

SCIENCE AND CHRISTIANITY SEMINAR
With particular consideration of creation-evolution debate
Swee Teng Tan, July 2008

GALILEO – A CAUTIONARY TALE

Does the sun revolve around the earth?

- Let's try and answer this question from the bible – Psalms 93:1; 19:5-6; (119:90); Joshua 10:12-13.

Copernicanism, Galileo and the church

- When Copernicus advanced his theory of heliocentrism in 1543, the earliest opposition came from all branches of the Protestant church – Lutheran, Calvinist, Anglican. They denounced it as being contrary to Scripture (see above texts), but on the whole, the Protestant opposition was muted and ineffective.
- It took longer for the Roman Catholic Church to respond, but when they did so, it broke with explosive force.
- At the focus of all the ecclesiastical wrath was the unfortunate figure of Galileo Galilei.
- Galileo published his *Dialogue concerning the two Principal Systems of the World* in 1632. In this book, he advocated the new Copernican theory in which the earth and the planets revolve in orbits around the sun, rather than the accepted Ptolemaic theory in which the sun and planets revolve in orbits around the earth.
- Galileo was immediately summoned to the Inquisition in Rome.
- In Galileo's trial in 1633, one factor that contributed to his condemnation was the authority of Aristotle, whose scientific writings, including those supporting Ptolemaic astronomy, had been greatly admired in Europe since the twelfth century.
- Another issue was the authority of scripture, especially the passages that implied that the earth is the centre of the cosmos.
- But in the end the crucial factor was his challenge to the authority of the church.
- Galileo was forced to retract his ideas about a moving earth as a heresy and condemned to life imprisonment.
- His book remained on the Catholic church's Index of prohibited books until 1831.
- However the Galileo debacle crystallized the issues with a new clarity, and within a few years, the Copernican theory of a moving earth was triumphantly pre-eminent among all who knew something about astronomy. Apart from Galileo's own contribution, the work of Tycho Brahe, Kepler and Newton was so decisive a vindication of the new world-picture that it is hard to see how Ptolemaic or Aristotelian cosmologies could ever survive, save in the darkest corners of obscurantism.

What principles do we learn from the story of Galileo about how we read the bible?

3 APPROACHES TO SCIENCE AND CHRISTIANITY

- Want to discuss philosophy of science and general approach to science vs faith using creation-evolution as an *example*.

Illustration from a coronial investigation

2 coroners and their explanations for a death:

Coroner 1 – He died from the bullet through his heart.

Coroner 2 – No, he died from strangling.

(*Conflict*: 2 competing claims about the same thing, and at least one of them is wrong.)

Coroner 1 – He died because the bullet pierced his heart.

Coroner 2 – He died because his number was up.

(*Compartmentalization*: The statements have 2 different scopes, and do not interact at all. The 1st statement is a scientific/observational claim, the 2nd is a religious/philosophical claim.)

Coroner 1 – He died because the bullet pierced his heart.

Coroner 2 – He died because someone killed him.

(*Complementarity*: The two statements are about separate parts of the same thing, and fill out the total picture. The 1st statement is about the means/mechanism, the 2nd statement is about the intention/mind behind the means.)

1. Conflict/Incompatibility

Biblical literalism/fundamentalism

- Doesn't matter about scientific evidence, primary source of information about the world is God/the bible.
- What are the problems with this approach?
- God reveals himself to us both in the universe (general revelation) and in his word (special revelation). God's creation bears his imprint and is a source of revelation from God – c.f. Ps 19:1-6; Ps 8; Acts 14:15-17; 17:22-31; Rom 1:18-21; 2:14-16.
- To accept a conflict between the reality of the universe and what the bible says is to pit general revelation against special revelation. It is to say that God's works contradict his word.
- Whenever there is an apparent conflict between scientific observation and the bible, to simply dismiss the results of scientific enquiry without attempting to see how it could fit with our understanding of the bible is to denigrate general revelation. It is to be anti-intellectual and to insist that faith ought to be irrational (i.e. faith and reason are incompatible).
- Ultimately this approach is self-defeating and apologetically disastrous. It is obscurantism (burying one's head in the sand).
- It is important to note that when I speak of general revelation as the results of science, I mean observed facts and not unproven theories. All scientific observations have to be interpreted/made sense of by hypotheses/theories. Some theories explain the observations so much better than other competing theories that they have generally come to be regarded as factual (e.g. the Big Bang theory). Other theories are on more shaky ground, supported by inadequate evidence (I would put the theory of evolution in this category).

Philosophical naturalism

- This is the assertion that there is no explanation of causes other than natural ones. If you can find a natural explanation, there is no need for a supernatural explanation. The assumption is that natural processes are adequate to explaining everything in the natural world. This is simply assumed by the vast majority of scientists but not defended. E.g. it is the view of Richard Dawkins. Thus, philosophical naturalism is really a religious belief, a theological claim.
- The problem is that we do not consistently regard natural processes as adequate explanations of causation.
- E.g. when my leg is bleeding, the natural explanation is that it was cut by the table edge, but the additional explanation may be that this happened because I was pushed.

