

*These notes are based on public talks I have given at a number of universities. These notes are updated from time to time. Last update: March 2010.*¹

MODERN ASTRONOMY, THE BIBLE, AND CREATION

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SUMMARY

This is the web version of a handout intended for Christians and others interested in Bible and science questions (particularly astronomical ones). In it I give my responses to some of the questions I am most frequently asked on the subject of the Bible and modern astronomy. I start out by emphasizing that many scientists and philosophers have strong religious beliefs and I give some quotes from famous scientists and philosophers. I list, and briefly discuss, some of the main theological interpretational viewpoints of the creation stories in Genesis. It is explained that there are more than just two extreme views on the origin of the universe and that the majority of scientists who are Christians adhere neither to the view that the Bible is irrelevant to the earth's origin (which exponents of atheistic evolution claim) nor the view that God made the earth essentially as it now is in six 24-hour periods about 6000 years ago (the “young earth creationist” position.) The origin of Bishop Ussher's date of creation is explained and the question of “days” in Genesis 1 is discussed. Examples of where modern astronomy is supporting the details of Genesis 1 are described. A list of suggested readings for those who wish to read more about Christianity, the Bible, and some of the scientific issues is appended.

INTRODUCTION

At home we have a highly useful one-volume encyclopedia, the *New Columbia Encyclopaedia* (1975 edn.). It is a wonderful book because it has most topics in it that we want to look up, and it has neither too much nor too little information. Now I'm not advocating the divine inspiration of encyclopaedias, but before the days of the internet I thought it would be interesting to see what our encyclopaedi said on two topics: “God” and “Atheism”. The entry for God is 24 cm long (a bit more than most people get.) It gives the names of God, discusses concepts of God, and ends with listing the classical arguments for the existence of God. There are cross-references to other articles (“Trinity”, “Religion” etc.). Now let's look at the entry for “Atheism”. This is so short that I will quote it in its entirety:

“Atheism, denial of the existence of God or gods and of any supernatural existence, to be distinguished from AGNOSTICISM, which holds that the existence cannot be proved. The term atheism has been used as an accusation against all who attack established orthodoxy, as in the trial of Socrates. There were few avowed atheists from classical times until the 19th cent., when popular belief in a conflict between religion and science brought forth preachers of the gospel of atheism such as Robert O. Ingersoll. There are today many individuals and groups professing atheism.”

The article is short (the article on agnosticism is about the same length). About half of it is taken up defining the term. The rest of the article is a short history. I was struck when I read the article that there are no “proofs” or arguments offered for atheism, just a reference to “a popular belief in a conflict between religion and science.” The coverage by our 20-volume *World Book* encyclopaedia is similar. Today a little exploration on the internet will quickly reveal that, as in bygone decades, the issue of science dominates attacks on belief in God.

In these notes I therefore want to focus on this question of “the popular belief in a conflict between religion and science”. The notes have three parts: in the first I want to give you, mostly in their own words, some statements by some of the major figures who have given us our modern view of the universe. In the remaining two parts I want to focus on the first chapter of Genesis, because it is in the question of origins that the conflict between religion and science is often considered to be greatest. First, I will present you with some of the major interpretive views of Genesis and then, for the final part of the notes, I will go through the first chapter of Genesis in the light of modern astronomy. At the end of these notes you will find an extensive recommended reading list, and references in my notes are mostly to books on this list.

SOME STATEMENTS BY GREAT SCIENTISTS

Part of the “popular belief” alluded to in my introduction is that great scientists are atheists or at least uninterested in religion. Let's see what some of the main figures in the development of astronomy had to say for themselves. If you're unfamiliar with astronomy, these particular astronomers were all major figures in the development of astronomy.

Nicholas Copernicus - the person responsible in modern times for the idea that the earth orbits the sun; Copernicus was a prominent churchman:

“[The world] has been built for us by the Best and Most Orderly Workman of all”

He pursued his research (he said) *“loving duty to seek the truth in all things, in so far as God has granted that to human reason.”* [See Hummel 1986, “The Galileo Connection”]

Johannes Kepler - the man who discovered the laws of planetary motion. A devout Lutheran and diligent student of the Bible. He was the person who discovered that Jesus was not born in 1 AD.

“I believe Divine Providence intervened so that by chance I found what I could never obtain by my own efforts. I believe this all the more because I have constantly prayed to God that I might succeed if what Copernicus said was true.”

¹ Not printed at university expense.

On his deathbed he said: “[my salvation lies] only and alone on the services of Jesus Christ.” [See Hummel 1986].

Galileo Galilei -- the first person to publish astronomical results obtained with a telescope. Opened up a whole new realm of astronomy. Many discoveries. He acquired many scientific enemies who eventually got even by bringing him before the inquisition since they couldn't win on scientific grounds. It is important to understand that Galileo's appearance before the inquisition was not a simple case of “the church against progress in science”. The Roman Catholic Church was in fact quite divided over the issues in the Galileo case. Galileo never blamed the Roman Catholic Church for what happened but blamed his fellow university professors instead. Here are some of his views on science and Christianity:

“The Holy Bible and the phenomena of nature proceed alike from the Divine Word...God is known...by Nature in His works and by doctrine in His revealed word.”

“The Bible teaches how one goes to Heaven, now how the heavens go.” [See Hummel 1986].

Sir Isaac Newton - Derived the theory of (“Newtonian”) gravity. Made the first reflecting telescope. Co-inventor of calculus. Many other contributions to science. Newton was a complex and unappealing character and he was unorthodox in his beliefs, but he wrote more on Biblical subjects than on everything else he did all put together. He published valuable contributions to religious knowledge (esp. on interpreting Biblical prophecy).

“There are more sure marks of authenticity in the Bible than in any profane history.”

[Biblical prophecy was not intended by God to] *“gratify men's curiosities by enabling them to foretell things” but rather that: “after they are fulfilled, they might be interpreted by events...The events of things predicted many ages before, will then be a convincing argument that the world is governed by Providence.”*

One of Newton's views of his own greatest published work he expressed as follows:

“When I wrote my treatise about our Systeme, I had an eye upon such Principles as might work with considering men for the believe of a deity & nothing can rejoyce me more than to find it usefull for that purpose.” [See Hummel 1986]

Sir William Herschel - discoverer of the planet Uranus, but more famous among modern astrophysicists as the father of stellar and galactic astronomy.

