NOTES ON SCIENCE AND CHRISTIAN BELIEF

By Professor Allan J Day
With contributions by others as listed under Chapter Headings

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Edited by Bruce Craven and John Pilbrow

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PREFACE

Over the last decade or so an increasing interest in the relationship between science and religion has developed. This has resulted in the proliferation of courses in science and religion at many tertiary institutions and the appointment of senior academics to positions in this area. Oxford University e.g. appointed its first Professor of Science and Religion within the Faculty of Theology in 1999.

The interest in this area has also been stimulated by the active financial support of the John Templeton Foundation. The Foundation awarded 100 Course Awards annually internationally for courses in Science and Religion over a five year period from about 1998 until 2002.

These notes form the basis of one such course in Science and Christian Belief conducted as part of the Ridley College Certificate of Bible and Ministry in Melbourne, Australia. They are intended to give a basic understanding of the issues raised by modern science and of the relationship of these issues to the Christian Faith. They cover briefly the historical background of the development of science and the interaction of such development with religious faith. They also address some of the philosophical issues with respect to religious and scientific knowledge and consider some of the positions that have been taken by various groups with respect to the science faith interface.

On this basis they explore the implications for theology of discoveries in modern science – important among these are the recent developments in cosmology and biology. Some of the misconceptions commonly held by secular humanists, by the general public and also by many Christians, with respect to the relationship between science and faith are considered.

The approach to Science and Faith is presented in a way that is consistent with both scientific integrity and Biblical authority. These notes are designed for both science and theological students as well as teachers who encounter these issues. Indeed our hope is that they will be useful to any who have an interest in the rapidly growing interface between science and religion.

The notes are also very much a work in progress. We recognize the cryptic format of some material and also that thinking evolves as new issues emerge. It is our intention to review these notes regularly and update them as the opportunities permit and in response to feedback.

These introductory notes, originally mostly written by Allan J Day in 2001, have been edited recently by Dr Bruce Craven and Prof John Pilbrow.

Author: Allan J Day
CHAPTER HEADINGS AND OUTLINES

Science and Christian Belief - Introduction to the Issues
Allan J Day
This provides a brief introduction to the relations between science and spirituality, and the diverse attitudes that some have taken. The following chapters explore these questions in detail.

1. Historical Overview — From Aristotle to the 18th Century
Jonathan D A Clarke and Allan J Day
Chapter 1 surveys the various ideas held, from ancient Greece to the 18th Century, concerning the natural world and its relation to theological ideas. Points of note are Galileo's exposition of the relation between the bible and the book of nature, ideas of a mechanistic universe from Newton onward, and questions of the age of the earth, leading up to Lyell's uniformitarianism.

2. Darwin and the Aftermath — Science and Faith in the 19th & 20th Centuries
Allan J Day
Chapter 2 continues the story, to Darwin's Origin of Species, and the various reactions to it. There was then no united opposition to evolution by Christian thinkers; attitudes varied. Only much later did the "young earth" viewpoint and many other anti-evolution positions become an article of faith for many Christians.

3. God’s Interaction with the World— Some Metaphysical Considerations
Jonathan D A Clarke & Allan J Day
Chapter 3 outlines various "world views" on the relation of the natural world to divinity, or to the belief that there is none. Of note here are "naturalism", the belief that the physical world is all there is, "deism", that God set the world going and then left it alone, and "theism", that God is constantly active in the world.

4. Rational Inquiry — Science and Theology and their Limitations
Allan J Day
Chapter 4 discusses the limitations of science and of theology. In particular, what is scientific knowledge, what are scientific theories? Science describes truth, and does not prescribe it; and scientific knowledge is not the only kind of knowledge. What is theology, and what is meant by verifying a theological theory? Theology of "motivated belief", not just "subjective perception".

5. Ways of Relating Science and Faith
Allan J Day
Chapter 5 discusses ways to relate science and faith under the headings of conflict (scientism, creationism), separation, complementarity, integration (assimilation), and rejection (new age).

1 Throughout we will use 19thC and 19th Century etc. interchangeably.
6. Cosmology, Creation and the Biblical Record
   Allan J Day & John R Pilbrow

   Chapter 6 discusses the biblical doctrine of creation in relation to the scientific picture of origins, as in modern physics and cosmology. Many recent viewpoints are surveyed, as well as the implications for God's continued activity, and some analysis of creation in Genesis.

7. Evolution and Creation
   Allan J Day

   Chapter 7 on evolution and creation, considers evolution by natural selection as a proposed mechanism, to be assessed on scientific grounds, whereas creation should be judged on theological and biblical grounds.

8. The Nature of Humanity
   Allan J Day

   Chapter 8 discusses the nature of humanity, with regard to the genetic code and neurophysiology, and also to biblical anthropology, regarded as a complementary approach, also valid.

9. Genetics, Reproductive Technology and Ethics
   Allan J Day

   Chapter 9 discusses genetics in relation to reproductive technology, and the consequent ethical questions.

10. The Earth and Its Environment
    Ross H. Macmillan

    Chapter 10 discusses the earth and its environment, with regard to the various understandings of the earth, and the several attitudes that may be taken to environmental questions (including utilitarian, conservation, sustainable development), and a theology of stewardship.
INTRODUCTION TO THE ISSUES

1. Allan J Day — Personal Background

At the time these lectures were last presented in 2001, Professor Allan Day had for 50 years a shared commitment to both science and Christianity. He had had time therefore, to think through and integrate the issues of science and Christian faith. In expressing a personal faith in Christ and pursuing a scientific career he found himself in the company of many scientists both in the past and in the present who have found no problem in being both scientists and Christians.

He argues that there is no need therefore for anyone to sacrifice intellectual integrity or to be embarrassed in having a Christian faith and in espousing a scientific approach to the world.

2. Issues That Need To Be Addressed

This is not to deny however that there are issues that need to be addressed and this is what this course is all about. Many of these issues have arisen as a result of the separation of science from theology. This separation was part and parcel of the development of modern science in the 16-17th Centuries and in some ways led on to the dominance of a secular world view, particularly over the last 150 years. This development was not intrinsic to the nature or practice of science, but rather of the way it was perceived by many as a dominant (or even exclusive) way of knowing about the world. These perceptions need however to be critically reviewed.

There are many misconceptions held by both non Christians and Christians about these matters that lead to unnecessary problems. We will attempt therefore, in the sessions that follow, to try and resolve some of these problems and misconceptions.

3. Fundamental Premise

As was expressed by some of the founders of the modern scientific movement, such as Francis Bacon and Galileo, we need to assert that God is the author of all truth, scientific and biblical. Scientific truth is the truth about nature read in the “Book of nature” while biblical truth is the truth about God read in the Scriptures. This separation was part and parcel of the liberation of science from medieval science and encapsulated in the comment of Galileo that

"The bible tells us how to go to heaven not how the heavens go”.

This well known metaphor of the two books taken up by both Bacon and Galileo however also indicates that there can be no conflict between the truths derived from the respective approaches. If there is apparent conflict we need to re-look at our interpretation of both.

HISTORY OF SCIENCE

1. Origin of Science

The development of modern science presupposed a God of order who created a world that was contingent on His will and therefore could be explored by experiment, not just discovered by reason alone. The world was conceived as part of God’s creation, not divine in itself.

2. Science as a Religious Activity

Many early scientists were devout Christians, who saw their science as an expression of their faith, as a way of exploring God’s ways in nature. This object is expressed in the Charter of the Royal Society, the first of the scientific societies, founded in 1662, as the account of its first historian, Spratt, records.
**MISCONCEPTIONS**

There are conceptual problems about the relationship of science and faith held by non Christians, including secular humanists, but also by many Christians. These misunderstandings need to be addressed if we are to understand the proper approach to science and belief. We cannot prove or disprove God by science, but we do need to see the logical issues and the mistakes made which have resulted in some false understandings.

**We will consider seven misconceptions.**

1. **That Science Does Away with the Need for God**

This is the secular humanist argument, i.e. God is a "God of the Gaps". Faith is a medieval construct, made redundant by scientific explanations.

**History of the enlightenment**

Medieval science did not separate primary and secondary causes — God was the ultimate cause. Now, it is reasoned, phenomena can be better explained by science. Thus God is envisaged as a 'stop gap' explanation — evidence of our previous ignorance, e.g. lightning — Act of God/static electricity. Laplace stated there was "no need of that hypothesis".

**God of the gaps — A shrinking God**

This represents a mistaken concept of God, an inadequate view of God. "A God who is too small". It reduces God to a secondary cause. It is not the Christian God. The God of theism is envisaged as being ultimately responsible for all of nature ("He makes the grass to grow"), but whose actions are described by scientific laws discoverable by science.

**Evolution/Creation issue**

This is well illustrated by the evolution-creation debate. The failure to distinguish God as the primary cause and evolution as a secondary cause investigated and decided by science.

As Christians we can allow for a full explanation of natural events in scientific terms – this does not constitute a threat to faith. God is not threatened by "our explaining him away". What is threatened is our **concept** of God, a God of the gaps made in our own image.

2. **That Science and Faith Are Incompatible.**

That they are strange bedfellows and cannot co-exist. **Thus it is assumed that only the material is real.** The only real knowledge is obtained by what we can observe, by the scientific method. Cf. Medawar.

**There are, however, other views of reality.** e.g."Religious or aesthetic or moral experience" is real.

**Science is concerned with "how" questions.** By observation and experiment. Its information is thus limited by its method.

**Faith asks "why", "who" questions.** The two complement each other cf. relationships, painting, SOS. Represent different "windows" of information. A different approach to reality - "complementary".

**Science needs Theology for a full explanation** i.e. Science generates "why" questions, but cannot answer them.

**Questions posed by the new physics** e.g. quantum physics and relativity. Where do the "laws of physics" come from? The role of "purpose", "elegance", "design". These all raise issues beyond physics or metaphysics.
3. **That Christian Faith Is Irrational – Superstition**

*But the Christian faith is based on rational data. It can be investigated.*

Death/resurrection events. Historic facts of the gospel and the Old Testament, and one can approach this with reason.

**However faith goes beyond**, but faith and sight are the poles of faith and truth. We can observe facts, draw conclusions - gives a basis for faith.

Atheism is just as much an act of belief — no more logical. i.e. We can choose to believe/disbelieve — one is not more logical.

4. **That Science Is Determinist**

Preset — rigid i.e. There is no basis for God to interact.

**Newtonian science** certainly presented a determinist world, with God as a "watchmaker" — Deism.

Now replaced by Einsteinian physics. Einsteinian science — quantum — "open systems", world of probabilities. Indeterminism e.g. Chaos and the butterfly effect, therefore less certainty — chance.


5. **That Science Can Prove God**

Many Christians consider science proves God — the argument from design. This is over-optimism. It can also be used to replace God. Deism etc. The new physics does not prove God. Ps. 8 "The heavens declare the glory of God..." but as seen by the worshipper.

**Problems of natural theology.**

Cannot discover God by reason alone. We are both finite and sinful, cf. Rom. 1:18ff.

**Therefore do not overrate science.**

It raises questions, but faith extends it.

Scientists are both non-Christian and Christian — neither standpoint is more logical but we acknowledge God "by faith" cf. Heb. 11 3.

6. **That a Scientific World View Is Unnecessary**

**Non-Christian mysticism**

In the present post-modern world scientific verification is giving way to mysticism, to incredulous practices such as astrology, Tarot spirituality, i.e. a rejection of "order" in the created world. For the Christian — God is a God of "order", i.e. God acts in a 'logical' way. The Gen. 1 mandate is to investigate this ordered world.