- Or to use a medical example, the cause of death may be cardiac arrest, but this may be caused by liver failure, which in turn is due to chronic alcoholism, which is caused by psychosocial factors such as abuse in childhood or failed relationships.

2. Compartmentalization/Independence

- This view believes that the bible's message is primarily theological, i.e. it is only about God. It is not written to explain how the natural world works. Rather, it is the task of science to find out the workings of the world. Science and the bible are therefore independent spheres which never intersect.

- My comment is that while it is true that the bible was not written as a scientific textbook, there are parts of it which give us a glimpse into scientific matters, and we ought to take these parts seriously. Genesis may not be *primarily* about science, but it does discuss things that are relevant to science. We cannot disbar the bible from making any comment on scientific concerns.

Methodological naturalism

- This is a method of doing science. It restricts the scope of science to explaining the natural world by means of natural processes only. In order to do so, it assumes that the universe operates according to regular principles.

- With methodological naturalism, science does not attempt to explain everything or pretend that it is the gateway to all knowledge. It is merely one branch of knowledge alongside many others, e.g. theology, history, each with their own independent methods of enquiry.

3. Complementarity/Integration

- This view sees science and the bible as complementary explanations of reality. They do not contradict each other, nor are they completely separate spheres of knowledge. There is some overlap between the purviews of science and the bible, and it is possible to integrate both of them to gain a fuller understanding of the particular phenomenon under consideration.

Primary and secondary causes

- Christian theology teaches that God is the cause of everything that happens. God is the *primary* cause, but he works through other entities – e.g. natural processes and laws, or human beings. These are known as *secondary* causes. They can be true causes in themselves and not merely instruments, although they are subordinate to God.

How methodological naturalism started and led to philosophical naturalism

- In many ways Francis Bacon was the father of modern science.

- The scientific method of his time was based on Aristotelian rationalism, a deductive approach presupposing the truth of Aristotelianism and into which all data had to be fitted, no matter how poor the fit (ideology driven).

- Bacon insisted that general axioms ought to be the end, not the beginning, of the scientific process. He recommended an inductive or empirical method where the scientist must start with observation/experimentation and then form hypotheses to fit the data (data driven). He shunned any speculation not grounded in observation, including religious speculation.

- Bacon argued that religious considerations must not be unwisely mingled with natural science. He wanted to restrict science to a study of secondary causes – the workings of natural laws. He dismissed the concern that this would make science a breeding ground for heresy and

atheism. Science is not the source of all knowledge, but deliberately restricts its own scope to the study of secondary causes only (i.e. only the physical world).

- Bacon's rationale was that knowledge of the natural world would not progress if one kept invoking God to explain things.
- Bacon's scientific method assumes for the sake of study that there are only secondary causes. This is purely a methodological assumption – *methodological naturalism*. Science does not tell us anything about primary causes (the spiritual realm). Science in Bacon's conception is a 'God-free zone', and so it cannot disprove God.
- But Bacon's scientific method was so successful that people came to believe that the assumption was the truth, i.e. that there is no explanation of causes other than natural ones. *Methodological naturalism* became *philosophical naturalism*.

CASE EXAMPLE: THE CREATION-EVOLUTION DEBATE

- This is a complex topic. To understand it well, one needs to be knowledgeable in biblical studies as well as cutting edge science in cosmology, geology, palaeontology, biology, history and philosophy of science. I make no pretensions to having mastered all these!
- The view one adopts on creation-evolution should not be made an article of faith. All the views to be described have been taken by conservative evangelical Christians.

Scientific data

Cosmology and the Big Bang

- This discussion is pertinent to our discussion of the age of the universe, and therefore, the earth.
- The current Big Bang theory postulates the following:
 - About 15 billion years ago, space, time, and the universe began when the initial singularity – all the matter and energy compressed into a point with zero dimensions – suddenly began expanding unimaginably rapidly.
 - After the first three minutes, atomic nuclei could form, yielding helium and hydrogen.
 - After about 500,000 years, the lighter elements could be formed.
 - After about a billion years of expansion, the stars and galaxies began to form, in which the heavier elements were produced. Some of these stars have died and some have scattered their matter – this is how the basic building blocks for biological systems become available.
 - About 4½ billion years ago planet earth was formed, condensed out of cosmic clouds.
 - Biological life first appeared on earth about 3-3½ billion years ago.
- Scientific evidence for the Big Bang theory:
 - (1) In the 1920s Edwin Hubble discovered that light from other galaxies was coming to us with a lower frequency than the one proper to the stars' elements: this is called the "red shift" and is due to the Doppler effect when a body is moving away. This then suggests that the universe is expanding, because the galaxies are moving away from us (and from each other).
 - (2) The background radiation of the universe is that of a 3° Kelvin body, and this is consistent with the after-effects of the initial "bang" 10-20 billion years ago.
 - (3) It accounts well for the comparative abundance of the chemical elements around us, which if you look beyond earth is mostly hydrogen and helium. The observed abundances of the light elements throughout the cosmos closely match the calculated predictions for the formation of these elements from nuclear processes in the rapidly expanding and cooling first minutes of the universe.

- (4) The equations of General Relativity, when solved, imply that the universe has a beginning ($t=0$, a first moment of time, when everything was compressed into a point with no dimensions).