“All human discoveries seem to be made only for the purpose of confirming more and more strongly the truths in the sacred scriptures.” [Quoted by H.H. Halley 1965, “Halley's Bible Handbook” 24th ed., p.19]

Albert Einstein - developer of the theory of relativity. It should be emphasized that he was not a man of orthodox beliefs, but he believed that science and religion needed each other and that *“science without religion is lame”*. He also said:

“Everyone who is seriously involved in the pursuit of science becomes convinced that a spirit is manifest in the laws of the universe--a spirit vastly superior to that of men...” [“Albert Einstein: The Human Side”, Princeton University Press]

“The highest principles for our aspirations and judgments are given to us in the Jewish-Christian religious tradition.” [Address to Princeton Theological Seminary, May 19, 1939. Published in “Out of My Later Years” Philosophical Library, 1950]

“What is the meaning of human life, or of organic life altogether? To answer this question at all implies a religion. Is there any sense then, you ask, in putting it? I answer, the man who regards his own life and that of his fellow creatures as meaningless is not merely unfortunate but almost disqualified for life.” [“The World as I See It”, Philosophical Library, 1949]

“Being a lover of freedom, when the [anti-Nazi] revolution came to Germany, I looked to the universities to defend it, knowing that they had always boasted of their devotion to the cause of truth; but, no, the universities immediately were silenced. Then I looked to the great editors of the newspapers whose flaming editorials in days gone by had proclaimed their love of freedom; but they, like the universities, were silenced in a few short weeks. Only the Church stood squarely across the path of Hitler's campaign for suppressing truth. I never had any special interest in the Church before, but now I feel a great affection and admiration because the Church alone has had the courage and persistence to stand for intellectual truth and moral freedom. I am forced thus to confess that what I once despised I now praise unreservedly.” [Interview in *Time* magazine, Dec. 23, 1940, p. 38]

The list could go on with quotes from many more great astronomers and physicists (such as Michael Faraday, James Clerk Maxwell, Sir Arthur Eddington, Sir James Jeans, Heber Curtis, and Henry Norris Russell to name but a few) and be continued down to the present day (with men like Allan Sandage), but it's always easier (and safer!) to refer to someone as a “famous scientist” when they've been dead a while! For an extensive series of short highly readable spiritual and scientific biographies of scientists of the past in various fields see “Scientists of Faith” by Dan Graves. Moving beyond astronomy, the following (more recent) quotes by two physicists are noteworthy:

Henry Margenau - former president of the American Association for the Philosophy of Science, a physics professor at Yale University and former editor of *Reviews of Modern Physics* (Margenau got his start in physics at the University of Nebraska):

“It is often said, and widely believed, that scientists on the whole are anti-religious or, at least, are not interested in religion. I believed that for a long time too. But no longer. ...as I perceive it, the fact is, the scientists, the physicists at least, who have been most active, most successful in developing the quantum theory and further innovations in physics, are very interested in religion. If you consider scientists of the type of high school teachers or grade school teachers or Carl Sagan, you find that, yes, there is a lack of interest. Quite a few of them are anti-religious. But, if you take the outstanding physicists, the ones who have done the most to advance modern physics, especially Heisenberg, Schrödinger, Dirac, you will find them all interested in religion. All these men were intensely interested in religion.” [In “The Intellectuals Speak out about God”, Chpt. 3, ed. R. A. Varghese, 1984, p. 45]

According to science historian Frederic B. Burnham, in an editorial in the *Los Angeles Times*, (Saturday, May 2, 1992, pp. B6-B7), the community of scientists now considers the idea that God created the universe *“a more respectable hypothesis today than at any time in the last one hundred years.”*

Robert Griffiths (a physics professor at Carnegie Mellon University and winner of the Heinemann prize in mathematical physics):

"If we need an atheist for a debate, I go to the philosophy department. The Physics department isn't much use" [interview in *Christianity Today*, April 3, 1987, p. 18]

SOME QUOTES FROM SOME PHILOSOPHERS

It is worth adding that Prof. Griffiths might have trouble finding his atheist for a debate in some philosophy departments too! The Society of Christian Philosophers, with about a thousand members, is the largest special interest group in the American Philosophical Association. The philosophical debate about God is far too vast to go into here, but here are some quotes from some noted contemporary philosophers:

Bernard J. F. Lonergan Before his death in 1984 Lonergan was described by *Time* magazine as "considered by many intellectuals to be the finest philosophical thinker of the 20th century". Over one hundred and fifty doctoral dissertations have been written on his work! He has also had the distinction of becoming the first philosopher to have witnessed, in his lifetime, an entire conference of fellow-philosophers convened solely in order to study his thought.

"I do not think it difficult to establish God's existence" ["The Intellectuals Speak Out about God", ed. R.H. Varghese, 1984, Regnery Gateway, p. 180 - the section of this book on Philosophy includes discussion with two other past presidents of the American Philosophical Association (quoted below) and is excellent (but not light-weight reading!)]

Alvin Plantinga (a past president of the American Philosophical Association). Writing about one of the classical arguments for the existence of God, he wrote that it

"...provides as good grounds for the existence of God as does any serious philosophical argument for any important philosophical conclusion."

["The Intellectuals Speak Out about God", p.191]

William Alston (another past president of the American Philosophical Association)

"I think that the Naturalist who is convinced that there isn't anything beyond what we can discover through sense-perception and what science tells us about, is simply shutting himself off from some of the ways we have to find out what there is" ["The Intellectuals Speak Out...", p. 158]

John E. Smith (another past president of the American Philosophical Association) was asked how he viewed some popular scientific writers such as Carl Sagan and the late Isaac Asimov presenting emphatically mechanistic (atheistic) views. He replied:

"Well, I think they are being dogmatic and the tide is against them...There will always be those who try to reduce the world to materialistic proportions. But then...it is...a phenomenon worth of study to find people animated by the purpose of showing that purpose is an illusion!" ["The Intellectuals Speak Out..." p. 161-162]

Kurt Gödel. It is also noteworthy that the most famous mathematical logician of the 20th century, Kurt Gödel, author of the famous "Gödel's incompleteness theorem" (1931) on the limits of mathematical proof, believed in the existence of God on the basis of a logical

proof of the existence of God. The proof can be found in full in the biography, "Reflections of Kurt Gödel", by H. Wang (1987, MIT Press: Cambridge, Mass.)

