

THE EVOLUTION OF THE UNIVERSE AND LIVING ORGANISMS

THE LECTURER

I am a relatively new committed Christian but I am a fully trained scientist and I therefore speak to you not as a religious authority but to give you an authoritative scientific exposition of certain matters which are frequently misunderstood and to explain how I personally believe these may be reconciled to Christian doctrine.

INTRODUCTION

I'm going to talk to you not only about the evolution of living organisms but also about the evolution of the universe itself. However, as a preliminary it may be appropriate to consider the relationship of Christianity and science as a whole.

We know that God is Truth (Deut 32:4, Exod 34:6, Ps 31:5) thus it seems to me to be inconceivable that He would have created the universe to be deliberately deceptive (i.e. for example created the universe with evidence of a long past history which it does not in fact have).

Also we are made in God's image (Gen 1:26). Therefore it seems to me to be likely that our minds are capable of apprehending at least some significant part of the universe that God has created.

For the two foregoing reasons it seems to me that we can be completely confident that scientific truth derived from honest observation of the universe must be totally compatible with Christian doctrine and with the word of God as expressed in the Bible (although our interpretation of what the Bible is saying to us may require some new thinking and even modification from time to time).

Hence I believe that as Christians we should not seek to attack or deny science but should rather work with science and scientists (a) to understand God better by becoming more acquainted with the universe he created and (b) to ensure that scientific knowledge and discoveries are not misused for purposes incompatible with God's Laws. Furthermore mankind was commanded to subdue and take charge of the world (Gen 1:28) and science is a tool (amongst others) which can be used to this end - if we use it correctly. Thus science can be seen as an aid in fulfilling God's commandments.

WHAT IS THE UNIVERSE GOD CREATED LIKE?

God has created expansively and generously. Indeed more than generously. There is no way in which I can imagine mankind ever coming to know a trillionth part of what has been created. The universe is so vast in extent as to be virtually inconceivable to us.

The sun is 93 million miles away from the earth. This is far enough, but the distance to the next solar system can only be usefully measured in terms of light years (the distance light travels in one year or around 9.5 trillion kms). The nearest solar system Proxima Centauri is 4.2 light years away. To get some idea of the scale in human terms I calculate that if the sun was a peanut in Harare then the earth would be a speck of dust half a metre away, the most distant planet in our solar system, Pluto, would be 20 metres away but Proxima Centauri would be another peanut in Bulawayo. Space is a very large and empty place.

We live in a large grouping of stars called a galaxy. Our galaxy is popularly called the milky way. The Milky Way has 100 billion stars and is 100,000 light years across. It looks roughly like this:

diagram

Yet the milky way is only one of billions of galaxies and is of average size and shape. These galaxies go on as far as (and indeed much further than) the eye can see. The diameter of the universe is certainly greater than 20 billion light years and probably more than 40 billion light years. There are certainly more stars in all the galaxies in the universe than there are grains of sand on all the beaches of the earth. What indeed are we that God should be mindful of us (Ps 8:4, Heb 2:6)?

THEORIES OF EVOLUTION OF THE UNIVERSE

In view of the limited time available I do not propose to follow an historical perspective but instead to leap straight to the origins of current theories.

Prior to 1965 many scientists (including myself) believed that the universe might be infinite in space and time (i.e. that it had no beginning and would have no end) - the so called steady state theory. Indeed my doctorate work was devoted to the subject of how galaxies might be created in such a universe and attempted to show that they must be as they in fact are (a sort of negative proof of the theory). However, other scientists believed that the universe originated at a specific time in the past at a moment of creation known as the "big bang".

In 1965 technicians at Bell Laboratories discovered low level microwave radiation coming from all parts of the sky. Having eliminated their original supposition that the signal was caused by pigeon droppings in their aerial they published their findings under the exciting title "Infra Red measurement of excess antenna temperature at 4080 Mc/s". It was soon realised that what had been discovered was an echo of the big bang already predicted by supporters of the big bang model such as George Gamow. Produced as gamma rays in the big bang the radiation has been red shifted (cooled) in the expansion of space to 2.7 K. Since that discovery and the work of Ryle and others showing that galaxies were more densely grouped in the past the big bang model has been the accepted one.