**Christian Semi-deism**

Many Christians consider God as an interventionist God. They fail to recognise God is the God of natural events; that nature is a picture of his works. Scientific Laws express God's rationality and make science possible.

Creation science — has a pseudo scientific approach to cosmology.

7. **That the Bible Is a Scientific Text Book**

i.e. That we can learn "how" God created world from Gen. 1 — NO!!

*E.g. "creationism — creation science".*
Literal interpretation — therefore must rewrite science. Correlate scientific theory with the Bible.

**However, the Bible doesn’t speak with scientific inerrancy but speaks in everyday language.** e.g. ‘The sun sets.’ Poetic language, myth revealing truth, creation expressed in terms of the cosmology of the Ancient Near East.

**Bible is concerned with who God is and who we are.**

Not with origins. Except that it affirms that without God the universe would not exist.

**CONCLUSIONS**

Faith and Science are complementary, not in conflict. They represent different windows on reality. Faith looks at the God of nature — by Scripture. Science looks at the Nature of God — by creation. Thus we can be both Christian and Scientists.

**GENERAL REFERENCES**

Alexander, D, 2008, *Creation or Evolution: Do we have to choose?* Monarch, Oxford and Grand Rapids.


Berry, RJ, *Real Science, Real Faith*, Monarch.


Chapter 1  HISTORICAL OVERVIEW

From Aristotle to the 18th Century

Jonathan D A Clarke and Allan J Day
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Authors: Jonathan D A Clarke and Allan J Day
1.1 **INTRODUCTION**

These notes will give a brief overview of the development of science from the classical period to the present day, and emphasise some of the salient issues that have emerged. Two main periods will be discussed.

1.1.1 **From Aristotle to the 18th Century**

This period saw the development of classical science, the rise of Christianity, and the integration of many aspects of the classical worldview and world picture into Christian thought. No sooner had this been achieved however, than classical science was challenged by the development of modern science.

1.1.2 **19th Century and beyond**

Much of the change from the classical to the modern scientific world pictures has been a change from a static to a dynamic understanding of the world. From being to becoming, as is sometimes said. Part of this change was also the recognition of the material insignificance of the earth and humanity in space and time. The challenges of these discoveries for Christian thought, largely framed in classical terms, were immense.

1.1.3 **Importance of History**

Why do we bother to study history? There are several reasons. By discovering how we got here we can better understand where we are. In the process we can rediscover lost perspectives and avoid pitfalls. In the context of studying the relationship between science and faith, studying the history of that interaction allows us to see what issues were important in the past, discover the roots of current debates, and from these forge better intellectual tools for understanding and use.

1.1.4 **Major Events**

This chapter sets out to answer three questions: The first is to identify the major events in the history of the science-faith interaction from about 200 BC to the middle ages. The second is to identify the themes that have characterised this interaction. The third is to underline the lessons that these hold for the present and future?

1.1.5 **Themes**

Several themes come through any historical overview. These include the facts that Christians have always integrated their theology with the contemporary understanding of the world. This is fraught with danger as the contemporary understanding is always in flux. There have been times when Christians have defended as “the” Christian position an obsolete scientific world picture.

1.1.6 **Lessons**

The lessons that emerge for Christians from this history are many. However several predominate. The first is not to attempt to develop a scientific model on the basis of the Biblical worldview – all attempts will fail. A second is to hold loosely to any attempt to relate or integrate Christian theology with contemporary science – the science will inevitably change. A third, and probably most important, is to exercise humility and charity with those with whom we differ.
1.2 FROM ARISTOTLE TO THE 18TH CENTURY

1.2.1 Rapid development
In contrast to classical science, modern science (that which developed subsequent to about 1600) has developed very rapidly. In 400 years our understanding of the natural world has changed more than in the 4,000 years previously. Equally impressive has been the application of that knowledge to technology. What is behind this explosive development?

1.2.2 Origins

Greek Science (6th-2nd Centuries BC)
The importance of classical thought to science is often overstated, as we will see. However, it cannot be denied that rediscovery of the science of the classical world, of which the Greeks were the epitome, was an important factor leading to modern science.

Judeo - Christian Theology
Less well known to the popular mind, but of at least equal and probably greater importance was the Judeo-Christian worldview. In particular the doctrine of creation allowed an attitude to the world that permitted modern science to develop and flourish.

1.3 GREEK SCIENCE

1.3.1 Positive Features

Nature was ordered, not capricious, therefore capable of rational explanation
The Greeks believed the world was Kosmos, not Kaos. It was ordered, orderly, and therefore could be understood by the rational mind. The great contribution of Greek thought to modern science was the importance of logic and mathematics.

Knowledge about nature was important
The Greeks were curious about the world. Explaining why the world was the way it is was important to them. Combined with their emphasis on reason, this allowed speculation about the world to be a legitimate activity.

Could be derived by deductive reason
Deductive reasoning about the nature of the world was an important part of Greek science. Through deduction, the Greeks arrived at conclusions about the shape and size of the earth, and speculated about the existence of atoms, the possibility of life beyond the earth, organic evolution and whether or not the earth was the centre of the universe.

1.3.2 Negative Features

Nature was non-created, eternal and therefore divine
This created a problem for the acceptance of Greek science in Christendom. There were temporary bans placed on Aristotle’s natural philosophy in the University of Paris in 1210 and 1215, and an attempt to expurgate them in 1231. Regarding nature as divine also resulted in a worship of nature and an attitude of worship towards the world. Inquiring into its workings could be seen as risking blasphemy.

Nature was governed by an inner force
Naturalism, pantheism, and vitalism are the common consequences of viewing the world as divine. Together with excessive rationalism, a contempt for hands-on
experience, the rise of mysticism in the classical world led to the near extinction of Greek science by about 200 BC.

**Man’s reason was paramount and linked to nature.**

With mankind as the measure of all things, it was considered possible to comprehend the universe through reason alone. This suited the cultural prejudices of the Greek world. Manual work was associated with slaves and artisans and therefore menial, compared with the lofty thoughts of the elevated classes. Experiments or observations required doing the sort of tasks associated with slaves and artisans, not philosophers.

**Thus experimental science was suppressed**

Reason and rationalism was superior to empirical knowledge and experimental science. Reason declared that the heavens were perfect and unchanging. Therefore comets and meteorites were declared atmospheric phenomena, and supernovae ignored.

### 1.4 MEDIEVAL SCIENCE

#### 1.4.1 Arab Science

The Arabs made many contributions to medieval science. First of these was the preservation of many Greek and Roman writings on scientific and mathematical matters. Secondly, the Arabs adopted many scientific ideas from the Indian subcontinent and China. Most important of these were “Arabic” numbers and zero, both Indian inventions. Thirdly, the Arabs themselves contributed much to mathematics, architecture, navigation, medicine, metallurgy, and astronomy. The arrival of this knowledge in Europe led to the full flowering of the medieval worldview and laid the foundations for the Renaissance.

For a more recent perspective, consult Peters et al. (2002).

#### 1.4.2 Aristotelian Christian Synthesis – Thomism

Properties of God derived by reason.

#### 1.4.3 Problems – Nature of God and Creation

The philosophy of Aristotle stood in sharp contrast to clear Biblical teaching.

Aristotle taught that the world was eternal, that God was an impersonal first principle, and that celestial matter was different to terrestrial matter, sharing some divine attributes. He also held that the soul (or souls) died with the body. Aristotle thus represented a great problem to Christian scholars of the 10th–14th centuries. He was clearly the greatest philosophical authority and this knowledge invaluable. Furthermore, Aristotelian metaphysics and logic were among the most developed in the ancient world and set the standard. On the other hand, Aristotle clearly held many things contrary to Christian doctrine. The options for Christian scholars were to reject Aristotle, and all the learning that went with it, to use him selectively, or to Christianise Aristotelian philosophy.

#### 1.4.4 Role of Natural Theology and Revealed theology

Natural theology is the study of what can be deduced about God from the natural world. Revealed theology is the study of what the Bible says about God. Overall, natural theology can be seen as revealing God’s impersonal attributes, while revealed theology is about His personal attributes. The relationship between the two is often strained. Natural theology, of itself, has tendencies to pantheism and deism. Revealed theologians have often ignored what is known about the world from science, especially when writing in the areas of creation, providence, and
eschatology. Both natural and revealed theology were part of the Thomistic synthesis, with natural theology closely identified with Aristotelian science.

1.5 **SCIENTIFIC REVOLUTION – 16TH & 17TH Centuries**

1.5.1 **Renaissance**

The Renaissance is the subject of much mythology. The myth suggests that it occurred when Europe rediscovered the purity of Greek rationalism and cast off the chains of ecclesiastical thought. In reality the rediscovery of the ancients and of Arab science occurred during the 12th and 13th Centuries. The scientific revolution of the 16th and 17th centuries was the sifting and rejection of much of classical science, not its rediscovery. The breaking of ecclesiastical chains was the Reformation, not the scientific revolution. Nevertheless, the reformation played a key role in preparing the intellectual ground for the scientific revolution.

1.5.2 **Reformation – New Understanding of Scripture**

The reformers critically re-evaluated earlier theology against the standard of Scripture. They also recognised that spiritual truth in the Scriptures was accessible to all those who sought it humbly before God. The reformers recognised the dignity of manual work as an act of worship (the so-called Protestant work ethic). Finally, there was a recognition that theology had to be useful, in encouraging ordinary people towards godliness.

1.5.3 **Judeo-Christian Input**

**God as creator**

Creation exists by His will, thus purpose is not intrinsic but resides in God. God is faithful in creation; therefore what we learn from it is trustworthy, because the creator is trustworthy.

**Cosmos as creation**

As creation, the cosmos is neither eternal nor divine. Therefore it should not be worshipped; rather it shares humanity’s createdness. Since the cosmos is contingent on God, its properties can only be discovered by investigation and experiment, not by pure reason. Because creation is not divine such investigation is permissible.

**Man is God’s regent – steward**

God has placed humanity in a position of responsibility in creation. These responsibilities include subduing and caring for creation, to fill it, to name the animals and till the earth.

**Sanctity of work**

Contrary to the ancient Greeks, work in the Bible is a gift from God; it is something humanity is commanded to do. Furthermore, work is sanctified by the Biblical revelation of God’s activity as a worker, such as a farmer, shepherd, potter, and metal smith.

**Rational Empiricism, Induction**

The scientific revolution of the 16th and 17th Centuries followed on from the Reformation with many similarities in basic methodology. It was characterised by the linking of two approaches hitherto largely separate. These were rational empiricism common to the practical artisans of the medieval period with the induction of classical and scholastic thought, combined with an imperative to see what the evidence actually pointed to, rather than relying on authority. This approach closely resembled that of the reformers for theology and Scripture. With respect to the relationship between science and the Bible, Bacon, among others,
argued for a “two books” approach. These were the book of nature and the book of Scripture.

1.5.4 Bacon’s Two Books

Book of Nature
Also known as the book of God’s works, the natural world could be investigated by science to discover God’s ways in it.

Book of Scripture
Also known as the book of God’s words, Scripture could be investigated to discover God’s will and purpose for His people.