The anthropic principle

- The physical properties of the universe are finely balanced to support life on earth – and perhaps nowhere else. It is like a “fine tuning” of the universe.
- Consider some of the constants in physics:
 - If the gravitational force constant were larger than it is, then stars would be too hot and would burn up quickly and unevenly; if it were smaller than it is, then stars would remain so cool that nuclear fusion would never get going – and then the stars could never have produced any heavy elements.
 - If the electromagnetic force constant were either larger or smaller, then you wouldn't have good chemical bonds.
 - If the rate at which the universe is expanding were greater than it is, then galaxies couldn't have formed; if it were smaller, then the universe would have collapsed back in on itself before any stars were formed.
 - If the speed of light were greater than it is, then the stars would be too luminous; if it were smaller, then the stars would not be luminous enough.
 - If the universe were older than it is, there wouldn't be any of the right kind of star in the right burning phase in the right part of the galaxy to be our sun; if it were younger, the right kind of star wouldn't have formed yet.
 - The relationship between gravity and the weak nuclear force is in a perfect balance, which has kept the universe expanding at its “comfortable” rate. In fact the two forces must be tuned to each other with the accuracy of one part in 10^{60} , which is the accuracy a marksman would need if he wanted to hit a one-inch target at the other end of the universe – 20 billion light years away.
- The list goes on and on.
- This isn't necessarily a knock-down argument for the existence of God.
 - It can be argued that we should not be surprised that we encounter conditions suited to our existence, for if they did not exist, we would not exist either.
 - Having said that, the fact that we *do* exist against all the odds is highly suggestive that it is by design and not by accident. An illustration: if 50 soldiers in a firing squad had their guns pointing at your heart, and each one of them missed, you could say that the fact you survived to tell the tale must be merely a result of the fact that they all missed and means nothing more. But it is still reasonable to argue that it is far more likely that they missed intentionally rather than accidentally.

Geology and the age of the earth

- During the 19th century there were many proposals for how old the earth is, ranging from a few million years to many billions. The reason was that there was no agreed basis for the estimates: some went by rates of erosion, others by the rate that the ocean changes its salt content, others by the rate at which limestone forms by sedimentation, others by the rate at which the earth would have cooled from its initial molten state. Toward the end of the 19th century, geologists were beginning to agree on an estimate of around 100 million years.
- Then in the 1890s radioactivity was discovered and in the first few decades of the 20th century techniques for dating rocks based on radioisotope decay were developed. This is the accepted modern method for estimating the age of the earth. Radiometric dating methods have been tested time and time again by competent geologists and physicists over the past 3 decades (source for this written in 1992).

- Geologists now generally agree that the best estimate for the age of the earth and meteorites is about 4½ billion years old. This age is consistent with current calculations of 11-13 billion years for the age of the Milky Way Galaxy (based on the stage of evolution of globular cluster stars) and the age of 10-15 billion years for the Universe (based on recession of distant galaxies).

Biological evolution?

What does 'evolution' mean in biology?

- Small scale variation within species (Micro-evolution)
 - The creatures we see today have developed from those that lived long ago.
 - E.g. the dingo developing from introduced dogs in Australia, or Darwin's finches.
 - Mere observation of changes in the natural world shows that such change takes place.
- Large scale/big picture change from species to species (Macro-evolution)
 - An unpredictable, natural process of how every living thing developed over time with genetic modification, affected by natural selection, chance, historical contingencies and changing environments.
 - This process resulted in changes from one species to another, ultimately culminating in human beings.
 - This process *has no specific direction or goal, it is random and purposeless.*
 - This view of evolution requires a 2-step process:
 - The first stage, chemical evolution, encompasses the origin of life from non-life.
 - The second stage, biological evolution, has to do with species to species evolution.

Darwinism

- It is almost 150 years since the publication of Charles Darwin's *Origin of the Species* (1859).
- Darwin offered a comprehensive theory to explain in a totally naturalistic way the origin of our universe and life in it.
- The mechanism of biological evolution is natural selection (popularly known as 'survival of the fittest'). This means that over time, genetic tendencies that represent advantageous characteristics will accumulate so that eventually there will be large-scale characteristic changes in life-forms. The result is evolution to new species that are better adapted to their environment and thus more likely to survive and reproduce.
- Natural selection ('survival of the fittest') – the process in which individuals better suited to their environment survive and pass their traits on to their offspring. Analogous to selective breeding.

Neo-Darwinism

- Since Darwin's time, the theory of evolution has undergone many changes and refinements.
- Neo-Darwinism is the synthesis of Darwinian evolutionary theory (natural selection) and modern genetics. It is a development of Darwinism incorporating the Mendelian theory of inheritance and subsequent advances in genetic theory to explain how traits can be passed on, how mutations can enter the gene pool. It also incorporates views on biochemical evolution.
- It is today's ruling theory of biological evolution as the big picture.
- Evolution is the reigning paradigm in the scientific community to explain origins, the most popular 'big picture' explanation.
- Neo-Darwinists claim that the origin and development of the universe can be explained in entirely naturalistic terms in virtue of purely natural laws operating over natural phenomena. It makes possible a full explanation of our universe without invoking God.