WHAT THE BIBLE SAYS ABOUT CREATION

It is in the area of creation that the most fuss is made about possible conflicts between the Christianity and science. The rest of this handout looks at the astronomical issues here.

First, before arguing (from any side) about origins and what the Bible says, it is important to actually read for oneself what the Bible says! The best-known passage is *Genesis 1:1 - 2:3*. What is perhaps less well known is that there is a second description of creation (in a different order) in *Genesis 2:4-7*. The difference in order suggests that we should not get too "hung up" about the order in Genesis 1.

There are many other passages in the Bible speaking about creation. I have a companion nine-page handout of over a hundred of these passages. Some of the ones I'd suggest looking up are *John 1:1-3*, *John 1:10*, *Colossians 1:16-17*, *Hebrews 11:3*. From these one learns that Jesus was involved in the creation and that more things than just our visible universe were created. This is precisely what modern astronomy is finding. Already we know that the familiar ordinary matter you and I are made of currently seems to be only 4% of the matter and energy in the universe. Of the rest, 23% is made of mysterious invisible "dark matter", and 73% is an equally mysterious "dark energy". *Job 38:4-11* is an interesting passage because of the poetic imagery used. It speaks of the "bolt" on the "doors" of the sea. I've never heard any Bible interpreter believe that the sea literally has a bolt! This should caution us into realizing that Genesis 1 is a quasi-poem and being aware that there might be figures of speech (the Bible abounds in these: who believes that because Jesus said, in *John 10:9*, that He is the door, that therefore He has hinges on his side?!).

DIFFERENT INTERPRETATIONS OF GENESIS

I would like to say emphatically that there are not just two interpretations of the origin of the universe: an (atheistic) "evolutionary" one and a Biblical "Creationist" one! It is important to realize that there are a wide variety of interpretations held by Christians. If you look at the writings of well known evangelical Christian writers (such as F. F. Bruce, Francis Schaefer, C. S. Lewis, R. C. Sproul, etc.) you will find that all of these people agree on the foundation Christianity – the person and work of Jesus Christ – but they do not agree on the exact interpretation of Genesis. For controversial issues St. Paul offers important guidelines in the 14th chapter of his letter to the Romans. First, in *Romans 14:5b* he says, "Let each person be fully convinced in his own mind". Christians are to use their minds! From this chapter of *Romans* we can see that true believing Christians are going to be of different minds over some topics. But verse 3 of the same chapter commands Christians not to regard fellow believers who are convinced of other viewpoints on non-essential doctrines with contempt. Rather they should "...pursue the things which make for peace and the building up of one another" (verse 19). In approaching a controversial topic I think there is an important need for humility.

Here then is a list of just some of the differing interpretations of the start of Genesis. The positions are not independent and there can be a lot of overlap (*e.g.*, someone

emphasizing the “Historico-Artistic” interpretation might hold to all or parts of any of the other views).

“*God made everything pretty much as it is now in six 24-hour days about 6000 years ago*” - the so-called “Creationist” position (a bad name! – I, and many writers on the subject prefer the name “Young-Earth Creationist” for this position). This is the position of the Creation Research Society (CRS), the San Diego based Institute for Creation Research (ICR), and a number of other “Creation Science” organizations. I have a lot of respect for people who hold this view because they are strongly committed to the Bible, but I don't believe it is the interpretation the Bible requires of itself, and it certainly clashes head-on with science. This viewpoint is something of an “American” view and has been much less common among Christians in Europe. The “Creationist” movement as we know it originated in the USA among Seventh Day Adventists (see the detailed history by R. L. Numbers, “The Creationists”, 1993, University of California Press, \$15). To get around the apparently overwhelming scientific claims for an old earth, the ICR holds to an “appearance of age” theory where the evidence for an old earth is an illusion created by God. Many challenge the theology of this theory since it requires God to be deliberately deceptive, while the Bible says, “God cannot lie”. There are many books that discuss the biblical problems with the Young-Earth Creationist interpretation (see bibliography; “The Fingerprint of God” has a good section on this).

“*Day-Age Theory*” - interprets the days of Genesis as geological ages.

“*Gap Theory*” - postulates that there is a gap between the initial creation (in *Genesis 1:1*) and subsequent events (starting in *Genesis 1:2*). The gap is presumably billions of years long.

“*Days of Revelation Theory*” - postulates that the 6 days of Genesis 1 were the six days over which God revealed things to Moses.

“*Theistic Evolution*” and “*Progressive Creation*”. These are perhaps the most popular positions among scientists who are Christians. They say that things happen the way science says that they do, but that God is still in charge and able to intervene as he wills. There are many theories in these categories. Opinions differ as to when and how God intervenes. “*Intelligent Design*” positions (see below) belong in this category. Theistic evolution is pretty much the official position of the Roman Catholic church.

“*Concordist Viewpoint*” - Emphasizes areas in which the Bible and science agree and assigns different (Biblical or scientific) explanations to different things.

“*Genesis is purely theological*”. (*i.e.*, it is not necessarily meant to relate what actually physically happened). This is a broad category covering a wide range of positions. I think this position takes a too low view of the Bible and I personally believe that the first few chapters of Genesis are vitally important theologically, but that there is more to them than that.

“*Historico-Artistic Viewpoint*” - emphasizes that we have to realize that the Genesis was addressed to people 3400 years ago in a form and in descriptive terms they would understand. Moses wouldn't have got very far if God had quoted from a modern

introductory astronomy text to him! (“Say, God, what's a quark?”). A senior physicist, who had been chairman of a large physics department in the US (and who was, incidentally, not someone with a high view of the Bible), once said to me, “if we put what we now believe to be true about the origin of the universe into poetic language someone would have understood 3000 years ago, we would come up with something very much like Genesis 1 & 2”. The historico-artistic viewpoint would also emphasize that Genesis 1 is in the form of a poem. It has a very definite literary structure. Phrases and patterns of words repeat (*e.g.*, phrases such as “Then God said...and it was so” or “...and God saw that it was good” or “and there were evening and morning...” But we must be careful to note that whether Genesis 1 is poetry or prose has nothing to do with whether it is an actual very literal description of what happened or whether it is allegorical or something. We must not make the distinction prose = fact; poetry = fiction.