1.6 COPERNICAN REVOLUTION

1.6.1 Copernican Astronomy - Prelude to Galileo

Aristotelian /Ptolemaic Astronomy
Built on the astronomy of the classical Greco-Roman period which, in its turn, is based on Babylonian and Egyptian astronomy. Key aspects of Aristotelian/Ptolemaic astronomy, as it was interpreted in the late Medieval period consisted of the following:

Authority, Tradition and Reason
Aristotle and Ptolemy were the authoritative texts. Although both these ancient scientists had made observations, in the late medieval period the rationalistic tradition was so strong that contrary observations were ignored.

An Eternal Cosmos
Aristotle believed that the heavens beyond the moon were eternal, unchanging, and composed of distinctly different material to the changing earth. The eternal nature of the heavens was not transferred across into the Medieval Christian understanding, but the unchanging character of the heavens was.

A Central Earth
The earth was central, not only to classical astronomy, but also classical physics.

Circular motions
The circle was the perfect shape in classical thought. It was obvious therefore that heavenly bodies would be both circular (or spherical) and move in circles.

See Fig 6.1 from Poole, M, Belief and Values in Science Education.

Alternative Systems
See Fig 6.6 from Poole (1995).

Copernicus - (1473-1542)
Copernicus suggested a central sun, but on purely rationalistic grounds; there was no empirical evidence to support it. It had little going for it except apparent simplicity.

Tycho Brahe – (1546-1601)
Tycho accepted the telescopic evidence that Mercury and Venus orbited the sun, but believed that the sun still orbited the earth, as did the other planets.

Kepler
Kepler postulated elliptical orbits, in one of the most significant breaks with classical astronomy after the abandoning of the geocentric universe.
1.7 THE GALILEO CONTROVERSY

1.7.1 Introduction

Nineteenth century writers on science and Christianity such as Draper and White used the Galileo debate as an example of their conflict model par excellence. The reality is both more complex and more interesting. Arthur Koestler in his Galileo biography Sleepwalkers observes,

The fame of this outstanding genius rests on discoveries he never made and on feats he never performed. Contrary to statements in even recent outlines of science, Galileo did not invent the telescope, nor the microscope: nor the thermometer, nor the pendulum clock. He did not discover the law of inertia, nor the parallelogram of forces or motions nor the sunspots. He made no contribution to theoretical astronomy, he did not throw weights down from the leaning tower of Pisa, and did not prove the truth of the Copernican system. He was not tortured by the Inquisition, did not languish in its dungeons and he was not a martyr of science.

The Galileo debate was initially a scientific debate with Aristotelian scientists. The theological problem came later and was largely precipitated by Galileo’s cavalier treatment of Pope Urban VIII. Koestler observes,

[Urban VIII] was the first Pope to allow a monument to be erected to him in his lifetime. His vanity was indeed monumental and conspicuous even in an age which had little use for the virtue of humility. His famous statement that he “knew better than all the cardinals put together” was only equalled by Galileo’s that he alone had discovered everything new in the sky. They both considered themselves supermen and started on a basis of mutual adulation type of relationship which as a rule comes to a bitter end.

The Galileo controversy can be divided into three phases.

1589 – 1610 - Scientific Controversy

Although known chiefly as an astronomer, Galileo (1564-1642) was notable also as a physicist (see below). Galileo studied medicine at Pisa, but did not complete his degree. He returned home and studied physics under a private tutor.

Galileo’s professional life included appointments at the universities of Padua and Pisa, and as Philosopher to the Grand Duke of Florence. During his career from 1589–1633 Galileo was involved in 6 major controversies with colleagues. Most of these involved his refutations of Aristotle, which aroused the antagonism of most of his contemporaries. These controversies demonstrated Galileo’s abilities at both debate and at antagonising his opponents in public controversy.

1611 – 1633 - Theological Controversy

Galileo’s 5th controversy in 1614 was over Copernican astronomy. The debate had taken a theological twist owing to the introduction of Biblical arguments in defence of geocentricity by Galileo’s opponents and Galileo’s use of hermeneutics to defend himself. It led to him being given written orders that it could be neither defended nor held. He avoided Copernicanism for the next 8 years, but in 1630 discussed Copernicanism, as he thought, hypothetically, in his book Dialogue concerning the two world systems. This book led to further accusations of Copernicanism and of ridiculing pope Urban VIII, which led directly to his trial and conviction in 1633.

1633-1642 – Final Years

Galileo was placed under house arrest following his trial. This meant being released into the custody of a friend and living in his house. Many of the restrictions of his sentence were ignored or soon lifted. Later that year he moved to his own home near Florence and continued to work on physics. Despite suffering increasing blindness from 1637 Galileo continued his researches and died in 1642.
1.7.2 1589-1610 — Scientific Controversy

University Background

Pisa 1589-1592
During this period Galileo began to study physics. He began the first of his disagreements with his Aristotelian contemporaries, most especially in the field of mechanics.

Padua 1592-1610
Galileo’s appointment to the University of Padua over the head of an Aristotelian rival was also a cause for controversy. This did not endear him to his opponents. During this period Galileo began to investigate optics, leading to more controversy. More important it led to experiments in lenses for telescope making, and the first telescopic astronomical observations.

Florence - 1610
Appointed to a prestigious post as a “philosopher” (scientific adviser in modern parlance) to the Duke of Florence, Galileo continued his astronomical research. He also began publishing his results, which led to the final controversy.

Contemporary Scientific Developments/Controversy

Supernova discovered
In 1572 and 1604 Tycho observed supernovae, new stars. The Chinese had known these for millennia, but they had been ignored in the western world. Kepler’s observations placed them among the fixed stars, challenging the assumption about the unchanging heavens.

1609 Telescope and its discoveries
In rapid succession Galileo discovered with his telescope the moons of Jupiter—proving that the earth was not always the centre of the universe, sun spots—showing that the sun was not unblemished and changeless, and the phases of Venus—strong evidence for a heliocentric astronomy. Galileo also showed that Saturn had strange protuberances, indicating that things in the heaven were not perfect circles or disks.

Comets
Tycho had also showed that comets were more distant that the moon. They moved in strange and then unpredictable ways, further undermining confidence in the eternal perfection of the heavens.

Character of Galileo

Aggressive, Antagonised opponents, “The Wrangler”
Galileo was a ruthless and aggressive debater. He not only offended his enemies, but alienated those who might have been sympathetic. He also was unprepared to admit mistakes, even when they were shown to him.

Populariser – Books in Italian widely read both for content and style
Galileo was a great populariser. He wrote in Italian for the ordinary person, rather than the more learned Latin. This upset many contemporary academics, just as modern popularisers such as Carl Sagan and Steven Gould upset theirs.

1.7.3 1611-1633 — Theological Controversy

Acceptance and opposition

1611 Visit to Rome
Despite being controversial and his own worst enemy Galileo was well accepted in his 1611 visit to the Jesuit College. This college was teaching the Copernican system. He was also well received by Pope Paul V and impressed Cardinal Berberini, who became Pope Urban VIII in 1623.

1611-1613 — Organised Resistance “Liga” - Colombe

Galileo had so antagonised his academic colleagues that several joined together to form a conspiracy to discredit him. To do so they raised the issue that his astronomical views were contrary to Scripture, in particular that his view of the centrality of Earth undermined the authority of Scripture. Galileo defended himself through judicious Biblical interpretation. These were delicate times for such a practice.

Sensitivity of the times (Reformation and the Counter reformation and Council of Trent 1545-1563)

Protestant threat

To the Catholic authorities the Protestant threat lay in the lay interpretation of Scripture. If everyone interpreted the Bible as they wished, then there might be no limit to the heresies that might be promulgated. Subsequent events have shown this fear to be not entirely without substance. Any lay interpretation was seen as an attack on the Church. Galileo offered a theological defence of his position on three occasions.

Theological Debate

1613 - Liga

The first was in a letter to Castelli, a student of his, defending himself against the verbal attacks on him.

1614 - Caccini Sermon

The second was in response to a sermon by Caccini attacking his astronomy and claiming that the Bible clearly indicated that the earth was fixed. In this Galileo argued theoretically about the nature of Biblical revelation.

1615 - Letter to Empress Christina

The most important of Galileo’s theological defences was his letter to the Grand Duchess Christina. This is a key document in the relationship between Christianity and Science. It had the following main points:
*The issue had been brought to the Roman court for the wrong reasons.
*Astronomical theories could not be matters of faith.
*The new cosmology was in harmony with biblical teaching if the Bible were interpreted correctly by established principles (but not by Trent)

Some extracts from the Letter to the Grand Duchess Christina

These indicate Galileo’s approach to science and scripture.

Regarding Scripture

The Holy Bible can never speak untruth, whenever its true meaning is understood. But the meaning is not always obvious from the literal sense as anyone can see in the Bible’s use of anthropomorphic terms for God’s hands and feet and eyes. Such terms are inspired by the Holy Spirit in order to accommodate them to the capacities of the common people, rude and unlearned as they are.

Galileo and the Book of Nature

The Holy Bible and the Phenomena of Nature proceed alike from the Divine Word ... God can be known by Nature in His works - and by doctrine in His
revealed word. The Bible is written for the primary purpose of the salvation of souls and the service of God.

Quoting From Cardinal Baronius
The Bible tells us how to go to heaven not how the heavens go.

Quoting From Augustine
Usually, even a non-Christian knows something about the earth, the heavens, and other elements of this world, about the motion and orbit of the stars and even their size ..., and this knowledge he holds to as being certain from reason and experience. Now, it is a disgraceful and dangerous thing for an infidel to hear a Christian, presumably giving the meaning of Holy Scripture, talking nonsense on these topics; and we should take all means to prevent such an embarrassing situation, in which people show up vast ignorance in a Christian and laugh it to scorn ... If they find a Christian mistaken in a field which they themselves know well and hear him maintaining his foolish opinions about our books, how are they going to believe those books in matters concerning the resurrection of the dead, the hope of eternal life, and the kingdom of heaven?

1616 - Admonition by the Vatican

Cardinal Bellarmine
The doctrine attributed to Copernicus that the earth moves around the sun is contrary to Holy Scripture and therefore cannot be defended or held.

Galileo was formally admonished in the letter from Cardinal Bellarmine. In it he was told that he was neither to hold nor defend the Copernican system. Galileo followed this instruction for 8 years but in 1630 published his book Dialogue concerning two world systems in which he presented cogent arguments for the Copernican system. The book was published in Italian for maximum circulation.

1623 Berberini becomes Pope Urban VIII

1630 Dialogue Published

In a style common to the time, the Dialogue consisted of a literary conversation between two protagonists seeking to sway a third party. One person represented the Copernican position, arguing with Galileo’s style and arguments, the other presented the official papal position as that of the ordinary, or common sense view. In a classical Latin dialogue this person was known as Simplicius, meaning straightforward. In Italian this became Simplicito with the implication of feeblemindedness. The Pope was furious, even though Simplicito carried the day.

1.7.4 1633- 1642 Final Years — Trial and Condemnation

Ecclesiastical concern over the Dialogue led to sales being halted and Galileo summoned to appear before the Inquisition in 1633. He was accused of holding, defending, and teaching Copernicanism in defiance of the church. Despite conflicting evidence whether or not Galileo had been told not to teach Copernicanism, the court considered that the Dialogue clearly defended it, something that had been expressly forbidden. Galileo was told to acknowledge this or face the consequences, most likely imprisonment. He acquiesced and signed a confession, essentially an out-of-court settlement. The Dialogue was placed on the index of prohibited books and Galileo placed under house arrest and excommunicated. His excommunication was only lifted by the Vatican in 1992.
1.8 **17TH CENTURY SCIENCE – NEWTON AND THE MECHANISTIC UNIVERSE**

The Newtonian revolution delineates a major watershed in the history of science. It marks the end of classical physical science that had dominated thought in physics and astronomy for almost two millennia. Copernicus, Kepler, and Galileo started the process in astronomy. Galileo and Kepler also began developing mathematical physics and were important predecessors of Newton. Kepler, Galileo and Newton showed the power of mathematics in describing the behaviour of the physical world.