- As to the origin and development of life, evolution says that from non-living matter there ultimately resulted a living cell capable of reproducing itself. Gradually over eons of time, ever-more complex life-forms continued to develop. Those that were least fit died, whereas the fittest reproduced. Through this process genetic characteristics that were most beneficial to survival persisted, and traits that were not helpful gradually left the gene pool as life-forms with those traits died off.
- How can new genetic options arise which eventually lead to new species? Evolutionists answer that genetic mutations are the source of this material. So natural selection, given enough time, by chance and mutations resulted in the multiplicity of life-forms in our world today.
- Biological evolution postulates enormous amounts of time for the evolutionary process, and this has implications for one's cosmology. Scientists committed to evolution typically postulate that the universe is some 10-15 billion years old. Planet earth originated around 4.5 billion years ago, and human beings came into existence around 1.5 billion years ago.

Arguments for and against neo-Darwinism

The fossil record

- Neo-Darwinists claim that the fossil record shows that living things today are the products of descent with modification from earlier living things.
- Neo-Darwinism took over Darwin's assumption that long-term evolutionary changes are the result of the gradual accumulation of many small changes.
- But in the 1970s, Stephen Jay Gould and Niles Eldredge advocated *punctuated equilibrium*, the theory that there have been long periods of stability interrupted by brief periods of rapid change. They pointed out that the fossil records show millions of years with very little change, interspersed with bursts of rapid speciation in relatively short periods – especially in the early Cambrian period, when all the known evolutionary groups (phyla) and basic body plans appeared in a very short period.
- Opponents of neo-Darwinism argue that the fossil record does not actually *show* that animals developed in such and such a way beyond the shadow of a doubt. You not only have to show that the ancient fossil bird *Archaeopteryx* really did descend from reptiles by purely natural processes, and that this really does show that birds developed from reptiles, you have to show that this happened without any supernatural interference. Further, you have to do this for every animal.
- One of the most striking features of the fossil record is that most new kinds of organisms appear abruptly. The sudden appearance in the early Cambrian period (about 570 million years ago) of creatures very unlike anything found in Pre-cambrian strata is particularly puzzling. As many as one hundred new phyla (groups of similar species with a common body plan) appeared in a relatively short interval, though only thirty of these remain today. Thereafter, few new phyla appeared – even when mass extinctions (such as those caused by the impact of comets) opened up new ecological niches; instead, extensive diversification occurred in existing phyla. Moreover, many species changed little over periods of millions of years.
- Phillip Johnson (author of *Darwin on Trial*) is impressed by the paucity of *transitional forms* in the fossil record. He says that *Archaeopteryx*, a birdlike creature with reptilian features, is one of the few plausible candidates for a link between species. If Gould is correct that speciation occurred rapidly in small, isolated populations, transitional fossils would be rare. But Johnson claims that even then we would expect more transitional forms than have been found. He holds that attempts to reconstruct a family tree from apes to humans are particularly speculative and subjective, influenced as much by philosophical preconceptions as by clear evidence.
- So, while it is quite possible that some kind of biological evolution occurs, e.g. from *Eohippus* to the modern horse, it is a different thing altogether to prove that neo-Darwinism is true. The

data may be compatible with neo-Darwinism but equally as compatible with other theories. The fossil record does not *prove* neo-Darwinism.

- Not only is it not proven, there are serious difficulties in crossing some of the gaps that standard evolutionary theory says have been crossed. E.g. getting from a reptile to a bird means you need to develop a scale into a feather; getting from an amphibian to a reptile means you need to develop a different kind of egg; getting from a fish to an amphibian means you need to develop a whole new kind of lung. To say that something *could* have happened is different to saying that it *must* have happened.

Documented cases of descent with modification

- Neo-Darwinists argue that documented cases of descent with modification in the natural world prove that evolution took place.

- It has certainly been observed that changing environmental conditions leads to natural selection of animals which have certain favoured characteristics. But these are micro-evolutionary changes (variations within a basic type) and do not prove macro-evolution. They do not produce major innovations such as an invertebrate giving rise to offspring with a spinal cord.

- Johnson accepts microevolution (small modifications in existing species) but not macroevolution (the formation of new species). He points out that artificial selection by animal breeders produce great diversity but no new species. The beaks of finches on the isolated Galapagos Islands changed when climate conditions changed, but no new species appeared. Artificial selection of fruit flies has produced forms that do not breed with their ancestors, but it is not clear that they should count as a new species.

Biochemical evolution

- Comparing the molecular structure of similar proteins in various living species allows us to estimate the time since their lineages diverged (assuming that they did). E.g. human cytochrome C consists of 104 amino acids, which differs only by 1 amino acid in rhesus monkeys, but by 12 in horses and 22 in fish, indicating (so it is argued) increasingly distant kinship.

- Apparently the evolutionary history established by this biochemical method provides independent confirmation of evidence derived from 2 completely different scientific fields: the study of fossil records by palaeontologists and the comparison of the anatomy of living species by taxonomists.

- However, I think this is a circular/tautologous argument. It is only to be expected the degree of *phenotypic* difference in organisms (i.e. the difference in structure and appearance) corresponds to the *genotypic* difference between them (i.e. the difference in their genetic code). This is because phenotypic characteristics are a product of genotypic characteristics.

