $\sqrt{N_d}$. Its relative standard deviation is $1/\sqrt{N_d}$, or $(\sqrt{N_d})/N_d$. This can be a very significant percentage or an inconsequential percentage, depending on the number of counts collected. For example, if only 4 counts are collected, the standard deviation is 2, and the relative standard deviation is 50%. But, if 100 counts are collected, the standard deviation is 10 and the relative standard deviation is 10%. If 10,000 counts are collected, the relative standard deviation is only 1%.

The number of collected counts depends on the amount of sample and the length of time over which disintegrations are counted, since disintegrations can be expected at the rate of about 5 counts per gram of pure carbon if the sample has the normal natural abundance of ^{14}C. The older the sample, the less ^{14}C, and the fewer counts can be expected over a given period of time. So, the oldest samples have the highest relative standard deviation. At a certain combination of age, sample size, and counting time, the relative standard deviation becomes so large that the answer is meaningless.

In addition, many samples are, by nature, very small. Generally, the sample must be digested and chemically treated in order to isolate just the carbon. The original sample is destroyed in the process. Museums are not pleased to give up substantial portions of important artifacts for dating purposes. So they give as little as they can to still obtain relevant data.

Most samples do not start out as pure carbon. Wood, which has a lot of carbon, is still only about 46% carbon. This ratio is close to the carbon fraction of most plants and fibers. And, the chemical technique for isolating the carbon is not perfect, so some is lost. The quality of the laboratory generally determines the loss rate. The very best will lose less than 5%. Those in universities generally lose over half because the work is done by students. This loss rate does not contribute to the standard deviation, because all that matters is the purity of the final sample. But it does impact the required size of the original sample, which may be limited.

The equipment used to measure the decay of ^{14}C has an upper limit for the sample size, too. The largest sample that can be measured in conventional equipment is about 8 g of pure carbon. Actually, the carbon first is isolated from the sample. Then, it is hydrogenated to make benzene, which is a liquid and easy to handle. To this is added a combination of chemicals called a scintillation cocktail. When ^{14}C decays, it emits a beta particle (an electron). This electron hits the scintillation cocktail compounds and makes a small flash of light. The flashes of light are counted. Actually, any nuclear event will be counted. But, since the only radioactive material in the bottle is ^{14}C (everything else having been removed in the purification steps), all the flashes of light are attributed to ^{14}C. Unfortunately, nuclear events are always happening around us. One example is cosmic rays. These events also cause flashes, so there is a background of counts that will happen if any ^{14}C is present or not. An excellent background is 0.2 counts per minute (cpm). The typical background is 0.4 cpm. Unless disintegrations from ^{14}C occur significantly more frequently than these background events, the ^{14}C data is lost in the noise of the instrument. Using the typical value used by the EPA for environmental measurements, a value must be more than five times the background to be significant. So, a sample must produce at least 0.8 count per minute (a total of 1 count per minute) to be "countable." Other scientists have used lower values. Some reputable researchers have used a value of three times the noise as the detection

limit, or a ^{14}C disintegration rate of 0.4 counts per minute for a total of 0.6 counts per minute. This idea will be applied to real values after a few more ideas are introduced.

The duration of counting (t_t) is limited by the drift in the electronics of the beta spectrometer. The best instruments can collect counts for 24 hours before drifting significantly. The older or less expensive models usually cannot go more than about an hour. But, assuming that the best instrument is used, at 5 disintegrations per minute, 7200 disintegrations per day would be collected per gram of pure carbon. For a 1-gram sample of pure carbon, the relative standard deviation of the count rate for fresh (not old) carbon would be 1.18%. This is a pretty good value, especially compared to the 10% relative standard deviation for N_0 (the number of atoms of ^{14}C when the sample was new, thousands of years ago). However, new carbon is not being counted. Rather, old samples are counted. If the sample were, for example, about 5,000 years old, it would be expected to yield only 2.5 disintegrations per minute, for a total of 3600 counts, with a relative standard deviation of 1.67%. This still is pretty good. But if the article is, for example, supposed to be 40,000 years old, the relative standard deviation climbs to 13.2% for a 1-gram sample. But, the relative standard deviation drops back to 4.7% if the sample size is increased to the maximum of 8 g. All of these numbers assume that the best instrument is used, and that is was able to count for a whole day without electronic drift. Further, it assumes that the instrument is 100% efficient. Most are about 80% efficient. The efficiency affects both the standard deviation and the point at which the counts from ^{14}C start to get lost in the noise. As N_d gets smaller, its relative standard deviation ($1/\sqrt{N_d}$) gets larger.