The rise of rationalistic, mechanistic philosophy in the tradition of Descartes paralleled the development of the new physics. Indeed, the success of the new physics appeared to lend empirical support to this philosophy. The mechanistic world picture thus played a role in the rise of agnosticism, atheism, and deism.

A revolution of similar magnitude was the discovery of earth history. John Green wrote in *The Death of Adam* (1961) that the change from a static and cyclic to a dynamic and evolving world view was the most marked characteristic of the transition from medieval to modern science. Accompanying this was recognition that the same laws operated in the universe as on earth. This transition marked the eclipse of Aristotle in physics, Ptolemy in astronomy, and Genesis in geology. All this occurred in the 17th and 18th centuries. The 19th century saw the same process in biology and palaeontology, where the Aristotelian view on the fixity of species was overthrown by an evolutionary perspective. This is the subject of a later chapter. The rise of the nebula hypothesis in the 19th and early 20th century provides a further example.

Christian responses to these different developments were many. Initially some attempted to develop a Biblical alternative, known as Hutchinsonianism, to mechanistic physics. Natural theology rose later, and attempted to use the rationalistic philosophy of Descartes and the new scientific discoveries to provide, not only a rational basis for theology but outright proofs for the existence of God. In the case of geology, the main issue was how to reconcile discoveries of an ever increasing geological past with the text of Genesis. Christians proposed various exegetical and hermeneutic schemes to resolve the problem.

**The Clockwork Universe**

**Rise of Newtonian physics**

*Aristotelean & neo-platonic physics*

Classical physics as understood in the middle ages was dominated by the thought of Aristotle. It was rationalistic-speculative, there was little empirical observation, and experiment was ignored. Key aspects included the following. Terrestrial matter was made up of four elements (earth, air, fire, and water). Celestial matter was made of a fifth element, the *aether*. All things were arranged in a hierarchy in a concentric cosmos. Formless matter was at the centre and matterless form on the outside. All things could be classified into a small group of universal properties. Ironically, Aristotle himself recognised the importance of observation, while many of his followers did not. Aristotle made many important biological observations in addition to his physical speculations. He can be called the greatest biologist until Linnaeus in the 18th century.

*Collapse of classical Greek physics*

The rationalistic physics of Aristotle was consistently refuted by Galileo, whose fiercest disputes were with the Aristotelian professors. Galileo worked particularly in problems of mechanics, buoyancy, and optics. Like Archimedes he was particular interested in the practical application of his knowledge. The visible success of inventions and innovations such as the

Authors: Jonathan D A Clarke and Allan J Day
pendulum clock, surveying instruments, and telescopes did much to cement the superiority of the new physics over the old. Kepler also played an important role, he disproved classical idealism, which saw the circle as superior to the ellipse and thereby the natural motion of the heavens. His studies of planetary motion showed that the planets moved in ellipses, not circles. They disproved classical idealism, which saw the circle as superior to the ellipse and thereby the natural motion of the heavens. His three laws of planetary motion anticipated Newton.

Newton developed new mathematical tools (calculus) to describe physical phenomena. He refined mechanics and optics to new precision. Newton also invented telescopes and through application of gravitational theory established the universal applicability of terrestrial physics. Newton thus completed the process begun by Galileo and Kepler in demonstrating the power of mathematics in describing the behaviour of the physical world.

1.8.2 Impact of Newtonian physics

Scientific

Newtonian physics transformed science and became the epitome of the scientific enterprise. The success of Newtonian physics in predicting the existence of Uranus and Neptune from the irregularities in the motions of other planets was perhaps its greatest triumph.

Newtonian physics was superseded in the 20th by quantum theory and relativity, but still provides a highly accurate way to describe and predict the behaviour of physical objects. Refinements and elaborations of Newton’s physics continue to provide the basis for modern mechanical, structural, and civil engineering. The Newtonian vision also provided a great incentive to physical scientists studying chemistry and electricity.

Metaphysical

Newton’s superb mathematical exposition of the behaviour of the physical world is often linked to the rise of naturalism. Mathematics explained the world so well, so the naturalists argued, that there was no need to invoke, or seek for, powers or forces beyond the material.

It is certainly true that metaphysical naturalism, both agnostic and atheistic, became more prevalent in the latter part of the 17th century. It is also true that many Christians were concerned by the materialistic implications of Newtonian philosophy. This partly gave rise to Hutchinsonianism (see below). Neither of these metaphysical consequences were direct consequences of Newton’s own theology. The success of mechanistic explanations in physics was perceived as powerful confirmation of materialistic explanations of the world, laying the groundwork for the metaphysical scepticism of the Enlightenment.

1.8.3 Christian responses

The faith of the founding physicists

Galileo’s faith has been discussed previously. Kepler was also strongly Christian (Lutheran) in outlook, although modern believers would be surprised in his practice of astrology and his leanings towards Pythagorean mysticism. Fascinated by harmony, Kepler saw the relationships of the natural world as evidence of God’s handiwork. Despite being embroiled in religious controversy — he disagreed with both Catholics and Lutherans over the nature of the Communion—he appears to have remained remarkably free of religious animosity. Newton was a devout, if heterodox Protestant. His understanding of the relationship between God and His world was theistic. Personal research led Newton to adopt Arianism, a fact he kept hidden. His extensive Biblical research is far more voluminous than his science but was little known until this century. Newton also followed the “two books” approach, but he considered discussion of science and faith unprofitable. When
president of the Royal Society he banned any discussion of religious topics in the Society.

**Mosaic science**

Not all Christians were comfortable with the mathematical science of Newton and his contemporaries. Almost unknown today, the followers of John Hutchinson (1674–1737) attempted to create a Bible-based alternative to Newtonian physics. Hutchinsonianism gained a following amongst many educated people of the time, including several Bishops, Peers of the Realm, and Samuel Johnson, but had died out by the end of the 18th century.

Hutchinsonians objected to Newton on several grounds. These included the “unscientific” concepts such as action at a distance (gravity), its supposed association with Latitudinarianism and deism, and the superiority of a science built on Scripture. The fundamental assumption of the latter was the belief that the Hebrew text was philosophically true in every detail and that the language itself contained the key to all knowledge. Their writings attempted to form a biblically based science, that would help defend orthodox Christianity.

The Hutchinsonians failed for a combination of reasons including the inability of the Bible to sustain a scientific superstructure and the success of Newtonian physics. Ironically for defenders of orthodoxy, Hutchinsonians defended a self-sufficient rather than contingent universe and emphasised God’s transcendence as against His immanence. This was very similar to the deism that they opposed. In their attitude to science and their use of Scripture they resemble, in many ways, the modern Creation Science movement.

**Deism and theism**

The rise of deism may reflect the strongly deterministic nature of Newtonian science and the exclusion of the “God of the Gaps”. Much of the theology of the enemies of Newtonianism was also conducive to deism, especially in the separation of God from the world and the emphasis of the world as a self-contained machine.

Despite the popularity of deism, many Christians and scientists remained theistic in their outlook. Indeed, the Newtonian revolution heightened the need to see God as immanent as well as transcendent, and as the One who worked by natural law, as well as by miracle.

**1.8.4 17th Century British Scientists**

These saw themselves as observing the ways of God in Nature (studying the book of God’s works). They did not see themselves in opposition to faith. The Royal Society was founded by such scientists. Unlike catholic Europe, Britain had a positive Science/Faith climate. With time however, some came to see that knowledge of God derived from the natural world was more reliable than revelation. Some have been referred to already.

**Francis Bacon— Two Books**

Book of Nature and Book of Scripture. Finding out about the ways of God.

**Church Sympathetic to Copernican Science**

Wilkins Master of Trinity 1659 and Bishop of Chester 1668 was the foremost Copernican proponent in Britain.

**Royal Society — Sprat history 1667**

Was founded by mainly Puritan Christians who saw themselves as exploring the ways of God in Nature and directing their study to the glory of God and the benefit of the human race.

**Isaac Newton 1642–**
His religious faith and theological writings have already been referred to. His *Principia* was published in 1679 and marked both the end of Aristotelian physics and the generation of the “mechanistic universe”. Its concepts generated two directions in the Science/Religion debate: that of a universe with no need of God, atheism, and that of a universe displaying the works of God, theism. Newton remained in the latter group. In his regard for matters theological Newton can be regarded as typical of his time and place. Indeed, Newton wrote more words on theology than on science. However, much of his theology was not quite orthodox, he was both Arian and Unitarian in his thinking.

**John Ray 1691**

The father of Botany, whose book *Wisdom of God Manifested in the Work of Creation* was widely circulated and read.

**Robert Boyle**

As a further example of the close relationship between science and theology in the minds of 17th century English scientists we have Robert Boyle. He established the Boyle Lectures to consider the ways of God in Nature.

**W Paley - Natural Theology**

Paley’s *Natural Theology — Evidences for the Existence of the Deity Collected from the Appearances of Nature* published in 1802 was to dominate the science scene in Britain until well into the 19th Century.

### 1.9 NATURAL THEOLOGY

#### 1.9.1 Development

Theology used for its utility value — to establish the need for God. To prove a benevolent God. This was the purpose of the Boyle lectures. The first given by Richard Bentley in 1691 was entitled “A refutation of atheism from the origin and frame of the world”. This role is illustrated by a quote from Linnaeus in 1754

*If the maker had furnished this globe, like a museum, with the most admirable proofs of his wisdom and power; if this splendid theatre would be adorned in vain without a spectator; and if Man the most perfect of all his works is alone capable of considering the wonderful economy of the whole; it follows that man is made for the purpose of studying the Creator’s works, that he may observe in them the evident marks of divine wisdom.*

Natural theology became the dominant spirituality of the deists. Rejecting Biblical revelation, they attempted to base their faith on evidence for God in the natural world. Because it was rational and scientific, it was considered that natural theology was a truer road to knowledge of God than “corrupted” human texts. Deists believed that God had created in the beginning, but did not intervene in the world. Natural theology was also attractive to theists and semi deists, who saw in it a powerful apologetic tool.

#### 1.9.2 William Paley

Natural Theology dominated (particularly in Britain) the relationship between science and theology during the 17th and 18th Centuries. It was successfully promoted by William Paley. His *Evidences for the Existence of the Deity* published in 1802 had enormous influence. It dominated Anglican Theology in late 18th and early 19th Centuries.

Paley portrayed nature as a watch and God as a watchmaker. Each aspect of nature was considered as a demonstration of the Deity — a proof of God as the master watchmaker (designer), e.g. eye, bird’s wing etc. It also portrayed a static creation, each creature being individually brought into being by a special act of God.
Many scientists were of course clergy, and science was stimulated enormously by the search for ever more evidences of God’s design in Nature. Natural theology declined as the deism to which it appealed declined towards the middle of the 19th century. Classic natural theology, in the style of Paley also went into eclipse when naturalistic accounts for the appearance of specific adapted organs such as the eye appeared to be provided by natural selection. More recently modified versions of natural theology have appeared in extrapolations from the apparent fine-tuning of the universe. It has also reappeared in the “Intelligent design” movement, which denies organic evolution and reinstates Paley.