“*The Answers are not in yet*”. This is part of my own viewpoint. I believe that God has not yet revealed everything to us in the Bible (see *Deuteronomy 29:29* and *I Corinthians 13:9-10,12*) and I know that we don't know all the answers in science yet.

“*Humanistic Evolution*” this non-Christian approach solves the problem by regarding the Bible as a bunch of myths and ignoring it. However, the Bible is actually very different from ancient middle-eastern myths and is a historical book, well confirmed by archaeology (see suggested reading list, especially Josh McDowell's “Evidence that Demands a Verdict”). The Genesis account is sometimes compared to the Babylonian creation epic, the *Enuma Elish*, found on tablets in the Assyrian Emperor Ashbanipal's library (667-626 BC) but they are fundamentally very different. The *Enuma Elish* is about gods and goddesses bearing children, getting angry with each other, wanting vengeance and killing each other. The difference between this obvious myth and the Genesis account is most striking.

The main controversy has been between people at the two extremes (young earth creationists and humanistic evolutionists). “Creationists” attack the science of “evolutionists”. I believe that this sort of attack is very bad both scientifically and theologically. The “scientific” explanations offered by “creationists” are mostly very poor science and I believe this sort of thing actually hinders some (many?) scientists becoming Christians. It is true that there are significant scientific problems in evolutionary theory (a good thing or else many biologists and geologists would be out of a job) and that these problems are bigger than is usually made out in introductory geology/biology courses, but the real problem with humanistic evolution is in the unwarranted atheistic assumptions and extrapolations. It is the latter that “creationists” should really be attacking (many books do, in fact, attack these unwarranted assumptions and extrapolations).

While discussing controversies and interpretations of Genesis I should mention something that has been much debated in recent years but is *not* an interpretation of Genesis: what is called “Intelligent Design”. This movement, which is often erroneously confused with young-earth creationism, is just exploring the question of what evidence there is in the universe for design by an intelligence. This is really a general, non-religious question (although with obvious religious implications), and there is no opinion on the interpretation of Genesis.

Also worth mentioning under different viewpoints is the Islamic creationist movement in the Muslim world. The leading spokesman of this is the Turkish writer,

Harun Yahya, whose work is widely read in the Moslem world. Yahya is non-committal about the age of the earth.

Although I'm writing this handout primarily for Christians, Genesis is, of course, a Jewish book. Jewish creationism includes a continuum of views about creationism, the origin of life, and the role of biological evolution that I cannot cover here.

It is worth noting that a number of important figures of antiquity interpreted the creation days of Genesis I as long periods of time. These include the famous 1st century Jewish historian Josephus, and many important early Christian writers including Irenaeus (a martyr in the 2nd century), Origen (3rd century), Basil the Great (4th century), Augustine (5th century), and Thomas Aquinas (13th century) [see "The Fingerprint of God", and especially "Creation and Time" by Hugh Ross, for references]. This is significant because none of these Bible interpreters of antiquity can be said to have shaped their scriptural views to accommodate contemporary scientific views for an old earth, since this scientific evidence dates only from the 19th century.

WHAT HAPPENED BEFORE CREATION?

Before starting in at the beginning of Genesis there is a common question that is worth addressing: "What happened before the beginning?" St. Augustine (354 – 430 AD) in his famous *Confessions* (his autobiography) quotes an old joke: "What was God doing before he made heaven and earth?" answer, "Making Hell for people who pry into mysteries like that!" (*Confessions, Book XI, Canto 12*; Augustine then goes on to have a profound discussions of the nature of time). The Bible *does* say what was happening before creation (*John 1:1-2; John 17:24; John 17:5; Ephesians 1:4; I Peter 1:20; Titus 1:2*). Look those passages up if you want to know the Biblical answer! The book "Genesis in Time and Space" by Francis Schaeffer has a particularly good discussion of the theology of this. I will spend the remainder of this handout going through the first chapter of Genesis verse by verse in the light of modern science.

YES, THERE WAS A BEGINNING

Genesis starts: "In the beginning..." This is an important and powerful phrase because modern astronomy says very strongly that there was a beginning. This is implied by the expansion of the universe ("Hubble's law") discovered in the late 1920's. The expansion implies that just under 14 billion years ago (see below) everything was in the same place. This time is commonly referred to as the "Big Bang".

The theistic implications of the Big Bang were immediately recognized (by Einstein, for example – see Ross's books in bibliography). So uncomfortable was this to many atheistic cosmologists that they went to, and continued to go to, considerable lengths to get round a start to the universe. Hugh Ross in his books gives a long list of theories meant to circumvent an origin to the universe. One theory I will mention here, popular 50 years ago, is the "Steady State Theory" which suggested continuous creation of matter to maintain a constant density in an expanding universe. The authors of this theory made it clear in their writings (see Ross for references) that their motivation was to do away with a moment of creation and what it implied. The "Steady State" theory was shown some 50 years ago to be incorrect when counts of radio sources showed that the universe was changing with time. In 1965 the remnant radiation from the Big Bang was discovered (the

"micro-wave background") which provided powerful support for the Big Bang theory and gave the *coup de grace* to the Steady State theory.

People often ask if the Big Bang was merely preceded by a "Big Crunch" or a "Big Bounce" of a previous universe. This theory is called the "Oscillating Universe" theory. Theoretical work over the last half century argues that on what are called "thermodynamic grounds", this attractive idea cannot work ["The Impossibility of a Bouncing Universe", Guth, A. H. & Sher, M, 1983, *Nature*, **302**, 505; see Ross's books for additional references and discussion]. As Ross puts it, "Far too much of the energy of the universe is dissipated in unreclaimable form to fuel a bounce. Like a lump of wet clay falling on a carpet, the universe if it did collapse, would go splat!" [p. 105 of "The Fingerprint of God"] Modern observational cosmology is making this discussion moot, however, as the latest results now strongly point to an infinite universe in which the expansion is actually speeding up because of the mysterious "dark energy" which is now believed to be making up 73% of the matter and energy in the universe.