Going back to the original formula, $\ln(N/N_0) = -\lambda t_a$, and combining it with the laboratory formula, $\ln(1 - N_d/N) = -\lambda t_t$, a single formula can be obtained that allows measurable values to produce the desired result: the age of the material. The formulas must be combined to avoid including the standard deviation of a value more often than needed, which would produce an unwarranted increase in relative standard deviation that depended only on mathematical manipulation and not on measurement. Starting with

$$\ln(N/N_0) = -\lambda t_a$$

rearranging

$$t_a = -\ln(N/N_0)/\lambda$$

taking the negative inside the natural log

$$t_a = \ln(N_0/N)/\lambda$$

Switching to the other formula

$$\ln(1 - N_d/N) = -\lambda t_t$$

rearranging to isolate N in preparation for substitution into the first formula

$$1 - N_d/N = \exp(-\lambda t_t)$$

exp() is a convenient was of writing "e to the power of."
This prevents having to have subscripts inside of superscripts.
Rearranging

$$N_d/N = 1 - \exp(-\lambda t_t)$$

$$N = N_d/(1 - \exp(-\lambda t_t))$$

One last expansion, $N_0 = mA$
(m = mass of carbon sample; A = abundance of ^{14}C in the carbon sample)
Substituting them all together:

$$t_a = \ln((1 - \exp(-\lambda t_t))mA/N_d)/\lambda$$

Having derived the formula that relates all the measurements, all the standard deviations may be compiled to determine the precision of the derived value. As can be seen in Table 1, most of the relative standard deviations are negligible.

Description	Variable	Value	Relative Standard Deviation
Number of disintegrations	N_d	25 to 2500	$1/\sqrt{N_d}$ (20% to 2.5%)
Decay constant	λ	1.21×10^{-4}/yr	< 0.01%
Testing time	t_t	24 hr	< 0.01%
Mass of carbon	m	< 8 g	< 0.01%
Abundance	A	4.32×10^{-13}	> 10%

Table 1. Relative standard deviations of measured values

The relative standard deviations of λ, t_t, and m are negligible compared to the other values. However, it is important to remember that the relative standard deviation of λ is based on the rather large assumption that the decay rate has been constant for tens of thousands of years. These three relative standard deviations will be ignored through the rest of the discussion. If they were included, the math would get much messier, but the final value would not be noticeably different.

The relative standard deviation of the value of the abundance of ^{14}C (A) was 10% or worse. The relative standard deviation of N_d depended on the sample size, the counting time, and the age of the object. This may range from 1% to 25%, depending on age and sample size. When N_d and A are combined mathematically, the resulting relative standard deviation (the sum of the squares of the relative standard deviations, square-rooted) will be between 10% and 27%.

The last step in calculating the relative standard deviation of the age is to take the combined relative standard deviation of N_d and A through the natural logarithm function. This process is entirely different than the methods used for adding, subtracting, multiplying, or dividing. For adding or subtracting, the new standard deviation is the sum of the squares of the standard deviations, square-rooted. For multiplying or dividing, the new relative standard deviation is the sum of the squares of the relative standard deviations, square-rooted. For natural logs, it goes like this; the standard deviation of the new value is the relative standard deviation of the starting value. For example, if the combined relative standard deviation of N_d and A is 10%, then the standard deviation of the natural logarithm is 0.1.

The important point of that relationship is that you start with a relative standard deviation and end up with a regular standard deviation. To get it back into a relative standard deviation, you must divide by the original value. This can be very significant or not very significant, depending on the values. For example, consider the arbitrary equation $y = \ln(x)$ in which x has a relative standard deviation of 10%. The relative standard deviation of y would be 0.1/y (relative standard deviation is the standard deviation divided by the value which it modifies). If y is greater than 1, then the relative standard deviation will be less than 10%, an improvement over the relative standard deviation of x. But if y were less than 1, the resulting relative standard deviation would be greater than 10%.

In this case, the value inside the natural logarithm parentheses was, originally N/N_0. This value is always less than 1 since the number of ^{14}C that remain (N) will always be less than the number at the beginning (N_0). The older the sample is, the smaller N/N_0 become. The natural logarithm of 1 is zero. So, the standard deviation of the age of a sample in which all the

expected ^{14}C was still present would be infinite. If the sample were fairly young (less than 10,000 years), the absolute value of $\ln(N/N_0)$ would be less than 1. (In standard deviations, everything is squared and then square-rooted, so all the negative signs go away. Plus, as was done in the derivation above, the value inside the natural logarithm can be changed to N_0/N by taking the negative sign inside the natural logarithm. But, this does not change the absolute value of the natural logarithm.) But when N/N_0 passes about 13000 years, the absolute value of the natural logarithm becomes greater than 1, so the relative standard deviation of the result gets smaller.