1.10 THE ENLIGHTENMENT, DEISM AND ATHEISM

1.10.1 Weakness of Natural Theology

Contained the seeds of its own destruction — exploited by Hume 1779 in his Dialogues Concerning Natural Religion. Along with the purposefulness of nature had to be added its apparent purposelessness on occasions. The problem of natural evil made evident by the enormous death toll of the Lisbon earthquake was particularly salutary.

*Cannot prove God, must always assume God’s existence*

By relying only on induction from scientific knowledge, natural theology could only offer God as a hypothesis. The likelihood of that hypothesis would wax and wane according to the evidence.

*Removes a personal God*

The deists denied revelation. By eliminating the God of the Bible who reveals Himself to his people and saves them, they were left with an emasculated religion of little personal substance beyond a vague mysticism. The deist’s God was distant, impersonal, and powerless to act in the real world.

1.10.2 Deism, Atheism

Deism the outcome of a mechanistic philosophy has two outcomes. as Pier Maupertuis (Essai de Cosmologie 1756) observed

*All the philosophers of our time belong to two sects. One group wishes to subjugate nature to a purely material order and to exclude all intelligent principles from it.... The others on the contrary, make constant use of final causes to discover the views of the Creator, penetrating his intent in the smallest of phenomena. According to the first group the universe could do without God. According to the latter, the tiniest parts of the universe constitute repeated demonstrations (of his being). His Power, Wisdom, and Goodness are painted on the wings of butterflies and in every spider’s web.*

Thus deism may, and in fact did, lead historically to both Atheism and Theism. To European Rationalism and the Enlightenment, to English Natural Theology and Paley’s Evidences. Deism and its mechanistic philosophy may therefore:

*Go on and exclude God — It may then lead to Atheism.*

If they were not able to prove the Deist’s God, they would be likely to lapse into atheism. This is what happened in most cases. Atheism was more attractive intellectually than the weak and distant God of the deists.

*Go on and prove God — it may then lead to Theism.*

If they were able to convince themselves of the existence of God there was always the likelihood they would come to realise that God was active in their lives. In this case they would become theists, especially Christian theists if they came to believe the God of the Bible manifest in Jesus. In
fact both intellectual destinations are flawed, or at least the track to them is flawed.

A mechanistic universe neither proves God nor removes the need for God. Paley’s evidences affirm a God he believed in, and Laplace’s “no need of that (God) hypothesis” simply disposes of a “God of the Gaps”.

1.11 THE AGE AND HISTORY OF THE EARTH

1.11.1 History of Geology

Principles of Stratigraphy

Lithostratigraphy

Serious study of geology began with Nicholas Steno (1638-86), the first to elucidate the basic principles of stratigraphy. He also demonstrated beyond reasonable doubt that fossils were of organic origin. Steno’s principles allowed the lithostratigraphic correlation of rocks over large areas.

Biostratigraphy — fossil sequences

By the end of the 19th century natural philosophers had begun to recognise that fossils always occurred in a particular sequence. This fossil or biostratigraphic succession made possible the correlation of rocks over long distances, even when rocks cropped out discontinuously or when lithological changes had occurred.

Biostratigraphy provided the basis for the geological time scale. It also showed that species were not eternal but appeared and became extinct through geological time.

Processes Involved

Diluvialism

A diverse group of people through the 17th and 18th century interpreted the earth in terms of Noah’s flood. These were the diluvialists, most of whom were English Protestants. Diluvialists argued that the present configuration of the earth was not its original one. Oceans, valleys, and mountains were seen as imperfections absent on a world created perfect. The original earth was a perfect sphere, imperfections were the results of Noah’s flood. Fossils in rocks were the flood’s victims. Diluvialism fell out of favour for two reasons. Firstly, nobody was able to construct a consistent model for the rise and fall of the flood from Biblical data. Secondly, the diluvialists themselves discovered an increasing body of evidence that proved that the geological record was not the result of a single, world-wide flood. Instead it was clearly the result of a wide range of processes operating over a large, though indeterminate, period of time. By the early 19th century few diluvialists remained. Those that did were increasingly isolated from the mainstream of geological research.

Neptunism and Plutonism/Vulcanism

Neptunism and plutonism were two rival theories that, in the late 18th century, replaced diluvialism. Neptunists argued that the geological succession was the result of precipitation out of a primordial ocean, even for crystalline rocks such as granite. Plutonists did not deny the sedimentary origin of many rocks, but argued that granitic and other coarse crystalline rocks were the result of the crystallisation of melts deep underground. The plutonists are commonly held to have “won” the debate, but the neptunists also made many important contributions to geology and mineralogy. The data they collected together reinforced the conclusions of the diluvialists, that the geological record could not be adequately explained by a single global event. Experiments by Buffon (1707-88) on
rates of cooling suggested that the earth had taken 74,832 years to cool from an incandescent state to its present temperature.

Catastrophism

Detailed mapping in the British Isles and continental Europe showed a consistent geological succession. Each consisted of several systems of rocks defined by their characteristic fossils. Each system appeared separated by an unconformity, signifying a major deformation and erosional event. The systems came to be interpreted as representing separate creations, each lasting epochs, and terminated by a global catastrophe. The deluge was seen as the most recent of these. This interpretation of earth history was thus known as catastrophism.

Catastrophism dominated geological thought, particularly in Britain. It provided a fruitful and successful framework for the understanding and researching of earth history for the first 30 years of the 19th century. Within its framework, geologists such as Sedgwick, Murchison, Cuiver, and Buckland, established the detailed geological succession over much of Europe. Catastrophism collapsed for several reasons. One of these was that the unconformities were not world wide in extent, but restricted to particular areas.

Elsewhere, the transition between eras and epochs was gradational, or marked by only one fossil assemblage replacing another. Another reason was that geologists became better acquainted with sedimentary processes. Deposits formerly attributed to catastrophies were recognised to be the result of normal processes similar to those observable in many parts of the world. An example of this was the widespread layer of boulders and gravel found over much of northern Europe and North America. Catastrophists initially attributed this stratum to the deluge. Subsequent work showed that these deposits were due to glaciation.

Uniformitarianism

The concept of uniformitarianism is commonly associated with Lyell (1797–1875). Other geologists, including Fleming, Scrope, and Lomonosov, were also important in its inception. It replaced catastrophism as the dominant interpretative framework for geology. Uniformitarianism assumed that the geological record is the result of processes now operating. It arose because of extensive study of modern processes of volcanism, deformation, and sedimentation. These showed that contemporary processes were capable of producing most of the observed features of the geological record, given sufficient time. Uniformitarianism became a dogma, despite abundant evidence for past processes different from any now operating, and for past processes operating at different intensities and rates to the present. Such dogmatic adherence to uniformitarianism proved an obstacle to the acceptance of several new insights in geology. This has included the role played by asteroid impacts and catastrophic flooding related to natural dam bursts because they appeared to violate uniformitarianism. Some uniformitarians, such as Lyell, were originally hostile to organic evolution for the same reason.

Actualism

Modern geology appears to have outgrown specific interpretative frameworks such as uniformitarianism. Instead, geologists seek to determine, from the evidence of the rocks, the actual processes that have formed them. All rocks are the result of the interaction of physical, chemical, and, in some cases, biological processes. Different processes result in different end products. This approach has been termed actualism. This method is particularly important, as geology becomes increasingly the
study, not just of the earth, but of all solid bodies in the solar system and beyond.

1.12 CHRISTIAN RESPONSES TO GEOLOGY

1.12.1 Christian Geologists

The proportion of active lay Christians and clergy who played a key role in the development of geological science is remarkably high, even in an age where most claimed nominal adherence to Christianity. Geological research really began with the establishment of its basic principles by Steno. Clerics included Steno in Norway and Italy, Burnet, Chambers, Buckland, Sedgwick, and Fleming in Britain. Active lay Christians included Miller in Britain, and Gray, Dana, and Dawson in the United States. All these attempted to relate their geological researches to their interpretation of Genesis. Such interpretations have gone through three phases as geological knowledge progressed.

Literalism — Biblicist input influencing science

Literalism assumes that the Bible contains technical data pertinent to earth history. The Bible and geology are in accord and the geological evidence interpreted appropriately. Diluvialism was constructed within a literalistic framework. Some diluvialists (Whiston, Halley, Woodward, Catcott) were theologically orthodox. Others (Descartes, Newton, Burnet) were not.

Literalism decreased in popularity as diluvialism was increasingly falsified. Literalists were also unable to construct an internally consistent literal reading of Genesis. By the second half of the 19th century it was held only by Christians on the theological fringe, such as the Seventh Day Adventists. Modern proponents are numbered among the various forms of “creation science”.

Concordism

Concordism is the reverse of literalism: Genesis is interpreted in the light of geology. Three main variants have been proposed, the restitutuion theory, day/age theory, and days of revelation theory. Concordism replaced literalism in the early 19th century and, in its various forms, was enthusiastically championed by Sedgwick, Buckland, Miller, Chambers, Gray, and Dawson. Almost all were conservative and evangelical theologians. Between about 1810 and 1960 many held to concordism. There are still many adherents.

Three factors served to reduce its popularity. The first was the resurgent of literalism in the guise of creation science among fundamentalist Christians. The second was the failure of concordism to develop a consistent correspondence between Genesis and geology. The third was the fear among fundamentalists that theologians had compromised too much in allowing science to determine the exegesis of Genesis.

Literary approach

The problems of concordism resulted in new approaches to the interpretation of Genesis. These were concerned primarily with discovering the theological teaching of Genesis within its cultural milieu. They did not attempt to use Genesis to constrain science, or to try and find correspondence between Genesis and geological history. These literary interpretations of Genesis focused on the theological content of Genesis, rather than the scientific, because 300 years of science had persuaded them that scientific readings of Genesis were not possible. This new approach appears to be a fruitful one, and draws on a hermeneutic tradition that extends as far back as Augustine.
1.12.2 Resurgence of Flood Geology

One of the most remarkable aspects of the relationship between Christianity and science in the last 40 years has been the reappearance of Young Earth Creationism (YEC) and flood geology in mainline denominations. Previously found mainly in fringe groups such as the Seventh Day Adventists, flood geology was reintroduced to other Christian groups in 1961 with the publication of *The Genesis Flood* by Whitcomb and Morris. Since then YEC has become the default position on science, faith, and the interpretation of Genesis in many evangelical and fundamentalist denominations. Indeed, for many it has become the hallmark of orthodoxy. This is ironic because in their approach to Scripture and to science YEC is typically unorthodox. Nor has it successfully answered the problems that led to YEC and flood geology being abandoned in the 18th century.

1.13 REFERENCES


Chapter 2  DARWIN AND THE AFTERMATH

Science and Faith in the 19th and the 20th Centuries

Allan J Day
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2.1 INTRODUCTION

2.1.1 Darwin and The Origin Of Species

Darwin and *The Origin of Species* dominates the science/faith debate in the 19th Century. *The Origin of Species* was published in 1859 after a long gestation period. The Huxley, Wilberforce debate at the British Association meeting was held on June 30th 1860 in Oxford.

These two events are commonly perceived as a simple contest between enlightened science and outdated religion. The truth is much more complex as recent historical evidence has made clear. They need to be seen in a broader context therefore, in relation to the social, political and religious scene in 19th C Victorian England.