Surprisingly we understand the evolution of the universe after its creation in the big bang remarkably well. Current theories describe the universe back to a point 10^{-43} seconds after its origin at which point General Relativity Theory breaks down. At that time the universe was only 10^{-33} cm across and could easily have passed through the eye of a needle. From that point in time it expanded rapidly producing the universe we now see.

Unfortunately I have no time today to explain to you how protons, electrons, neutrons and eventually atoms were formed in the aftermath of the big bang. For those who are interested in more detail I recommend Stephen Hawking's book "A Brief History of Time".

We are now confident that our picture of the creation of the universe is quite accurate. Using the equations of General Relativity it is possible to predict the proportions of the elements that should exist today in the universe. According to these theories the proportion of hydrogen to helium at the time when atoms first came into existence about 1 million years after the big bang should be 76% hydrogen and 24% helium. When we measure the ratio of hydrogen to helium today and adjust our calculations for the amount of hydrogen burnt up in fusion reactions inside stars we find this predicted proportion to be almost exactly correct.

If stars had not come into existence no elements heavier than helium would have been created. Elements up to iron are produced in the nuclear fusion furnace of an ordinary star. Elements heavier than iron are produced in those exploding stars known as supernovae.

Galaxies and stars came into existence as a result of density fluctuations in the sea of atoms which came to exist. The remaining traces of such density fluctuations have been detected by the COBE satellite programme. Stephen Hawking has shown that if gravity is attractive, the universe is expanding, and time travel is impossible then the universe must have started in a singularity. This singularity and thus the whole universe could have originated out of nothing as a random fluctuation at the quantum level. All the apparent matter and energy in the universe as we know it is balanced by the negative energy of attraction of gravity between all the matter in it and thus the totality is essentially nothing.

Where is the place of God in all this? The answer is that this is a scientific description of the universe and has no necessary place for God. It does not prove that God exists but equally it does not prove that God does not exist.

Originally theologians supported and welcomed the big bang theory because they considered that it provided a necessary role for God as the originator of the universe (the person who lit the blue touch-paper of the big bang as it were). However, Hawking's theories of quantum gravity give us a strong indication that the universe may have originated as a random quantum fluctuation. Whilst this does not prove that God did not cause the fluctuation it does not give him a necessary role. Quantum theory does not operate in terms of cause and effect but in purely probabilistic terms. The argument for God as a first cause of the universe thus becomes irrelevant.

In my view the existence of a scientific explanation of the origin of the universe does not invalidate it as an example of God's creative activity. Scientific and religious explanations should I believe be seen as complementary. Both true but different. The scientific explanation deals with what and how, the religious with the why.

The suggestion that an explicit intention lies behind the universe finds much support from modern cosmology:

Anthropic Balances

Earth's temperature. The internal nuclear energy levels needed to form carbon. However, I do not believe that we can infer an infinite God from a finite universe and certainly not the Christian God.

Intelligibility of the Universe to Man

This may be a pointer to God but again does not prove the existence of God.

Hope in a Futile Universe

Cosmology reveals a future of futility and death - heat death or big crunch. Even if mankind were to survive that long. Christianity offers hope. The resurrection of Jesus offers the hope of resurrection to a new life free of the limitations of this world.

CREATION OF THE UNIVERSE AND THE BIBLE

What does the Bible have to say to us about the subject of creation? Many will answer that the world was made in seven days (strictly it should be six days of course). Personally I believe that over rigid adherence to this doctrine is one of the greatest barriers to the acceptance of Christianity amongst young people today. A recent survey of American teenagers showed that more than one third of them rejected Christianity because they could not accept the idea of a seven day creation 6,000 years ago.

What are the fundamental assertions of the Bible concerning creation? I believe they are the following:

God is the Sole Creator of the Universe

"In the beginning God created the heavens and the earth". How does this relate to theories of the creation of the universe we have just discussed. I see no contradiction. In any event I believe that the primary intention of this Biblical statement (and indeed all the Biblical statements in Genesis) is theological and not scientific.