The relative standard deviation of N/N_0 gets larger with age, but the value by which it is divided gets larger also. Figure 2 shows the relationship between age and the resulting relative standard deviation for a 1-gram and an 8-gram sample of pure carbon. The mass of the original object would be at least twice that mass, since the percentage of carbon is rarely more than 50%. The curves turn up sharply at the right end because the ^{14}C becomes so depleted that there are not enough disintegrations to count. The curves turn up on the left because the ratio of N and N_0 is not different enough from 1 to be statistically significant. For the curve to reach 10,000 years, the carbon sample must be at least 0.27 g. The sample must weigh at least 0.9 g to reach 20,000 years, 3 g for 30,000 years, and more than the maximum of 8 grams to reach 38,000 years. This is based on the very best of conditions and equipment: 24-hour counting period, 0.2 cpm background, 100% efficiency, and a detection limit that is only three times the noise. Based on this graph, but not on the assumptions that produced it, ^{14}C dating is useful only between 5000 years and the upper limit imposed by the size of the sample and counting time.

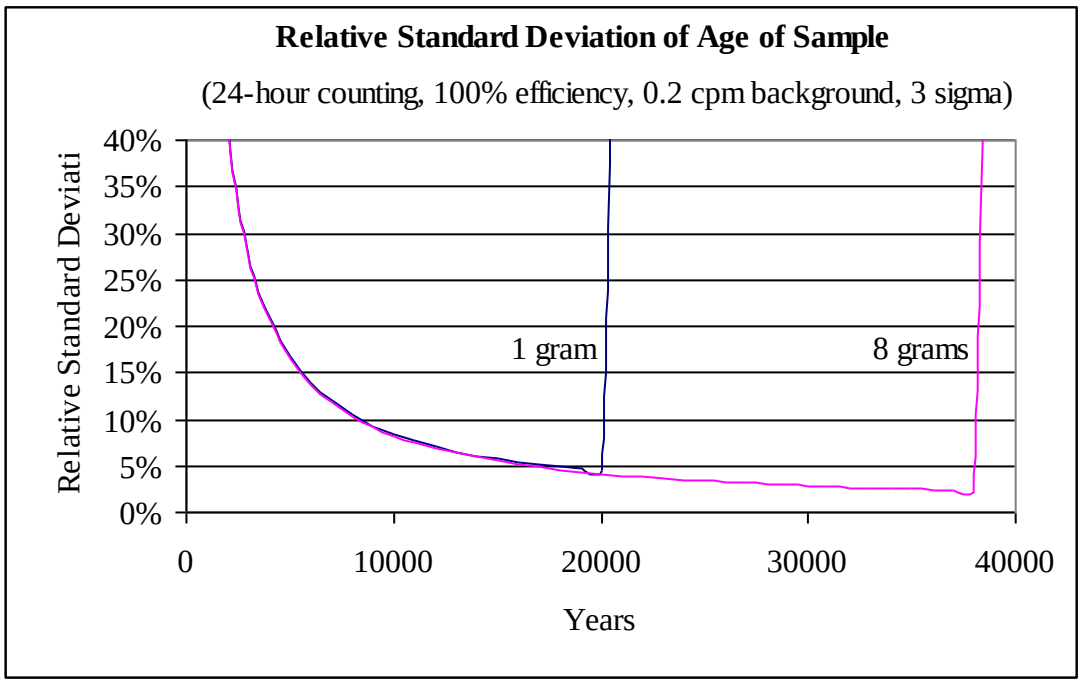


Figure 2. Relative standard deviation of the measurement of the age of 1 gram and 8 gram samples of pure carbon.

Figure 3 shows the same relative standard deviation comparison for potassium/argon data. Potassium is a common mineral in some rocks. A certain fraction of the potassium on earth is in the form of an unstable isotope, ^{40}K, which decomposes to argon. The half-life is 1,260,000,000 years. The natural abundance is 0.117%. The method is not useful for ages that are less than 100 million years because N and N_0 are not sufficiently different. The same types of assumptions apply to potassium/argon dating that apply to ^{14}C dating.

- **Assumption 1:** The abundance of ^{40}K was the same during the period from 100 million to 600 million years ago as it is now.
- **Assumption 2:** The rate decay of ^{40}K has been constant over that time.
- **Assumption 3:** It is further assumed that these constant decay rates are constant according the formulas we have developed. These rates have been measured only for less than a century.