DNA

- The fact that all living things use DNA to encode their characteristics and to pass them on to their offspring has been used by neo-Darwinists as an argument in favour of evolution.

- But this fact does not necessitate neo-Darwinism. It is just as plausible that God used a good idea over and over again, as engineers do all the time. This feature on its own does not decide between several possible theories.

- Neo-Darwinism says that evolution proceeds by building on countless small changes in DNA: that tiny percentage that leads to more successful reproduction is passed on to the offspring and the rest are weeded out. The trouble is that it does not show that this is the way it happened, it merely states one possible explanation. It does not exclude other possible explanations.

- Neo-Darwinists cannot explain how life arose from the primordial soup, i.e. how the first cell came into being. They have to posit that millions of years of random mixing and shuffling of

molecules culminated in the appearance of one living cell that could consume surrounding chemicals to make exact copies of itself.

- If DNA is an information encoding and storage system, then the message cannot arise from the system itself. The information must come from outside the DNA, just like the words on this paper come not from the paper itself but from the author. A natural process can only work by the properties of the things involved, but information transcends these properties. To say that a natural process produced an information system is a contradiction in terms.

Purposelessness in the natural world

- Dawkins asks how cheetahs (which are well equipped to kill gazelles) and gazelles (which are well designed to avoid being killed by cheetahs) could both have been designed by the same God. Instead he asserts that these characteristics can be explained if it is the survival of DNA that is to be maximised.

- Another argument Dawkins uses is the widespread suffering, pain and fear in nature and the senseless tragedies that occur in human life. This is better explained by “blind, pitiless indifference” than by purpose and design.

Organs of irreducible complexity

- How can organs of extreme perfection and complication, such as the eye, have developed? Again, Darwin never answers the question apart from saying “I can imagine that it happened this way”.

- Johnson argues that random mutations could not have produced the coordinated functioning of many parts that occurs in complex organisms. An effective eye, for example, requires not only the coordination of diverse parts but also the presence of neural and cerebral structures.

- In response to arguments that the various parts of the eye could not be products of separate chance mutations because one part would be useless without all the other coordinated parts, Dawkins argues that the eye could have arisen from many small improvements. A rudimentary light-sensitive cell or a very simple eye is better than nothing. Image-forming eyes have evolved independently at least forty times among vertebrates, and nine distinct eye structures can be identified.

- Dawkins argues that many systems in nature are far from perfect in their design, e.g. the human eye being “wired backwards”. He thinks no sensible designer would have made it this way, but it fits evolutionary change that starts from what is available and improves it, even if the end result is not the most efficient design.

- Johnson replies to Dawkins’ speculation that webs on the limbs of small tree-climbing animals would have enabled them to glide, leading eventually to wings for flying. Johnson says that such webs would have hindered climbing and food-grasping long before they could have supported flight. He says that Darwinists have elevated chance into an ultimate principle that is inherently anti-theistic.

Biochemical processes of irreducible complexity

- The biochemist Michael Behe argues that the “irreducible complexity” of biochemical systems shows that they cannot be the product of gradual evolution. He traces, for example, the long chains or cascades of molecular reactions that occur in the eye and in the immune system. He claims that such complex interlocking systems could not have had simpler functional precursors because they would not have worked if even a single step or component had been missing. They are all-or-nothing systems that must have been designed all at once, not by stages. “Since natural selection can only choose systems that are already working, then if a biological system cannot be produced gradually it would have to arise as an integrated unit, in one fell swoop, for natural selection to have anything to act on.”

- Behe suggests that the information for designed systems might have been introduced in the earliest single cells and remained dormant for billions of years, or it might have been added

later to produce a complex biochemical system. Both these scenarios assume a predetermined divine plan of intelligent design rather than a dynamic and open-minded process in which interaction with a changing environment plays a crucial role.

The origin of human beings

- Neo-Darwinism has no explanation for the properties of humankind e.g. language.

Some Christian responses to neo-Darwinism

Scientific creationism or 'creation science'

- At the time of the Scopes trial in 1925, Christian fundamentalists rejected all evolutionary ideas and accepted a literal interpretation of Genesis. The 'creation science' movement in the 1980s.
- This position adopts a young earth view and literal days of creation.
- In Australia, represented by 'Creation Research'.

Intelligent design

- This movement, unlike creationism, does not bring the bible into the debate. It merely seeks to interpret scientific data without adopting a naturalistic philosophical stance. It aims to deal with the data in an impartial, open-minded way. Proponents argue that 'intelligent design' fits the data better than purposeless chance (i.e. naturalism). They claim that neo-Darwinism among biologists is more the product of their naturalistic assumptions than of clear scientific evidence.

Theistic evolution

- In Australia, represented by ISCAST (Institute for the Study of Christianity in an Age of Science and Technology).
- Theistic evolutionists believe that science tells what happened and how it occurred, whereas the Bible explains who was behind it and why. God used the mechanism of evolution and guided it to ensure that things developed as he wanted.
- Theistic evolutionists accept everything that the neo-Darwinists say about evolution – i.e. that everything developed purely by natural processes and God never intervened in any special way in the history of the development of the universe or of life. The only thing they don't accept is the philosophical naturalism that underlies it.