2.1.2 Darwin and the aftermath

Darwin’s theory of natural selection was variously received as an affront to creation — a new “world view”, or alternatively as an evidence of God’s sovereignty over nature. Its basic scientific tenets were however largely ignored by many scientists particularly by prominent Christian physical scientists such as Kelvin and Clerk Maxwell and also by many prominent religious spokesmen such as Spurgeon.

The June 30th 1860 debate was not reported in the press at the time and has taken on a life of it’s own in the hands of those who were engaged in a struggle for hegemony in 19th C England. There was neither universal acceptance of Darwinism by the scientific community in the late 19th C nor universal rejection by the theological community, but rather a range of views expressed on both sides. Darwinism however, was often exploited by those with a variety of political and social reform ideas — ideas as diverse as Marxism, exploitative capitalism and liberal humanism. Such promotion was often carried out without the blessing of Darwin himself. It is necessary therefore to examine the historical context for the arrival of Darwin’s theory on the world stage and also the variety of perceptions and reactions that resulted from it.

2.2 BACKGROUND TO DARWIN

2.2.1 18th Century Geology and the Age of the Earth

Archbishop Ussher and a Young Earth

Ussher, who was Archbishop of Armagh and a notable scholar, had arrived at an estimate for the age of the earth and of a date for creation, by appropriate “scientific” and literary research. His views were almost universally accepted in the 17th C. They represented the best of 17th C scholarship and his dates were enshrined in the margin of many editions of the King James Bible. Creation was considered to occur in 4004 B.C and there was no reason to doubt this on the basis of the contemporary science.

18th Century Developments in Geology

The 18th C. however saw a revolution in understanding of the age of the earth, brought about by the activity of a variety of earth scientists (Buffon, Hutton, Lyell and others), who established from both fossil and rock strata evidence that the earth was of much greater antiquity and that the processes involved were the result of progressive changes resulting from processes that could be observed today (uniformitarian geology). These findings are described more fully in Chapter 1.

Author: Allan J Day
The result of these developments was a general acceptance of the concept of an old earth with a long history that made evolutionary development feasible. Lyell’s Uniformitarian Geology became the basis for geology in the 19thC and his Principles of Geology (1830-33), first published in 1830, the standard geological work and also the valued companion of Darwin on his historic “Beagle Journey”.

2.2.2 Early 19th Century Background

19thC Establishment

The early 19thC saw a growing professionalism in science with geology and later biology becoming independent scientific disciplines. Ecclesiastical control of science, and education generally, was however in the hands of an Anglican establishment most of whom had a classical non scientific background and training. Non-Anglicans were excluded from the Universities. This hegemony was resented by many non-conformist professionals who saw established religion as inhibiting scientific development. The prevailing theology was natural theology - using science to prove God.

Early 19thC Theology

This was dominated by William Paley (1743-1806) and Natural Theology. His book, Natural Theology - Evidences for the Existence and Attributes of the Deity first published in 1802 and repeatedly republished throughout the 19thC, set the scene. The argument from Design envisaged God as the divine watchmaker and every variation in nature was exploited as an evidence of design and of special creation by a beneficent Creator. The earth was envisaged as a static unchanging earth with each element and species owing its creation to a special act of God. Darwinism changed all that and the struggle was therefore often determined by a resistance to changing concepts of nature not so much to a changing concept of a creating God.

Climate of Dissent

There was also a climate of dissent arising from the enlightenment. Vestiges of the Natural History of Creation was published anonymously by Robert Chambers in 1844 and was met by a shocked, but nevertheless popular reaction. Chambers used progressionist geology and evolutionary biology (which did not arise with Darwin) to provide a naturalistic explanation for the origin of the earth and the evolution of life including man. It preceded the Origin of Species and set the tone for the reception of Darwinism (and also for some of Darwin’s hesitancy to publish). The Romantic movement sought to promote nature, not as a mechanism but as an organism — Mother nature — bringing in pantheistic naturalistic overtones.

Pre Darwinian Evolution

It needs to be realised that Darwin did not originate the concept of evolution. What he did was to provide evidence for a feasible mechanism — Natural selection.

Erasmus Darwin

Darwin’s grandfather Erasmus Darwin in the 18thC. had suggested evolution, a concept of progressive change, as a possible process to explain living things.

Lamarck

Lamarck, the French Biologist, had also promoted evolution and suggested as a possible mechanism the inheritance of acquired characteristics. Unlike Darwin however he was unable to sustain his ideas by experimental evidence.
2.3 EARLY DARWIN AND THE ORIGIN OF SPECIES

2.3.1 Background and training

Darwin was born in 1809 into a well known and well endowed family. He was the son of Robert Darwin a rich Shrewsbury doctor and related by both marriage and descent to the Wedgewoods. His early intentions to enter medicine were truncated by his departure from Edinburgh University after seeing only two operations, and his training for the Anglican ministry at Cambridge was thwarted by his consuming interest and diversion into natural history. Although he found Paley’s “Natural Theology” fascinating, his interests lay more in collecting biological specimens and in field trips with Adam Sedgwick the Professor of Geology and Henslow the Professor of Botany. Henslow suggested that Darwin join HMS Beagle—which was about to sail on a survey mission in 1831—as a companion to its Captain, Robert Fitzroy.

2.3.2 The Beagle Journey 1831-1836

The Beagle journey lasted five years, not two as originally planned, and was the turning point in Darwin’s career. Darwin collected specimens that depicted the enormous diversity of living things. He was fascinated by the diversity of species that existed in geographically separated areas such as the Galapagos Islands. He saw no validation of special creation, but rather of a process that promoted diversity in separated communities.

2.3.3 Malthus and Population Control

In 1838 shortly after returning home Darwin read Thomas Malthus’s controversial book Essays on Population Control. It was a picture of the survival of the fittest in a world faced with a population explosion. The population was increasing more rapidly than was the ability of the environment to support it. The resultant struggle for existence against the enemies of famine and disease etc. formed both a basis for the competitive industrial society and the embryo mechanism for Darwin’s Natural Selection.

2.3.4 Alfred Wallace

Darwin however delayed publishing his conclusions. He recognised that they would not receive a good response in the theological climate (and scientific climate) of natural theology with its concept of a static creation and of special creation of individual species. His delay was also conditioned by his struggle with the implications for naturalism that his theory clearly had, as well as for the religious sensibility of his wife, Emma, who was a devout Christian. He was eventually forced into publication by the very similar conclusions regarding “natural selection” arrived at by Alfred Wallace in 1858. This finally goaded him into publication, firstly in a joint paper with Wallace and then in the Origin of Species which appeared in 1859. It sold out the first day.

2.3.5 The Origin of Species - 1859

The Origin of Species presented the data Darwin had collected, both in his voyage on the Beagle, and in his researches since, in support of his theory of the mechanism of evolution — natural selection. It is important to point out that Darwin’s theory was not the theory of evolution — that had been previously suggested. His genius however was to present a feasible mechanism to support evolution as a concept. He demonstrated the capacity for both overpopulation and of variation in biological species and also of the survival of those variants that were best fitted to survive in hostile and competitive environments. This was his theory of “Survival of the fittest” although it was not Darwin who labeled it as
such. He recognised and considered many of the objections to his theory and discussed them fully in the “Origin”. He had no mechanism to account for either the generation of variation or of its fixation in succeeding generations. That was to await the arrival of Mendel and genetics. He also had no concept of the time span now known to be involved. This was to await the radioactive dating of the mid 20thC. Thus many of the objections foreseen by Darwin have been eliminated by subsequent work. His contribution is therefore all the more remarkable.

2.4 RESPONSES TO DARWIN

The responses to Darwin need to be seen in the light of the context of the times. It was not a debate between progressive science and outdated religion as commonly perceived. Darwin’s theory was exploited by those like Huxley who wished to use it to attack the ruling ecclesiastical establishment, or by Spencer who wished to promote a social theory of human progress, long since debunked. It did however have naturalistic overtones that were recognised and debated and needed to be taken seriously, but it also could be seen as it was by many Christians, particularly by Calvinist conservatives, as an example of God’s activity and sovereignty in the world.

2.4.1 The British Association Debate 1860

It was not surprising that the establishment theologians should react to the attack on natural theology implicit in Darwin’s theory. Samuel Wilberforce, Bishop of Oxford, a High Churchman and a Paley “natural theologian”, who was by no means ignorant of current science, was an early opponent. He was prompted by Cambridge anatomist, Robert Owen, a notable special creationist and also a member of the ruling culture. They were prize targets for Huxley, a rising biologist excluded from church based Universities and espousing naturalistic views. It was seen as a chance to oppose and destroy the church’s grip on science. Darwin was caught up in this politicking but was a very reluctant contributor. Huxley was portrayed as “Darwin’s Bulldog”.

The debate took place on June 30th 1860 at the British Association meeting in Oxford. It was not reported in the press and the commonly reported view is that published by Huxley some years after the event. It is one of complete humiliation of the “ignorant and bigoted” Wilberforce at the hands of the enlightened scientist Huxley. It is from this report that the widely known jibe about “rather having an ape for a grandfather than an ignorant and bigoted bishop” is drawn. All good publicity stuff for Huxley’s campaign against the church’s hegemony. There are reasons to believe that the events were somewhat different, that Wilberforce presented a much more intellectual case, prompted by Owen and that Huxley’s prominence was not as he indicated. Hooker claims himself as the major contender, while the supposed main event itself seems to have been only a small component of the proceedings. Draper (who was later to write the influential polemic history against the Roman Church and science) was a preliminary and very boring prelude to the Huxley/Wilberforce exchange.

The whole reporting of the Debate was part of a very effective publicity campaign waged by the scientist agnostics against ecclesiastical control of the universities and culminating in the publication of J.W.Draper’s History of the Conflict between Religion and Science (1875) and Cornell University’s founder A D White’s A History of the Warfare of Science with Theology in Christendom (1895). Both of these histories are now discredited. Huxley and his companions used the Darwin issue to discredit the church and to promote their agenda. This was further served by their imitation of the church in the development of a “church scientific”, in the events of the X Club and even in the use of Darwin’s funeral in Westminster Abbey against the wishes of the family as the final assault (See Russell 1995).
2.4.2 Scientific Responses

As indicated above, Darwin recognised that there were many scientific objections to Natural Selection. Nevertheless his theory received good support from scientists. However there were some natural scientists who were not convinced. It was only with the 20thC. and the development of Neo Darwinism that scientific support for natural selection became part of scientific dogma. It was not easy to dissociate the overtones of naturalism from Darwinism and this is still the case today in both the scientific and theological responses.

Regarding science and faith in the 19th and 20th Centuries, see Russell (1989).

Pro Darwin

Huxley and his colleagues of the X Club saw Darwinism as a clear example of naturalism. Their espousal went well beyond the scientific aspects of natural selection. They adopted a positivist view of science and saw Darwinism as an alternative explanation of Creation, denying any role for a Creator. Thus, for Huxley etc., Darwinism moved from science to metaphysics. As indicated above this stance also had political aspects in their struggle for hegemony in Mid 19thC England. Asa Gray was the most prominent biologist in North America in the mid 19thC, Professor of Botany at Harvard and a friend and advisor of Darwin, and he was also an evangelical Christian. He saw no threat to Christian theism from the theory of natural selection and wrote frequently about both the scientific and Christian aspects of Darwinism. He was a correspondent and supporter of Darwin from before the publication of the “Origins”.