For example in v16 "God made two lights, the greater light to govern the day and the lesser light to govern the night". I find it significant that the sun and moon are not called by their names. I consider that this is because they were the names of gods in other primitive surrounding cultures and the writer was seeking to ridicule this idea. A further example along the same lines is the use of the Aramaic verb "bara" to create. This verb is used in only three places in Genesis. In the opening verse for the creation of the universe, in v27 for the creation of humanity and in v21 for the creation of the great sea monsters. One can understand the special use in v1 and v27 but why in v21? I believe that the answer to this problem is again theological. In many other creation stories the creator god has first to subdue the great sea monsters. I believe Genesis is seeking to criticise this false view and underline the fact that everything was created by God.

Of course Christianity does not see God simply as the creator or first cause of the universe but as the foundation of all that goes on there. He sustains the world in being. To put it

another way he didn't merely wind up the clockwork or light the blue touch-paper, he holds the world in the palm of his hand.

God is the Source of Order in the Universe

What is striking to me about the first chapter of Genesis is the pattern and order of Gods creation. In my view the structure of the seven days reflects a logical rather than a strictly chronological order. This is a theme to which I shall be returning later after we have discussed the evolution of living things. In brief summary the first three days deal with shape and the second three days with filling that shape. Some scholars have suggested that the week of creation reflects a picture of God as the supreme craftsman.

It is also interesting to note that the number 7 is not just present as the number of days. For example the number of Hebrew words in v1 is 7. v2 has two times 7 or 14, the word "God" occurs 35 times, the word earth 21 times and the phrase "God saw that it was good" 7 times. The number 7 is associated throughout the bible with completion fulfilment and perfection.

The overall message is that the universe is good and ordered because of God. Science is, of course, based on the assumption of order in the universe and our ability to discern it. Thus Christianity far from attacking or being attacked by science fundamentally affirms it. Scientists who explore the order of the universe are able to do so because of God. God is the guarantee of the physical equations by which the universe began and has evolved. He is not a god who needs to be inserted only to explain that which science cannot presently understand. God is the source and guarantee of all physical laws.

This sort of idea used to be used against biblical Christianity. In the mechanistic Newtonian world view of the universe God might have provided the mechanism but he would then have to sit back and watch it operate. However, chaos theory and quantum theory, although they operate according to basic laws, show the near or often total impossibility of knowing the outcome of the operation of those laws. Perhaps it is in this way that God is able to intervene and perform the miraculous.

I believe that the order in the universe should be seen as a reflection of God's faithfulness and miracles should be seen as acts of grace where he suspends his normal ways of working.

God puts Relationships at the Heart of the Universe

The high point of creation is humanity created in his image in order to be in relationship with him. Even before the creation of the universe God was already in a dynamic relationship in the trinity. He did not need to create but did so as an act of extravagance and delight.

God is Meant to be Worshipped

Worship breathes through the first chapter of Genesis. Indeed there is evidence that it was used in a liturgical form (i.e. as worship). It is not prose nor is it entirely poetry. It is more like a hymn of creation.

Initial Conclusion

Thus in summary I believe that our ideas about God are complementary to scientific ideas of the origin and evolution of the universe. He provides the answer to why there is a universe, the source of underlying order in the universe, of our importance and of the need for relationship with and worship of Him.

THE EVOLUTION OF LIVING ORGANISMS

Let us turn from consideration of the creation and evolution of the universe to the creation and evolution of living things.

The concept of evolution by natural selection (although not that of evolution per se) has its origin in Charles Darwin. Darwin's book shook the world in 1859 and his arguments have become widely (although incorrectly) accepted in our time.

The fact is that Darwin's ideas are not and never have been compatible with the fossil record.

The fossil record and only the fossil record provides direct evidence of major sequential changes in earth's biota. Another unique offering of the rock record is a timescale for evolution. Darwin himself acknowledged this in "the Origin". Darwin's escape lay in the condemnation of this record. To this end he devoted a whole chapter of the Origin. Indeed he himself said "he who rejects these ideas on the incomplete nature of the geological record will rightly reject my whole theory".