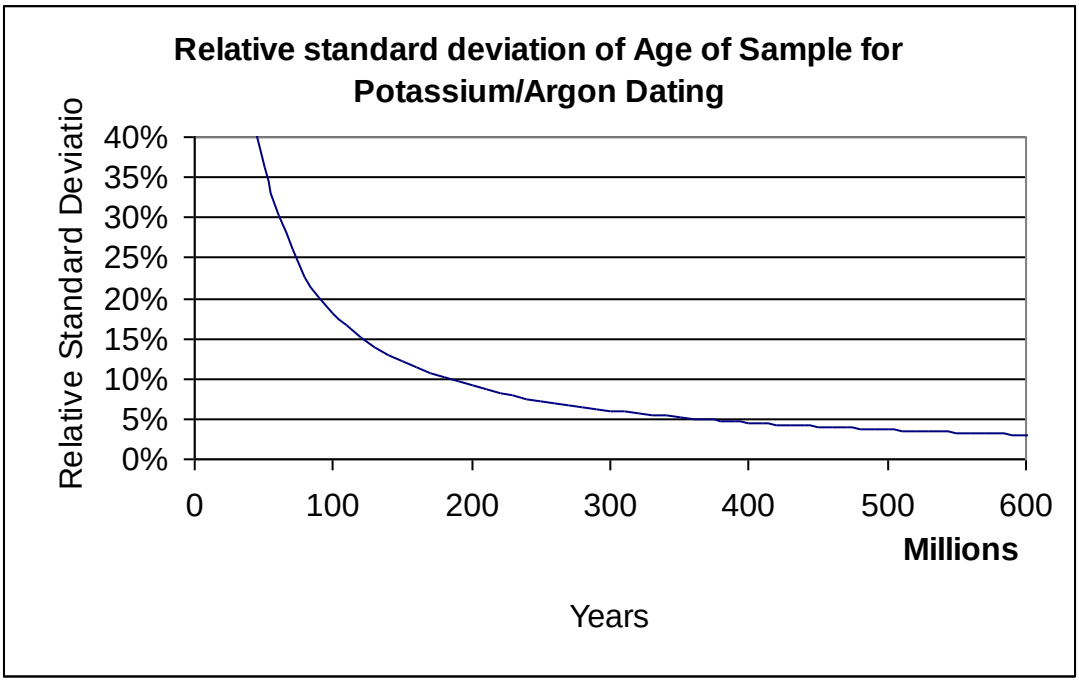


Figure 3. Relative standard deviations of the ages assigned by potassium/argon dating.

In summary, statistical analysis limits the range of ages that can be determined by current dating methods using the best equipment and the largest sample sizes for the longest counting times: 5000 to 38,000 years, and greater than 100 million years. Despite the limitations imposed by these methods, many ages of objects are published that fall outside those ranges.

The ^{14}C method assumes that the rate of neutron bombardment from the sun to the upper atmosphere has been the same for 60,000 years. But the rate of neutron bombardment sometimes changes on a scale of decades, so the assumption is not reasonable. If the quantity of neutrons has been increasing over time (as would be expected from a shrinking sun, with more neutrons able to escape from the nuclear reactions in the core because the outer layers of the sun

are getting thinner), all ages determined by ^{14}C dating would yield results that indicated that the artifact was older than it really is.

The ^{40}K method assumes that the abundance of ^{40}K has been the same for more than 100 million years and that the potassium in the rocks has not exchanged with the environment in that same period of time. Yet, those who use such dating methods assume that mountain ranges are formed in similar time scales, and that continents rise from and sink into the molten interior of the earth on similar time scales. So, rocks cannot be assumed to have been isolated for that long. Interestingly, if time scales on earth were measurable across hundreds millions of years, the quantity of radioactive material on earth would be huge, based on the quantity that survives to this day.

Whenever an age based on ^{14}C is published, it should carry with it the size of the sample, the background rate, the efficiency, and the counting time. Without these data, the validity of the given age cannot be determined. Many samples are measured using only 0.1 g. With that size of sample and the very best equipment, the ^{14}C counts can never be separated from the background.

Attitudes Necessary for Understanding the Scriptures

1. The author intended to be understood by his immediate audience. The author's intention is the only valid understanding.
2. Context determines meaning. A definition from one place cannot be transplanted to another place. Context determines if language is literal or figurative.
3. Conflicting understandings cannot both be true.
4. We must seek what the Word of God is trying to tell us, rather than trying to use the Word of God to validate our beliefs. We must have more confidence in the Word than in our own understanding of it.
5. The meaning must be apparent to an ordinary person. Special training is not required.
6. If the explanation is longer than the verse, you have added something that God did not.
7. Sin is never excusable, but is forgivable.

Rules of Interpretation

1. Who was the speaker or writer? The Bible contains statements that were accurately recorded, but are totally false.
2. Who was the original audience? Did the author intend for the audience to include me?
3. What does each word mean in this context?
4. What kind of writing is it (e.g., history, letter, song, prophecy, instruction, exhortation, sermon, genealogy, law)?
5. What is the historical setting? Events current to that time may affect understanding.
6. Is the language literal or figurative?
    a. What is the author's interpretation?
    b. What is the point of the context?
    c. What is the one main point?