Anti Darwin

Louis Agassiz (1806-1873) was a French Protestant geologist and zoologist who came to the USA in 1846. He brought a natural history that was based on catastrophism and a series of separate creations. He persistently opposed Darwinism in the USA. His stance was seen by his popular churchgoing audience as a defence of Biblical as well as scientific creationism. He was not however influenced by theological presuppositions and was never associated with organised religion. His reactionary views on racism and slavery made many orthodox Christians uneasy. Although he was a gifted teacher his many students failed to follow his anti Darwin position. William Dawson (1807-1899) was a Canadian Presbyterian and a highly acclaimed geologist at McGill University in Montreal. He occupied the Geology Chair at McGill and was one of the developers of that university as both a scientific and secular institution. He carried his objections to Darwinism throughout his career and was frequently quoted by anti-evolutionists.

Physical Scientists

Far from being agnostic many of the most prominent physical scientists of the late 19th Century were devout Christians. They included Faraday, Joule, Clerk Maxwell and Lord Kelvin. They had little to say about Darwinism. They were certainly not part of any anti-Christian science movement that promoted a conflict approach based on science.

2.4.3 Theological Responses

There was certainly no united opposition to Darwinism amongst theological opinion on either side of the Atlantic. Some like Hodge saw Darwinism as naturalism and as atheism. Others like McCosh, also from Princeton, espoused Darwinism as an example of God’s activity in Creation.
Pro Darwin
The pro-Darwin stance taken by many Christians often came from those with widely different theology. In Victorian England liberal and moderate spokesmen were prominent in their support. Charles Kingsley the author and Anglican clergyman wrote in support of Darwinism glorifying a Creator "who made things make themselves". He was a correspondent of both Darwin and Huxley. Frederick Temple who later became Archbishop of Canterbury spoke positively of evolution in his university sermon on the day following the June 30th, 1860 debate. More liberal theologians often exploited Darwinism to include Spencer’s social Darwinism and to support a view of humanity that included social progress. On the other hand many conservatives in both Scotland and the USA found in Darwinism an example of God’s hand that denied the prevailing deism and semi-deism and asserted a Calvinistic view of God’s sovereignty and activity in creation. These included prominent spokesmen such as George Wright of Oberlin College and James McCosh of Princeton, as well as influential Scottish theologians such as Iverach. See Moore (1979). The theological reaction to Darwinism was far from the universal rejection suggested by the popular press.

Anti Darwin
Apart from the emotive reaction of a variety of biblical literalists there was an informed and concerned response from a number of influential conservative theologians. The most effective of these was Charles Hodge, Principal of Princeton and perhaps the most influential conservative theologian in the USA. His closely argued book What is Darwinism concludes that “it is atheism”. Hodge distinguished three aspects of evolution: the concept of evolution, the scientific concept of natural selection itself and the concept of natural selection without design. He had no argument to make against the first two but only about the third. His opposition was therefore against naturalism which he saw to be represented by Darwinism as it was promoted.

Neutral Responses
Many in Victorian England were content to ignore Darwinism and to oppose only its exploitation by social theorists etc., no comment being made about the merits of Darwinism as a scientific theory. The most popular preacher of the late 19thC. was Charles Spurgeon, whose London congregation exceeded 12,000 each Sunday, and whose sermons were speeded across the Atlantic and published in the secular press in the USA the following week. He rarely commented on Darwinism and when he did it was to address theories derived from it, not the theory of natural selection itself. He was content to let the scientists decide their matters on scientific grounds. It was a wise approach that could well be emulated today by many of his contemporary admirers. It is apparent that the dispute about Darwinism in the late 19thC was a debate about opposing world views, not about a conflict between science and faith. Many saw Darwinism from a positivist perspective, as more than science, and used Darwin’s theory to promote a naturalistic world view. This was rightly opposed by theological opinion that espoused a theistic world view with God as Creator and Sustainer. Other theological opinion could see Darwinism as consistent and indeed supportive of a theistic world view and had no problem with embracing its strictly scientific claims (see Moore, 1979).

2.5 Darwin’s 20th Century Legacy
The embers of the 19thC. debate about Darwinism are still glowing, and in some quarters bursting into flame, but the issues are still the same. There is a need to distinguish between the debate about differing world views, which is not a scientific debate and the debate about the merits of Darwinism as a scientific mechanism to explain biology. What has changed in the 20thC however is the mounting evidence in support of Neo-Darwinism
and the universal acceptance of the theory by the 20thC. professional biological community. Amongst this community however, are the “descendants” of Huxley, who still wish to use Darwinism with its convincing scientific credentials to promote an agnostic or atheistic world view. Richard Dawkins is perhaps the most outspoken and widely known contemporary exponent. His unquestioned communication skills and excellent description of the scientific picture of evolution hide his confusion of science with metaphysics and his promotion not so much of evolution as science, but of a naturalistic world view. Amongst the professional scientific community are also those who have no problem with holding both a theistic world view and an acceptance of evolution as “theistic evolution”\(^1\). They see evolution and neo Darwinism as the most convincing mechanism to explain God’s activity in nature. Despite this there is still an active anti evolution movement which has emerged in the late 20thC. as the Creation Science Movement. While contending for a creationist world view they see this as inconsistent with any acceptance of scientific evolution. A better understanding of the 19thC debate helps to put this in context. In many respects the issues have been addressed and can helpfully be reviewed if Christianity is not to be considered anti science and obscurantist.

### 2.6 ANTI-EVOLUTION MOVEMENTS IN THE 20TH Century

#### 2.6.1 Fundamentalism and its 20thC History

Conservative Christianity was not only affected in the 19thC by the scientific naturalism debate but also saw the biblical criticism movement as an increasing threat to biblical authority and supernatural Christianity. As indicated above, the reaction to Darwinism was somewhat mixed in the USA, but by the end of the 19thC and until the mid 1920’s it was not a large issue. In any case Darwinism as a mechanism was having its struggles in the scientific realm until the genetic basis for variation and hereditary etc. was determined and later evidence brought about its general acceptance.

The fundamentalist movement was a specifically American phenomenon set up in the first two decades of the 20thC. It was concerned to preserve the essentials, the fundamentals, of orthodox Christianity and numbered among its founders and supporters many of the important conservative theologians of North America including the influential Princeton School. Their concern was to maintain the essential doctrines of the deity of Christ, the Incarnation, the Resurrection and of Biblical Authority in the face of liberal assaults. Special Creation was never a tenet of the early founders. In fact, some of the leaders of the Fundamentalist movement accepted Darwinian evolution as an acceptable method of Creation, e.g. B.B. Warfield, the Princeton theologian, who championed Biblical inerrancy in his theological writing. Even those who had anti-evolution views (and these became more vocal in the 1920’s) accepted an old earth and some form of “Scriptural geology”. Thus although many of the early fundamentalists were unable to accept evolution as a method of creation, few had any difficulty with an old Earth and uniformitarian geology. This remained the case until the strict biblical literalism of the Creation Science Movement appeared in 1961 and came to dominate the anti-evolution agenda (see Berry, 1988).

After the first world war the social, moral and political position in the USA was blamed on the theory of evolution. Now the anti-evolution stance became a mark of the fundamentalist movement and political activism to prevent its propagation was involved. William Jennings Bryan was the high profile leader of this political

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\(^1\) Bishop Antje Jackelen, Lutheran Bishop of Lund in Sweden, in *Theology and Science* Vol 5 (2), July 2007, p. 151, argues against using the term *theistic evolution* and instead encourages the development of a theology of evolution.
movement. Three times presidential candidate and an outspoken fundamentalist, he led the legal battle to prevent the teaching of evolution in schools.

2.6.2 1925 Scopes trial Tennessee

In 1925, the law in Tennessee, as well as in a number of other Southern States, prohibited the teaching of evolution in schools. A challenge was mounted by civil liberties contenders and Scopes, the deliberately offending teacher, was charged and convicted under the anti evolution statutes. However the case was made into a national event with Bryan acting for the prosecution and Clive Darrow, a prominent civil liberties lawyer, for the defence. Although the case was lost, the battle for removal of the restrictive statute was not. Bryan and the anti evolution case was ridiculed and eventually the anti evolution statutes prohibiting the teaching of evolution were removed. There was, however, continued silent pressure for removing offending material from textbooks and sanitizing, as it were, the teaching of biology. Thus while evolution was permitted, it was actively opposed and covertly restricted in a conservative USA.

2.6.3 Popularisation of antievolution in USA

There was considerable support in the USA for a campaign against evolution. This was mounted in the public arena by two self styled scientist preachers, Harry Rimmer who had a considerable fundamentalist following in the 1930’s, and George McCready Price. Rimmer adopted an old earth anti evolution, without a strict biblical literalism as did most of the anti evolutionists of his day. McCready Price on the other hand, resorted to a strict biblical literalism and a flood geology that arose initially from a vision to Ellen White the founder of Seventh Day Adventism, from which tradition Price emerged. He supported his interpretation and his science by a somewhat bizarre geology that returned in part to the diluvialism that had been discarded by the scientific community 100-150 years before. He was not taken seriously by the geological community, but his ‘Creation Science’ has persisted in the Creation Science Movement founded by Henry Morris in the 1960’s.

2.6.4 1957 Sputnik and its effect on US education

The humiliating defeat of the USA by the Soviets in the space race, marked by the successful launch of the first manned satellite, goaded US education into a rethink of science education policy. This resulted in a much more aggressive approach to modern biology in schools. Evolution was now taught actively in schools, with non-sanitized text books instead of the half hearted compromise that had prevailed.

2.6.5 1961, Morris and Whitcomb — The Genesis Flood

A reaction to this action was the publication of a book that was to galvanise the antievolution sentiment in the USA and elsewhere. It was the much reprinted Genesis Flood by two anti evolutionists — Henry Morris, a hydraulics engineer, and John Whitcomb an Old Testament teacher at a small conservative college. They used the young earth flood geology of George McCready Price to present and document a strict literalist interpretation of Genesis and to launch a so called “creation science” to support this interpretation. The movement has been extremely successful in convincing over 40% of the US population of the truth of their views, despite the clear testimony of the professional scientific community. The movement, as early 20thC movements before it, has been active in seeking to establish its position by legal means, calling for the mandatory teaching of Creation Science in schools as an alternative to evolution.
2.6.6 1982 Act Defining Creation Science as religion

Statutes were enacted in several US States mandating the teaching of “Creation Science” along with evolution in state schools. The Arkansas State Act 590 was contested and overturned in a celebrated case in 1982. Creation Science was judged to be a religion and not science and therefore inadmissible in the US Education System for science classes. Legal action in relation to the teaching of evolution in schools continues to be pursued actively in the US Southern states. In 2000 in Kansas laws were enacted to make it non obligatory to examine evolution in biology examinations. Other States are pursuing similar actions. As in the 1990s debates, the issues have been confused. As was evident in the Darwin debate of 100 years ago there was a failure by many of those rightly seeking to maintain a theistic world view to recognize that creationism is not opposed to the scientific theory of natural selection; or of failing to understand that the truth of any scientific theory needs to be decided on criteria that are acceptable on scientific grounds and not on any presupposition based on a biblical interpretation. The conflict between science and religion suggested by the long evolution debate does not represent any intrinsic conflict between science and faith but simply a conflict between differing interpretations of the Genesis record.

A recent historical overview of the situation has been provided by Frame (2009, Chaps 10 & 11).