The first edition of the Origin was almost entirely without palaeontological examples. New discoveries during the 1860's and 70's enabled Darwin to include new evidence in later editions. The most notable of these was the German discovery of Archaeopteryx in 1861. This creature was about the size of a crow and was shown to be intermediate between dinosaurs and birds. It had the skeleton of a dinosaur but the feathers of a bird. It is now believed that birds descended from dinosaurs. This and discoveries of sequential fossil forms of recent mammals such as horses was tantalising. It pointed towards change but failed to provide evidence of slow gradual change as required by Darwin's theory.

The currently generally accepted theory of evolution is the punctuational theory first suggested by Ernest Mayr in 1942. This theory contends that evolution occurs rapidly in small isolated populations of a species isolated from other members of that species, usually geographically. This small population can then undergo rapid change by mutation quickly fixed by inbreeding. if the mutation is (very rarely) a favourable one it can then spread out rapidly by adaptive radiation.

The point is that if the transition is rapid and the population is small and localised fossil evidence of the event would never be found. the other aspect of the argument is that the general failure of the record to display major transitions from one major group to another did not reflect the poor record for large well established species, but the slow evolution of such species: full fledged species are not the entities that undergo major evolutionary change.

If the punctuational theory is correct one would expect large well established species to exist for long periods of time without major change. this is in fact the case. G R Cope of Birmingham University has assembled all available evidence on beetles and we find that beetles in the ice age are virtually identical to existing species. This means no change during more than 1,000,000 generations. This view is reinforced by studies of many other species e.g. freshwater Bowfin fishes which turn out to be almost totally unchanged after 100 million years.

Darwin suggested that such living fossils had survived by being confined to a narrow geographic area and not subject to competition. This is not the case. Some are widely distributed and some are narrowly distributed. they cannot be adequately explained on a natural selection model.

There are many other circumstances which cannot be explained on the gradualistic theory e.g. the evolution of modern mammals in only 12 million years at the end of the age of dinosaurs.

The fossil record does not convincingly demonstrate a single transition from one species to another. In deducing the poor nature of the fossil record from his theory Darwin seriously violated his commitment to empiricism.

In order to find support for the punctuational model of evolution by quantum speciation we need to find a new young species that is still trapped in its isolated point of evolutionary origin. Until recently such species were not known but in the past few years a number have come to light. Lake Nagubago in Uganda is a small lake formed by the closure of a part of Lake Victoria by sandbank formation some 4-5,000 years ago. Lake Nagubago has five species of cichlid fish which are unknown elsewhere but each of which resembles a species in the main lake. Species in the main lake have survived unchanged for more than 3 million years.

How do species form? Small changes to but a single regulatory gene which controls many structural genes can give rise to major widespread changes. Similarly metamorphosis in amphibians is controlled by a single gene Mexican Axolotls were changed back to land animals in this way.

Turning now to human origin it seems certain that homo sapiens did not evolve by way of a linear sequence back to slender australopithecine. We probably evolved from a hairy arboreal quadruped, likely Aegyptopithecus.

Somewhere probably not more than 100,000 years ago and certainly not less than 40,000 years ago (fossils found) homo sap came into being. It is a mistake to believe that we were the first tool using creatures. Neanderthal man certainly used tools and the even more primitive homo erectus used implements of polished wood and bone and trapped animals. Nor can we even say that we were the first creature to believe in an afterlife. The Neanderthal burial sites at Le Moustier France and other sites in the Iraqi mountains reveal beyond all

possible doubt that Neanderthals revered their dead and believed that they would have an afterlife.

However, I see no conflict between this evidence and the Christian belief that "a soul" was injected into the first man by God. Also this view of evolution supports the notion of there being a first man as a result of evolution in a small population.

Nevertheless we are left with the problem of reconciling this view with the first chapters of Genesis.