Biblical data (Genesis 1-2 & the days of creation)

2 creation accounts

- It is clear that there are 2 distinct and complementary accounts of the creation story: one from 1:1-2:3 and the other being 2:4-3:24.
- 1:1-2:3 is a panoramic prologue to the rest of the bible. It is a sweeping overview of the major steps in God's creation of all things, culminating in the creation of humanity.
- 2:3-3:24 then focus specifically on the creation of the first human beings, elucidating fundamental human institutions such as marriage and work, and especially, seeking to explain the fall of humanity into sin.
- There is a continuity of themes between chapters 1 and 2. But there is also a difference in the perspectives or emphasis between these two accounts on the creator and his method of creating and relating to the creation.
- Ch 1 portrays the creator as an absolute ruler who speaks and his commands are accomplished. He sees that what results from his commands is good. We don't get a

description of the mechanics of how the commands are fulfilled. The emphasis is on God's sovereign, omnipotent, orderly creation of all things, not just human beings.

- Ch 2 portrays the creator more as a craftsman who works patiently with his materials to form them as he wants, who is intimately involved with his creation, who 'gets his hands dirty'. He responds and reacts to situations (esp. when he notices that man is alone and concludes that this is not good). Genesis 2 focuses on events that culminate in the creation of humans as male and female and the institution of marriage between them. None of God's other creatures receive such dignity and extended attention in the creation accounts.

Ancient Near Eastern creation accounts

- Since the late 19th century, various ANE accounts of creation such as the Babylonian *Enuma Elish* have been unearthed. In these accounts, the creation of the world usually resulted from battles between the gods. Different parts of the universe were identified with different deities or parts of their bodies. Human beings were made to be slaves of the gods, to do the work that the gods had tired of doing.
- In contrast, the Genesis account corrects the prevailing ANE worldview. There are not many gods, but one God. The universe did not arise from a clash of wills, but from One Will who made everything without the slightest hindrance purely by his word. God is not identified with nature wholly or in part, but stands absolutely above it. The sun and moon are not gods to be worshipped, but part of nature made by the one God.
- Thus the Genesis account primarily makes a theological rather than scientific point. (This is not to say that it does not reflect historical or scientific reality in literary language. Theology and history are not mutually exclusive; they can go hand in hand, as in the gospel accounts.)

Structure of Gen 1:1-2:3

5 parts:

- (1) Summary statement of the whole teaching (1:1)
- (2) Negative comment about the state of the earth at the time of creation (1:2)
- (3) The six days of creation (1:3-31)
- (4) Summary and conclusion (2:1)
- (5) Epilogue about the seventh day (2:2-3)

The 6 days of creation are arranged in 2 triads:

The 6 days can be broadly divided into days 1-3 and 4-6. In days 1-3, a formed structured reality takes shape, the prominent verbs being separating and gathering. In days 4-6, this reality is filled, the prominent verbs being making and filling.

Day 1 – Light created

Day 4 – Light-bearers created

Day 2 – Sky and sea separated

Day 5 – Sky filled with birds, sea with sea creatures

Day 3 – Land and sea separated

Day 6 – Animals and human beings made to fill the land

The highly structured pattern in the days of creation highlights the ordering of the world. It is a structured account of the structuring of the world. The orderliness of creation makes science possible because God has made the universe in a way that is intelligible to rational scientific inquiry.

Genre

- It is clearly anachronistic to read Gen 1-2 like a scientific textbook about the origins of the universe. That was not the author's intent. It was not primarily written about the mechanics of how everything came into being.
- It conveys theological points, but is not written as one might write a theology.

- To read it as straightforward history (in the mode of modern historiography) creates certain tensions, even contradictions, between the two accounts and even within each account.
- Some propose that the genre is myth – depends what you mean by the word ‘myth’. It could be ‘myth’ in the sense of being a symbolic portrayal of historical reality. Blocher suggests that it is a ‘literary-artistic’ representation of creation. It is partly literal and partly symbolic. (It’s not a question of *whether* the account is historical, but of *how* history is recounted. C.f. how the book of Revelation is also a symbolic depiction of reality.) One difficulty with this view (which doesn’t negate it however) is how one ought to distinguish between the literal and the symbolic in the account.

Views of how to reconcile the bible with science

24-hour day theories

- The predominant view at least until the 1700s. Some in the past believed that the moment of creation could be pinpointed with great accuracy. Archbishop James Ussher put it at 4004 BC, while John Lightfoot went further and calculated that creation occurred on 18-24 October 4004 BC, with God creating Adam on 23 October at 9am!
- There are 2 major variants of this view:
 - One is that creation occurred in 6 24-hour days but began longer ago than 4004 BC because the genealogies in Gen 1-11 are incomplete. The universe is older than that, but not as old as 15-20 billion years. Human life began between 10,000-20,000 BC, in which reckoning the earth is still relatively young.
 - The other view is a young earth and a 6 solar day creation position.

Day-age theories

- The days of creation are not literal 24-hour days, but refer to long periods of time. After each creative act, God used natural processes working over eons of time to develop the various life-forms in our universe. Such an understanding allows for micro-evolution but does not require macro-evolution, for God is still responsible for the major creative changes.