WHEN WAS THE BEGINNING? I: WHERE DID "4004 BC" COME FROM?

Not from the Bible! The 4004 BC date originated with Irish scholar James Ussher (1581 – 1656). For an excellent article on Bishop (or Professor) Ussher see *Sky & Telescope* magazine, November 1981, p. 404 (400th anniversary of his birth). What Professor Ussher did was very scientifically respectable for his day (Kepler and Newton did it, for example). In fact, lots of people attempted to get dates of creation from the Bible. Alphonse des Vignolles in 1738 (writing what can be regarded as the first "review article" on the subject) claimed to have collected over 200 different dates from Jewish and Christian sources ranging from 3483 BC to 6984 BC! (– all supposedly based on the Bible!) For example, the traditional Jewish calendar starts in 3760 BC. The reason why Ussher's date of creation became particularly well known is that some unknown person included his dates in the margin notes of a printing of the Authorized ("King James") Version of the Bible.

While it is often believed that such dates are derived by adding up ages in the genealogies in the Bible and the reigns of kings, in actual fact, people's ages and king's reigns are often not given so people have to make pure guesses! Ussher got his date by assuming average reigns and life spans and finding when the autumnal equinox fell on a Sunday (people believed that the universe had to be made with the sun in a special place; Kepler had favored the summer solstice; Ussher had favored the autumnal equinox since there were fruit in the Garden of Eden! – an obvious British northern hemisphere bias!). Such things are clearly not "based on the Bible".

A more serious problem is that if you inter-compare genealogies in the Bible you discover that there are large gaps in them. If you compare *I Chronicles 6:1-15* with *Ezra 7:1-5* you will discover that Ezra omits 6 generations in verse 3. Another example of missing generations is Matthew's genealogy of Jesus (*Matthew 1:17*). In verse 8 Matthew omits the names of three kings who can be found listed in *I Chronicles 3:11-12*. In both of these specific examples I have given, we have someone described as "begetting" someone (to use the King James word) who is not their son, but some generations later. The Greek word used by Matthew is also used elsewhere in the New Testament to describe non-genetic relationships. The important point is that the Bible does not intend for a genealogy to be used as a chronology! (Its purpose is to show someone's lineage). Note, in particular, that the Bible itself never adds up the ages and reigns.

With these considerations one can see that an age of 13.7 billion years CANNOT BE EXCLUDED BY THE BIBLICAL GENEALOGIES.

HOW LONG DID IT TAKE?

1. What is Meant by a “Day”?

The Hebrew word for day (*Yom*) has the same three meanings in the Bible as in English usage: the time when the sun is above the horizon and it is light; a period of 24 hours; and a more general period of time (“in so and so’s day”). The very first verse in the Bible which uses the word day (*Genesis 1:5*) uses two meanings of the word (the first two meanings) and we only have to go as far as *Genesis 2:4* to find the third meaning. The allowable interpretations of the word “day” do not require a 144 hour creation. The Hebrew words *boger* (morning) and *oreb* (evening) also have a number of meanings. The fact that the Jews adopted a seven day week is sometimes brought up as an argument for a six 24-hr period creation, but, as Hebrew scholar Gleason Archer puts it, this is no stronger argument for it than that the 8-day celebration of the Jewish Feast of Tabernacles is a proof that the wilderness wanderings of Moses occupied only eight days!

2. God’s Timescale

II Peter 3:8 tells us that “with the Lord one day is as a thousand years, and a thousand years as one day”. *Psalms 90:4* also says that a thousand years is like “a watch in the night” (about 4 hours.)

HOW DID IT HAPPEN? – THE LANGUAGE OF GENESIS I, “FORM”, “MAKE” AND “CREATE”

“...God created the heavens and the earth.” The three Hebrew words used to describe God’s actions in bringing the universe, the earth, life and mankind to approximately their present state do not rule out the possibility that natural processes were involved once the realm of nature was brought into existence.

The Hebrew word *yatsar* (translated “formed”) can be shown in numerous usages in the Old Testament to describe actions that were not instantaneous but accomplished by the use of natural processes (*e.g.*, molding).

The Hebrew word *asah* (translated “make” or “do”) has widely varying subjects in the Old Testament and the action often involves natural processes and materials.

The Hebrew word *bara* (translated “create”) is a special word in the Bible which only has God as its subject. The word itself does not imply whether an action is instantaneous or not, but the same action is sometimes also described by the other two words (*yatsar* and *bara*). The three terms *bara*, *asah*, and *yatsar* are used in *Isaiah 43:7* in parallel grammatical constructions where they are seemingly interchangeable.

WHEN WAS THE BEGINNING? II: THE EVIDENCE OF ASTRONOMY

The early years of the 21st century are golden years of cosmology. Thanks to new surveys and, in particular, to results from the *Wilkinson Microwave Anisotropy Probe*

(“*WMAP*”) published in February 2003, astronomers now confidently believe that the age of the universe is almost 14 billion years. The latest (2008) *WMAP* results give an age of 13.73 billion years, with a formal uncertainty of ± 0.12 billion years. An age of this order is supported by quite a number of independent lines of evidence. These include: the expansion of the universe, the ages of the oldest star clusters in our galaxy (globular clusters), the cooling of white dwarf stars, and nucleocosmochronology (a sort of “radio-active dating” of the chemical elements themselves - distinct from the dating of rocks).

BACK TO THE STORY...

“And the earth was formless and void...” (*Genesis 1:2a*) There is no doubt that soon after creation the universe was indeed “formless”. Understanding how this very smooth featureless universe produced the filaments, clusters of galaxies, voids, *etc.*, which make up what astronomers call the “large-scale” structure of the present-day universe is a very active field of research. The formation of smaller-scale things such as stars and planets is also being vigorously researched.