As I said in my introduction I cannot reconcile the concept of a God who created a deliberately deceptive universe with a righteous and truthful God. Nor can I reject scientific evidence of the age of the universe, the past history of mankind or the fact of evolution. How can these concepts be reconciled with the Bible.

The Gap Theory

One possibility is the so called gap theory introduced by the 19th century Scottish preacher Thomas Chalmers. The gap is between verses 1 and 2 of Genesis 1. It argues that verse 1 refers to the original creation which could have been billions of years ago. However, the fall of Satan is responsible for bringing ruin and destruction upon creation and verse 2 is translated as the earth became formless and void. The rest of Chapter 1 is thus a seven day work not of creation but of reconstruction.

I personally do not accept this theory for two reasons (a) most scholars do not accept that the translation of v2 as became is allowable (b) more importantly there is little support elsewhere in the Bible for the idea that the fall of Satan had such a ruinous effect.

The Days are Ages Theory

Another attempt at reconciliation was suggested in the nineteenth century by Hugh Miller. It sees the Hebrew word "yom" (translated as "day" in modern bibles) in terms of an unspecified period of time such as millions or billions of years. It then argues for a general agreement between the order of creative acts and the fossil and other evidence. I used to support this idea when I was becoming a Christian but I have been led to abandon it. Firstly it seems unlikely that the writer of Gen 1 used the word "yom" in this way (although this meaning is possible). This is shown by the fact that the days are part of a week.

Also there is emphasis on "morning" and "evening" (Gen 1:5 and 1:8). More importantly the agreement between the order of creative acts and our knowledge of events is at variance. trees appear before marine creatures (Gen 1:11,20) and evening and morning appear before the sun and moon.

Days not of Creation but of Revelation

This theory argues that the seven day week of Genesis 1 is indeed a literal week but that it is not a week of God creating but of God explaining to Adam how and what he created. The revelation would thus be thousands of years ago but the actual creation would be an unspecified time before that. This theory explains some odd features of Gen 1 e.g. god

resting on the seventh day when other parts of the Bible make it clear that God never rests or grows weary (Isaiah 45:28). The rest could have been for Adams benefit.

However, I do not accept this theory. It requires translating Gen 1:1 as God made known the heavens and the earth which is not supported by the Hebrew words.

The Literary Approach

This requires consideration of what the literary nature of Genesis is. The Bible contains many different literary forms prose, poetry, allegory (e.g. Judges 9:8-15), fable (e.g. Ezekiel 16). In understanding any particular section of the Bible it is important to know and understand the kind of literature involved.

For example the phrase "the eyes of the Lord range throughout the earth" (2 Chron 16:9) does not mean that God literally has mobile eyes (or indeed eyes or even a physical person at all) but is a picture of our Lords interest in this world and its affairs.

What kind of literature then is Genesis 1-3. First there are elements which are clearly theological rather than scientific (e.g. the reference to the sun and moon as lights). Second there are non-literal elements in Genesis (e.g. no mention of morning and evening on the seventh day. Or when God creates man does he literally breathe? There are word plays such as the word for "pain" in childbirth which sounds similar to tree. It is interesting that Revelation uses the images of the serpent and the tree of life from Genesis symbolically.

Thirdly the structure of Genesis 1 indicates that it is a theological rather than a scientific statement.

I conclude from the available evidence that Genesis 1 is not to be understood as strictly scientific history (although that does not mean that it contributes nothing to history or science). Real historical events can be described in a symbolic way e.g. Jesus's parable of the wicked tenants (Matt 21:33-41). This way of dealing with events is common in our culture (e.g. Shakespeare's King Lear).

This viewpoint leads to an easy marriage of the Biblical and scientific viewpoints. Both are true but they differ in the questions they address and answer. God could not have written Genesis 1 as a textbook of modern cosmology. People in that era (indeed most people today) would not have the means to understand it.

Science does not show us that the Bible is wrong but it may show us when our understanding of the Bible is wrong. The different interpretations of Genesis over the centuries should not be seen as a failure but are a record of Christians striving to achieve a better understanding of the Bible and of God. Just as scientific theories can change so may our understanding of God's Nature and purposes and our interpretation of his word in the Bible.