Literary framework theory

- The author of Genesis is a literary artist of first rank, who deliberately arranges and sequences the material in ch 1. The whole sequence of 7 days of creation is not a chronological account of the sequence of historical events when God created our universe. Rather, the author uses the literary device of artistic symmetry to tell a story that conveys great theological truth.
- Did the actual events of creation follow the order in the Genesis days? In this view, that is possible but not really the point of the narrative. The literary interpretation takes the form of the week attributed to the work of creation to be an artistic arrangement, a modest example of anthropomorphism that is not to be taken literally. In this interpretation, the only historical points to be made are that God created the universe, and that somewhere in the mix of whatever he did, he created a first man and woman (Adam and Eve) who fell into sin and implicated the whole race by so doing. Once we remove the idea that the days teach a historical sequence, the age-day vs 24-hour day debate becomes irrelevant.
- This position leaves to science questions about how creation was done, when it was done, how long it took. There cannot be a conflict between science and Scripture on this point, for they address two different sets of questions.

Biblical arguments and counterarguments

Concerning the meaning of the word ‘day’:

The use of ‘day’ in the OT

24-hr day	<p>The most frequent use of the word 'day' is of a 24-hour solar day. This is the natural sense of the word in Gen 1, for there is no indication in the text that it refers to ages. The original readers would have understood it this way.</p> <p>Linguistically, when 'day' is used with numerals (e.g. 'first day'), it invariably means a 24-hour period, except in Zech 14:7 (though in Hebrew, 'one day' can also mean 'unique day').</p> <p>The repetition of 'it was evening and it was morning' seems to indicate a literal day is intended. Its absence for the 7th day still makes sense because God did not create on the 7th day but rested, and so it was not necessary to distinguish the 7th day from subsequent days.</p>
Day-age	<p>The Hebrew word for 'day' does not just denote a 24 hour period, but also:</p> <ul style="list-style-type: none"> • Daylight as opposed to darkness (Gen 1:5, 16, 18) • Light and darkness together (Gen 1:5, 8, 13) • Used to summarize all 6 days of creation (Gen 2:4) • An indefinite period of time (e.g. the day of His anger, the day of trouble, the future day of the LORD) <p>After all, Scripture does say that a day is to the Lord as a thousand years, and a thousand years as a day (Ps 90:4; 2 Pet 3:8)</p>

The relationship between the light of day 1 and the sun of day 4

Day-age	<p>It is unlikely that each of the 6 days could be literal 24-hour days. If the sun, moon and stars were not actually created until the 4th day, and if the light created on the 1st day was not the sun, the 1st 3 days couldn't be solar days like we experience now.</p> <p>The whole purpose for creating sun, moon and stars was to separate day and night and mark off days and years, so if they didn't begin functioning till day 4, the 1st 3 days are not like the solar days we experience now.</p>
24-hr day	<p>Even if there is no sun, God still has the earth revolving on its axis, and the events of the 1st 3 days could still have lasted 24 hours each.</p>
Day-age	<p>The heavenly luminaries could have been created on the 1st day, but obscured from earth by cloud cover. What God did on the 4th day was to part the clouds so that they became visible and could serve their appointed duties for those on the earth. The 'made' of 1:16 should be translated in the pluperfect: 'had made'. Thus there is no way of telling how long (from earth's perspective) the 1st 3 days actually lasted – could have been ages.</p>
24-hr day	<p>If the sun, moon and stars were created on the 1st day and only made visible on the 4th, time would have been measured by the earth's rotation around the sun even if it was not visible, i.e. the days would have been solar days.</p> <p>There is no particular reason to translate 'made' in the pluperfect when it does not take such a meaning on the other days of creation.</p>
Literary framework	<p>Days 1 and 4 represent the same chronological event. The result of day 4 is the same as that attributed to the creative activity of day 1. Therefore, day 4 is a recapitulation of day 1. Day 1 gives God's command and day 4 shows its fulfilment.</p>

Vegetation created on day 3 before the sun on day 4

24-hr day	<p>Vegetation created on day 3 would only have needed to wait one 24-hour day for sunlight on day 4, in any case, there was light from day 1. This is more a problem for the day-age theory as it is hard to imagine that vegetation can go without</p>
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	sunlight for long geological eras. Even if the sun was already there but not visible, could enough sunlight penetrate through the cloud cover to sustain plant life for billions of years?
Day-age	The day-age theory is compatible with vegetation being created on day 3 and the sun being revealed only on day 4 because light from the sun would still have penetrated the cloud cover and enable photosynthesis. Anyway, it is possible that the cloud cover was gradually lifting on the 3 rd day so that the luminaries became visible on the 4 th day.

Multiple events on day 6

Day-age	The events of the 6 th day would seem to last longer than a 24-hour day. On the 6 th day, Adam is created first, then God plants the garden of Eden and puts Adam in it, then he sees that Adam is alone and decides to do something about it. He creates the beasts and birds and brings them to Adam for naming. Adam does this, and having finished the task, God says that none of the animals is a suitable mate for Adam. God puts Adam into a deep sleep, takes one of his ribs, and makes Eve. Adam awakens and recognizes that Eve is his proper mate.
24-hr day	God can do anything. Adam could have named the animals quickly without observing them very long, or he may have named only representative animals from various groups.
Literary framework	In chapter 1, the animals are created before human beings, but this is reversed in chapter 2. This may indicate that the accounts are not structured strictly chronologically. (Alternatively, Gen 2:19 could be translated in the pluperfect: 'The Lord <i>had</i> formed every animal...')