“...the Spirit of God was moving over the face of the waters”. It used to be thought that space was a vacuum and the idea of water in space would have been ridiculous. Modern radio astronomy, however, has shown that there is lots of water in space and that it is associated with the formation of stars like the sun and planets like the earth. We are also now fairly sure that the formation of the solar system took place in “darkness”. (An old theory that the planets were formed by a passing star colliding with the sun was refuted in 1939). Infrared cameras on telescopes are letting us penetrate the darkness around newly-forming stars and see the disks from which planets like the earth will form. Comets are mostly water (ice) and the outer satellites in the solar system are predominantly water and ice.

“Let there be light!” (v. 3). There is no shortage of explanations here. When the Bible speaks of light it is talking about what scientists now call “electromagnetic radiation.” Astronomers speak of the first 60,000 years or so of the universe as being “radiation dominated”. From about 300,000 up to a few hundred million years after creation, astronomers speak of the “cosmic dark ages” when the universe was a relatively cold place without stars. The first stars then lit up and reionized the universe as we know it today. We are just now starting to see far enough away (and hence far enough back in time) to see back to this era. I’m not sure of the interpretation of verses 3 and 4 of *Genesis 1*, however. A fundamental question is: is the Bible talking about the early days of the universe as a whole, or of the earth? The “light” in verse 4 perhaps makes most sense under current astronomical understanding as the light of the sun. Although it used to be thought that the sun is as old or older than the earth, recent investigation of the formation of stars like the sun suggests that the sun formed after the planetary system (by about 200 million years), but this is somewhat of a technical distinction since when astronomers talk about the “age” of the sun they are measuring from what they call the “zero age main sequence”. Why should God in *Genesis* have made the same technical distinction as modern astronomers? Perhaps what verses 3 and 4 are referring to is the blowing away by solar radiation of the dark dust enshrouding the early solar system (to produce something a bit like the present day picture of the β Pictoris system). If that “light” is sunlight, the explanation of the later date for the appearance of the sun from the earth (verse 16) would be the clearing of the earth’s initially cloudy atmosphere (the newly formed earth probably looked more like what Venus currently looks like). As soon as we have a rotating planet

(albeit cloud-covered) exposed to sunlight, it is astronomically OK to speak of “morning” and “evening” before the sun becomes visible.

vv. 6-8. The description of the separation of the earth from water and things in space presents no problems.

v.9. “Let the dry land appear.” A number of lines of evidence point to the newly formed earth being completely covered with an ocean with at most a few islands (for a review see Cogley and Henderson-Sellers 1984, *Rev. Geophysics & Space Physics*, **22**, 131 “The Origin and Earliest State of the Earth's Hydrosphere”). The large continents as we now know them appeared later. Incidentally, we have also realized that much of the planet Mars was also under water.

v.11. “Let the earth sprout vegetation”. At this point, as a self-respecting astronomer I'm inclined to throw up my hands and say “Yuk, biology!” (Biology is one of those subjects students have said that they were taking my classes to avoid!) However, so long as by the Hebrew word here we understand the origin of the “plant kingdom” we're doing OK in the order of things as we currently understand them (the unlikely reading of “grass”, however, would not fit in as grass appears to have come very recently in the earth's history).

vv. 14-19. “...lights in the expanse of the heavens...” Perhaps the simplest explanation is to say that this refers to the clouds clearing and the sky becoming visible. It seems to me that this is less likely to refer to the creation of a sun at this stage even though astronomers now think the sun is a little younger than the earth (see note on the relative ages of the earth and sun under discussion of verses 3 & 4 above). The best theory for the origin of the moon is that it resulted from a collision of a body with the earth after the earth had formed. This makes the moon younger than the earth, but I would personally favor the interpretation that verse 16 refers to the moon becoming visible from the surface of the earth. We also have a choice of interpretation for the appearance of stars in v. 16 (the word “stars” in the Bible includes what we now call planets as well). Again, what is described at the end of v. 16 could be the stars (and planets) becoming visible, but it is interesting to note that almost all of the stars we see in the sky have formed since when we believe life on the earth started! A check of a list of the 100 brightest stars, for example, reveals that they are all (astronomically speaking) “young” stars. The Pleiades star cluster, for example, is only 125 million years old (very recent geologically speaking).

v. 20 onwards. The amount of biology gets worse and by *Genesis 2:9* we're even getting into the social sciences! I will just end this little look at how science currently seems to fit in with Genesis 1, by noting that with the appropriate interpretations of the Hebrew words, the order of the origin of life forms, culminating in man, can be brought into reasonable (but not perfect) agreement with our modern scientific understanding. It is worth noting that Genesis does not always say “God created”. In the case of “cattle and creeping things”, God says “Let the earth bring forth...”. To me this implies that life has been brought forth out from the material of the earth. Mankind is no exception to this, as in *Genesis 2:7* we are explicitly told that we are formed “of the dust from the ground”. Although this is getting outside the realm of astronomy, it should be realized that, despite some popular claims to the contrary, science has no satisfactory explanation of the origins of life yet. Note that the question of the *origin* of life is a separate problem from the question of the validity of some theories of *evolution*. The evidence is very good (and gets stronger every year) that all life on earth descended (*i.e.*, evolved from) from a common origin. There is still a problem of the ultimate origin of life. A discussion of the current controversies over evolutionary theory and how Christians view these controversies, is beyond the scope of this handout, but the now extensive literature discussing and reviewing

books such as those of Phillip E. Johnson (“Darwin on Trial”) and of biochemist Michael J. Behe (“Darwin's Black Box”) will give you some of the flavor of the diversity of opinion of Christian biologists (and geologists).

Although I'm sidestepping biology issues, I do want to give one quote. It's by the Nobel prize winning neuro-biologist and author of several noted books in the body-mind problem, Sir John Eccles: “*We come to exist through a divine act. That divine guidance is a theme throughout our life; at our death the brain goes, but that divine guidance and love continues. Each of us is a unique, conscious being, a divine creation. It is the religious view. It is the only view consistent with all the evidence.*” [“The Intellectuals Speak Out About God”, p. 50]. This is probably a good place to state that I personally have no theological problem with the idea of God doing things in the ways described in modern theories of evolution (*i.e.*, “theistic evolution”).

In sketching out possible astronomical interpretations, I've focused on the order in Genesis 1. It should be noted again that the order of some of the events described in Genesis 2 is different from the order in Genesis 1, so (again) we should not get too “hung up” on the order of events.

CONCLUSIONS

What I've sketched above is just a series of possible interpretations of Genesis 1 & 2. The main point that I'd like to get across from doing this is that given that there is a possible scientific explanation of most things, one cannot say “science disproves Genesis”. Another point is that we do not have to take Genesis as something “just theological”. It is quite likely that Genesis is describing physical things that happened in space and time in the history of our universe. Having said this, however, I must say again that I personally don't believe that anything like all the answers are in yet. I know, even from the limited experience of my career as an astronomer, that the science will change. Some of the numbers quoted in this handout have changed over the last decade. For example, the age of the Pleiades star cluster was widely believed to be around 65 million years, but newer evidence has favored the older 125 million year age quoted above. As of this writing, the latest results from the *WMAP* satellite study give an age of the universe at 13.73 ± 0.01 billion years. However, I personally am not going to be the least bit surprised if someone proves that the age of the universe is outside that “ ± 0.01 ” billion year range (for example, if it is only 13 billion years or more than 14 billion years). There have been spectacular advances in cosmology in the last few years, and in understanding the origin of planets like the earth. I also do not believe that all the answers are in yet about the Bible. I believe that there are “secret things that belong to the Lord” (*Deuteronomy 29:29*, see also *Romans 11:33-36*), and that God in His wisdom has not yet revealed to us the meaning of everything in the Bible (“For now we see in a mirror dimly...now I know in part” *I Corinthians 13:12*). I personally am not expecting a revelation of the full scientific meaning of Genesis 1 & 2 in my life on this earth; I'm expecting to learn at the end of time (“...when the perfect comes, the partial will be done away...then I shall know fully...”, *I Corinthians 13:9-12*).

I don't think that these questions about the origin of the universe (and of life) are just remote irrelevant cosmological questions. They profoundly affect our world views, our morals, and the way we live our lives. There is a profound difference between believing that God created the world and people in the world rather than insisting that the origin of our universe and of ourselves is to be traced to an accidental chance combination of blind

impersonal physical forces. It has been said that it is doubtful whether the latter, purely mechanistic, atheistic view of our origins can be a sufficient basis for such human values as goodness, truth, justice and beauty, *etc.* It has also been argued that in the atheistic view, man is left without ultimate meaning and value, that it is pointless to speak of “human rights”, for example, and that in atheism existence is ultimately absurd.

The Judeo-Christian worldview is very different from the atheistic view. In the Judeo-Christian view mankind was created in the image of an infinite personal God. This belief gives people significance, dignity and value. In the Judeo-Christian worldview it is the relatedness to the infinite personal Creator God that gives meaning to the human understanding of what is good, true, just, and beautiful. Existence is not absurd, but is ultimately meaningful.

Acknowledgements: I have drawn heavily on material given in the bibliography. In addition I would like to thank my wife and many other Christians who have contributed directly and indirectly to these notes. Some of the comments on the moral implications I owe to the Rev. Doug Phillips of East Lansing.

A BIBLIOGRAPHY

This is a list of recommended further readings, about the Bible, about Christianity and about the scientific issues raised by Genesis. Some of my price quotes are more than a few years out of date, and will be a few dollars too low.

The Bible

If you don't have a Bible, I'd recommend getting a modern, but accurate translation such as the *New American Standard Bible* (NASB), the *New King James Version* (NKJV), the *English Standard Version* (ESB), or the *Holman Christian Standard Bible* (HCSB). If you've never read the Bible before, I'd suggest starting, not with Genesis, but in the New Testament, with one of the Gospels, perhaps John's gospel.

Bible Study Helps

A couple of inexpensive useful books for understanding the Bible are “Unger's Bible Handbook” by Merrill F. Unger (1967, Moody Press) and “Richards' Complete Bible Handbook” by Lawrence O. Richards (1987, Word Books). These books both give historical background and archaeological information, useful tables and maps, and so on. If you would like a copy of the Bible with extensive commentary in it, I would particularly recommend the *Zondervan NASB Study Bible*.

Introductory Books About Christianity

“Mere Christianity”, C. S. Lewis (1952, MacMillan). Starts with the question “Does God Exist?” If you saw the 1990s movie “Shadowlands” (very loosely based on part of the life of C.S. Lewis), you should read this classic by Lewis to get a more accurate picture of what he was like. C. S. Lewis was the author of *The Chronicles of Narnia* series (including, *The Lion, the Witch, and the Wardrobe*.)

“Basic Christianity”, John R. Stott (1971, InterVarsity Press). A short explanation of what it means to be a Christian and the evidence for Christian faith.

“More than a Carpenter” Josh MacDowell (Here's Life Publishers). Examines the claims of Jesus Christ.

Books Discussing the Evidence for Christianity

“Evidence that Demands a Verdict” (Vols. 1 and 2) Josh MacDowell (1988, Here's Life Publishers). A detailed examination (in note form) of such things as the evidence for the resurrection, the reliability of the Bible and so on. Vol. 2 includes a lot of information about theories about how we got the book of Genesis.

“Letters from a Skeptic”, Gregory A. Boyd and Edward K. Boyd (1994, Victor Books, \$11). Subtitled “A son wrestles with his father's questions about Christianity”, this book consists of 60 letters exchanged by Dr. Gregory Boyd and his non-believing father (Edward Boyd) over a three-year period in which they “debate” many objections to Christianity, the church, and the Bible.

“The Case for Christ”, Lee Strobel (1998, Harper-Collins/Zondervan) \$13. The former legal editor of the Chicago Tribune retraces his spiritual journey from atheism to faith. In this hard-to-put-down book he presents interviews where he puts the toughest questions about Christianity to world-renowned experts.

Genesis

“Genesis: An Introduction and Commentary” Derek Kidner (1967, Tyndale Press/InterVarsity Press) (Vol. 1 in the Tyndale Old Testament Commentaries series, general editor D. J. Wiseman). This is my recommendation for a good inexpensive commentary on the book of Genesis as a whole. A “commentary” on a Bible book is a scholarly book that discusses individual verses, and addresses issues such as the range meanings in the original language (Hebrew in this case), possible variant interpretations, cultural background, and other relevant passages in the Bible. (~\$10)

“The Origins Solution” Dick Fischer (1996, Fairway Press). Interesting for its discussion of the relationship of Genesis to other middle-eastern ancient histories, and for discussion of the questions of where some of the other events of the first eleven chapters of Genesis fit into history (*e.g.*, Adam and Eve, the flood and the tower of Babel). (\$20)

Genesis and Science

“God Did it, But How?” Robert B. Fischer (1981, Academic Books/Zondervan: Grand Rapids; second edition 1996, SA Press). This is the best book I know of for a brief and succinct introduction to the issues of the Bible and science.