The seventh day is different

Day-age	The seventh day has no ending, for Heb 4:1-11 implies that God's Sabbath rest continues until now. If the days of creation are parallel to each other (and this is implied in the rationale for the Sabbath legislation of Exod 20:9-11), then the 1 st 6 days could also have been prolonged periods of time. Israel's work week should be analogous, not identical, to God's creation week.
24-hr day	The Sabbath legislation to work six days is based on the week of creation, and seems to require that the word 'day' takes the same sense in both instances. Additionally, God's rest is said to be eternal, and surely that doesn't require the other days of creation to be eternal in span.

Each day contains evening and morning

Day-age	'Evening' and 'morning' can be used in a figurative sense (e.g. Ps 90:5-6), like other natural phenomena in the bible. They may simply be a literary device indicating that each creative 'day' was a period of time marked off by a beginning and ending.
24-hr day	If 'day' is figurative and not literal, how do we know that other elements of the creation account are not also figurative? Could even Adam and Eve be imaginary or symbolic?

Genesis 2:5

Literary framework	Gen 2:5 places the creation of man prior to the creation of vegetation, which contradicts chapter 1, unless chapter 1 is not structured in strict chronological
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	<p>order. Note that it is taken for granted that God operates by natural rather than supernatural means.</p> <p>Gen 2:5 is problematic for day-age theorists, because if there was no rain on earth until day 6, how would life-forms created on day 5 survive through a long geological age? (But Cassuto in his commentary argue that the 2 expressions for vegetation in 2:5 refer to cultivated plants rather than any kind of vegetation. Collins suggests that it was the dry season and therefore there were no plants there at the time, not that they hadn't existed before that.)</p> <p>Gen 2:5 is also problematic for the solar day position, because if vegetation was created on day 3, then the absence of rain for 3 days (until day 6) is not long enough to make the land devoid of vegetation.</p>
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Concerning the relation of sin to death:

24-hr day	<p>The fall caused various changes in nature (Gen 3:17-19). Paul wrote in Rom 8:18-22 of creation being subjected to futility, groaning and corruption, not by its own will, certainly referring to the results of the fall. The corruption suffered by creation can't be moral (for plants and animals are not moral agents) and must therefore refer to physical death.</p> <p>Passages like Isa 11:6-9 seem to show that in the future Messianic kingdom, there will be a change in animals' behaviour toward one another.</p> <p>In light of these considerations, it seems possible that there was no animal or human death prior to the fall.</p>
Day-age	<p>It is dubious that no animal or plant life died prior to the fall of Adam and Eve. The bible doesn't require this to be the case, for the teaching in Romans 5 about death resulting from sin only applies to the human race. The futility and frustration imposed upon creation in Rom 8 is not about plant or animal death, but has to do with sinful humanity's flawed rule over creation.</p> <p>Isa 11 employs figures of speech depicting a startling peace between nations in the future Messianic reign.</p> <p>Animal death is not an indication of moral evil. Ps 104:21-24 celebrates the predatory nature of lions as part of God's good creation.</p>

Concerning an old universe:

Day-age	<p>Biblical genealogies (including those in Gen 4-5, 10 & 11) do not comprise a strict chronological list without gaps in between. A person listed as father may actually be a great-great-grandfather of the person named as a descendant.</p>
24-hr day	<p>It is granted that the genealogies in Genesis have gaps, but at earliest, Adam would have been created between 10,000 BC and 20,000 BC, not billions of years ago.</p>
24-hr day	<p>God created things with apparent age. Adam and Eve were not created as babies, similarly trees, flowers and animals were created mature.</p> <p>Light takes millions of years to travel to earth from distant stars, so God created the universe with light already reaching earth, seeming to have travelled millions of light years when in fact it hadn't.</p> <p>This would not be deceptive because God told us what he did.</p>
Day-age	<p>If the universe was created with an impression of age, then God has deceived us. If the universe is young, then most of what we see in the stars is fictitious, because most of the universe is more than ten thousand light-years away.</p>
24-hr day	<p>The geological data such as the configuration of rocks in layers and the fossils in them can be explained in terms of the Noahic flood of Gen 9.</p> <p>Alternatively, God created things to look older than they actually are.</p>

CONCLUSION

- Weigh carefully the scientific data:
 - How much do you think it supports neo-Darwinism?
 - In my view, belief in a gradual process of macro-evolution is not necessitated by the scientific data.
 - Distinguish the question of the age of the earth from the question of evolution. Neo-Darwinism requires an old earth, but the converse is not true.
- Weigh carefully the biblical data:
 - What interpretation of Genesis 1-2 do you think is most credible?
- Then see if your view of science and the bible can fit together and complement each other.
 - Distinguish belief in creation from creationism. Just because one rejects belief in naturalistic evolution doesn't necessarily make one a young earth creationist.

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