“The Christian View of Science and Scripture”, Bernard Ramm (1954, Eerdmann's). Although over fifty years old this remains an important detailed book on the subject of science and scripture in general. It gives many possible scientific explanations of things in the Bible. Incidentally, for the astronomy parts, Ramm draws heavily on “The Astronomy

of the Bible” by the astronomer Walter Maunder (of sunspot fame - the Maunder's were British Pentecostals).

“The Galileo Connection”, Charles E. Hummel, (1986, InterVarsity Press). The first half of the book is about Copernicus, Kepler, Galileo and Newton and their life and faith. The second half is about Genesis 1 & 2, and there is a nice epilogue about a Christian mathematician, Blaise Pascal.

“Creation and Time”, Hugh N. Ross (1994, NavPress). Perhaps the best book available on the question of the timescale of Genesis 1. Includes some material about the implications of modern astronomical observations that can also be found in Dr. Ross's other books (see below). (\$11)

“Genesis in Time and Space”, Francis A. Schaeffer (1972, InterVarsity Press). A good discussion of the theological implications of Genesis 1 - 11.

“God’s Universe” Owen Gingerich (2006, Harvard University Press). By a former Harvard University astronomer and noted science historian. (\$17)

Cosmology

“The Fingerprint of God”, Hugh N. Ross (1991, Promise Publishing Co.: Orange, California, about \$10). Discusses the important implications of modern cosmology (at approximately the level of a university introductory course) for Christian faith. Includes discussion of the history of philosophy and a very brief (note form) discussion of the problem of suffering and evil and an excellent discussion of Genesis 1 and 2. Lots of references to the literature. Ross is an astrophysicist. He is weak on biology and geology. Note that this book (and the next one) predate the discovering of “dark energy” driving the acceleration of the universe.

“The Creator and the Cosmos”, Hugh N. Ross (1993, NavPress, about \$10). This has quite a bit of material in common with his earlier book, and is at the same level, but is more up to date. If you're really interested in the theological implications of modern astronomical discoveries, Hugh Ross's books are a good place to turn. Many Christian astronomers have praised Ross's books.

Dr. Ross has a very useful web site (<http://www.reasons.org/>).

Biographies

“Scientists of Faith”, Dan Graves (1996; Kregel Resources). This book consists of 48 biographies of historic scientists and their Christian faith. It's a wonderful little book. It consists of short, concise, well-written, scientific and spiritual biographies and a little additional historical commentary. Each biography is kept to about three pages. The book is great for browsing and casual reading in addition to being a useful reference. Something I particularly admire about Graves's book is that it presents the faults of the scientists as well as their strengths, because, as the author puts it “that is how the Bible depicts the

saints” (\$10). A lot of information about the beliefs of Nobel prize winners and other notable scientists can be found at <http://www.nobelists.net/>. This includes a large number of quotes in the scientists' own words.

History of the “Young Earth” movement

“The Creationists”, Ronald L. Numbers (1992, University of California Press). This is a very detailed history (about 450 pages) of young-earth creationists. Lots of details, and references to original sources. The Seventh-Day Adventist connection is well documented. (\$16, paperback edition)

The Origin of Life and Evolution

I don't have the inclination or space here to go into the biology issues which have been generating enormous controversy and many books in recent years. My first advice to someone interested in the Bible and biology issues is to talk to a Christian biologist or to a Christian geologist for geology issues. To sample the range of opinions Christian biologists and geologists have on the various issues I recommend looking at back issues of the journal of the American Scientific Affiliation (*Perspectives on Science and Christian Faith*) or some of the articles they have available on-line (see their website below). A number of Christian biologists have written books (*e.g.*, Francis Collins, former head of the Human Genome Project, see, “The Language of God” 2007, Free Press, \$15)

SOME ORGANIZATIONS

The American Scientific Affiliation) (“ASA”)

(<http://www.asa3.org/>) – a fellowship of men and women of science and disciplines that can relate to science who share a common fidelity to the Word of God and a commitment to integrity in the practice of science. The ASA was founded in 1941 and has grown significantly since that time. The stated purpose of the ASA is “to investigate any area relating Christian faith and science” and “to make known the results of such investigations for comment and criticism by the Christian community and by the scientific community.” As already discussed, I particularly recommend the ASA Journal as a source of book reviews. You will find good discussions of the strengths and weaknesses of some of the books recommended here in their journal and on their home page (see above). The ASA can be contacted at P.O. Box 668 Ipswich, MA 01938 or (508) 356-5656 or asa@newl.com

In addition to the American Scientific Affiliation, other organizations you might be interested in include:

The Affiliation of Christian Biologists

<http://www.messiah.edu/departments/bioscience/acb.htm>

The Affiliation of Christian Geologists <http://www.wheaton.edu/acg>

Chr-astro (Christian professional astronomers) <http://www.calvin.edu/~dhaarsma/chr-astro/resources.html>

Includes a list of articles written by Chr-astro members, and many resources.

Association of Christians in the Mathematical Sciences <http://www.acmsonline.org/>

Christian Engineering Society <http://enr.calvin.edu/ces/index.html>

The Society of Christian Philosophers <http://www.societyofchristianphilosophers.com/>

Leadership U – a useful web site for Christians interested in finding scholarly articles on the interface of Christianity and a wide range of academic and non-academic subject areas, including the humanities and social sciences as well as science. Many thousands of articles available on-line. <http://www.leaderu.com/>

Reasons to Believe – also has interesting information. <http://www.reasons.org/>

List of religious affiliations of Nobel prize winners: www.nobelists.net
(and huge number of quotes).

[The obvious disclaimer: my inclusion of a web link here should not be construed as my endorsement of every opinion in every link or article on every web site!!]