2.6.7 Intelligent Design (ID)

Frame (2009, Chap. 12) covers the recent development of intelligent design (ID) and the legal ramifications within the USA. The issue came to a head in 2005 in the much publicised court case in Pennsylvania, Kitzmiller et al versus the Dover School District.

The legal action originated in a decision of the School Board to direct Year 9 biology teachers to question the scientific basis of evolution... Teachers were told to explain that ‘the theory [of evolution] is not a fact.....Intelligent design is an explanation of the origin of life that differs from Darwin’s view...’ After a six-week hearing, United States District Court Judge John Jones III ruled in December 2005 that Intelligent Design was a religious concept and that it could not be taught in science classes as an alternative to the theory of evolution. While noting that Darwin’s theory was imperfect, Judge Jones went on to say: “the fact that a scientific theory cannot yet render an explanation on every point should not be used as a pretext to thrust an untestable hypothesis grounded in religion into the school classroom”. (Frame, 2009, p. 201).

In an article in The Melbourne Anglican (Day, Sept. 2005, p. 15), the author explains why ID is flawed scientifically, philosophically and theologically. It is flawed scientifically because it confuses metaphysics (religious belief) with science. It is flawed scientifically because it proposes a ‘secondary cause’ that cannot be tested scientifically. Finally, it is flawed theologically because the god of ID is a ‘god of the gaps’, not the Christian God of the bible or of the creeds. It sells God short – a God who gets smaller with every advance of science.

2.7 THE NEW PHYSICS2

At the end of the 19th century, Newtonian physics with its deterministic universe was the dogma of physics. The created universe was thought to be deterministic and predictable. But quantum physics changes this. The physical world had become relative,

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2 See Chapter 6 for more detailed discussion of the ‘New’ Physics.
an unpredictable, holistic. It marked a "quantum shift" in the way the world of nature could be viewed.

2.7.1 Einstein and Relativity

The speed of light was found to be a constant, not changing with the speed of the light source. From this starting point, Einstein showed that there is no universal time scale. Different observers measure time differently. However, the term "relativity" can mislead, since Einstein's theory is completely deterministic. His later "general relativity" extended these ideas to accelerated bodies, and interpreted gravitation as a distortion of the framework of space and time near massive bodies.

2.7.2 Bohr and Complementarity

Radioactive atoms decay at random times, though the rate of decay is characteristic of the element concerned. While light travels as a wave motion, its interaction with matter happens in discrete amounts called "quanta", whose size depends on the frequency of the light, as e.g. in Einstein's description of the photoelectric effect. Particles of matter also have observed wave properties. Both wave and particle descriptions seem unavoidable. Bohr proposed that wave and particle descriptions are "complementary", each being appropriate in its domain.

2.7.3 Indeterminacy

Since "particles" have wave properties, the position and velocity of a "particle" cannot both be measured with complete precision. If one is measured precisely, then the other cannot be measured at all. Heisenberg's Indeterminacy principle formulates this. However, the usual "Copenhagen interpretation" of these effects follows the "positivist" philosophy in asserting that an electron has no defined velocity unless it has been measured (which it often cannot be). This viewpoint seems to make the existence of the external world depend somehow on an observer. However, this is an interpretation of the observations, and is not compelled by them. The observed randomness seems to contradict any deterministic view of the world. Bohm proposed a deterministic theory, involving particles and "guiding waves", but his approach has not won acceptance.

2.7.4 Quantum Theory

These phenomena have been described mathematically by wave equations (by Schrödinger and Dirac), and "quantum field theory" which gives more emphasis on particle aspects. These apparently disparate theories are mathematically consistent, though a conceptual picture is hard to obtain. It has been truly said that "what the physicist believes is a mathematical formula". But the formulas describe, and predict, observations to an astonishing precision, and not only on an atomic scale. (Devices such as lasers depend on quantum effects.) There are also serious difficulties. A measurement of a quantum effect is supposed to be by a "classical" (Newtonian) apparatus — but why is this not part of the quantum world? Also, quantum theory and general relativity are incompatible, so gravitation does not fit with quantum theory.

2.7.5 Chaos

While computing a model concerning weather prediction, Lorenz found that extremely small changes in initial conditions made a great difference to the result. The computed path moves into a region, called a "strange attractor", whose location is known, but where it is within this region is not predictable, unless the initial conditions are known to an impossible precision. This phenomenon is called "chaos" (not related to "random"), and it has been found in
various models described by nonlinear equations. Even if we live in a deterministic world (and we do not know this), it is a much less predictable world than was previously supposed.

2.7.6 Cosmology

The color of the light from distant galaxies is shifted toward the red end of the spectrum. In the usual interpretation, this "red shift" results from the galaxies moving away; the universe is expanding, so must have begun from a small beginning at some definite past time. This "Big Bang" theory is supported by observations of microwave radiation, by observed abundances of chemical elements, and by theoretical considerations from general relativity. A rival theory of "continuous creation" of matter, with no starting time, does not agree with some of the mentioned observations. There are also difficulties with the "Big Bang". Not all redshifts are easily interpreted by receding motion; the degree of uniformity over great distances is explained by "inflation" of the early universe (but how was it caused?); and the discrepancy between redshift distances and gravitation has led to the postulate that most of the mass of the universe is unobserved (perhaps unobservable) "dark matter". So it may be premature to tie one's philosophy to the Big Bang. Nevertheless in spite of some of the difficulties mentioned above, there is a strong consensus that the age of the universe is 13.7 billion years.

2.7.7 New Natural Theology

Calculations of how various chemical elements may have been made namely those elements necessary for our life and other carbon-based life, show that various details (energy levels in atomic nuclei) had to be set with extreme precision, otherwise these elements (and we) would never have existed. A similar comment applies to other physical details, such as the peculiar properties of water, and the astonishing chemistry of carbon. These facts have suggested various versions of the "anthropic principle", according to which the extraordinary precision of these physical properties was somehow put there to enable life to exist. Of course, this is a "God of the gaps" theory. But it is hard indeed to see how these physical properties might have evolved. However, sceptics have postulated an infinite number of other (unobservable) universes, having different physical constants, and our universe as some sort of random selection.

2.8 NEW AGE RELATIVISM

The end of the 20th century has seen some disillusionment with a scientific world objectively described by science. Many people, though dependent on technology, blame science for many problems of the modern world, especially environmental problems. Many have rejected a scientific world picture, and replaced it by a "new age" relativism. There is no uniformity in these views; however common ingredients are: A world view that is subjective (true for me, maybe not true for you) instead of objective (one truth out there to be found); Mysticism and holistic "alternative science" (often with no great concern for evidence); aspects of Hindu religion (especially belief in reincarnation).

Some of the views held are as follows:

*Monist* - "All is One".
The world and God are regarded as the same.

*Pantheist* - "All is God".
Often there is belief in "Mother Nature", or "green theology". The "Gaia" theory, that the whole biota behaves, in some ways, as a feedback system, may be extended to almost deify the earth.

Author: Allan J Day
Autonomy of human beings.
Individuals are thought to have great potential to help themselves.

Relativism.
It is asserted that there is no absolute truth in science and religion. (This assertion becomes the only absolute truth!) Of course, these various views are in conflict. But "new age" is not a consistent system. There have been attempts (e.g. by Capra and Tipler) to synthesize science and faith into a holistic system drawing on eastern religions and a mistaken understanding of the new physics. Indeed, some post-modern writers have extensively quoted terms from mathematics and physics, but misunderstanding their meanings, so as to produce nonsense!

REFERENCES
Berry, RJ, 1988, God and Evolution, Hodder and Stoughton, London.
Russell, CA, 1985, Cross Currents - Interactions between Science and Faith, IVP, Leicester, Chapters 8, 9, 10.
Chapter 3  GOD’S INTERACTION WITH THE WORLD

Some Metaphysical Considerations

Jonathan D A Clarke & Allan J Day
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3.1 THE WORLD AND GOD

3.1.1 What do we mean by “God”? 
This may seem a strange question in a Christian course, however the word “God” can mean very different things to different people, even among Christians. In the interface between science and theology, even more diverse definitions can be found. Biblical theism encounters pantheism, panentheism, deism, semi deism, atheism, and agnosticism. Unless otherwise stated, we will use the word God to mean the God of Biblical theism, the triune creator and sustainer of the universe who has revealed himself through His works and His word, most clearly in the person and work of Jesus, the Word incarnate.

3.1.2 How does the world work?
The world we see about us could, in principle, work in a number of ways. Different models have been developed by different cultures. Science and magic (not to be confused with the occult) are different ways of answering this question. Science attempts to answer this question by examining the material interactions in the world. Magic seeks to understand by exploring the hidden connections between things. Historically, science has proved effective in understanding the work of the world, whereas magic has failed. Religion, in contrast, deals with personal relationships between the human and the divine.

3.1.3 How does God interact with the world?
The big question at the root of understanding the interrelationship between science and Christian faith is this: how does God interact with the world? Does He work in the world directly, or through secondary causes? Can God only work through one mode, or can He work via several modes? How are we to understand miracles? These notes will outline some possible answers to these issues.

3.2 METAPHYSICS?

3.2.1 Understanding the big issues
Metaphysics is a branch of philosophy that studies the big issues such as ‘what is reality?’

What is knowledge? Is there a God? If so, how does he (or she!) interact with the world? Is there one reality or many? Is there a purpose or goal to everything (or anything)? In the area of the interaction of science and Christian faith there are several important areas.

3.2.2 Attitude to basic reality
What is reality? Is there an actual world “out there” with which we interact, or does it exist only in our consciousness? Naive realism would say “yes”, there is a world out there, and what we sense is how it is. Critical realists would agree on the reality of the external world but would be more cautious about accepting appearances. The earth might look as if it were the centre of the universe, but is it really the centre? Idealists would say we have no way of knowing whether there is an external reality, what matters is our mental states. Science requires critical realism to be effective. Some people have adopted an idealist approach to some scientific questions. The scholastics regarded theories as useful fictions, not necessarily corresponding to the world. Part of Galileo’s problem was that he insisted that Copernicanism was actually true, not a useful fiction. Similarly, some physicists have adopted the same attitude to quantum mechanics. Another important question is whether there is only one reality or several. Monists such as positivists argue that there is only one reality, the material world.
Transcendentalists also argue that there is only one world, the spiritual, and believe that the material world is an illusion. Dualists argue there is both a transcendental and a material reality.

3.2.3 Relationship of God and the world

If the world is indeed real, is that existence independent of or dependent on God? Has God created a world that is capable of independent action, or does God uphold the world? Is God one with the world, wholly or in part or is God transcendent? If God is transcendent, does He interact with the world continuously, occasionally, or only in the beginning?

3.3 WORLD VIEWS

3.3.1 What is a worldview?

A world view is a basic understanding of the world as a whole, how it relates together, not in the details of its operation, but in its metaphysical character. A worldview allows people to live, function, and make sense of what happens to them in their lives.

3.3.2 Examples

There are many examples of worldviews. There are a number of different though closely related worldviews within Christianity. More divergent from Christianity are the worldviews of Judaism and Islam. More distant still are worldviews of the atheist, pantheist, and polytheist. Science is not a worldview, although it arises out of a worldview. If people speak of a “scientific world view” they are either misusing the term or speaking of scientism, where some aspects of science have been elevated to metaphysical significance.

3.4 WORLD PICTURES

3.4.1 What is a world picture?

A world picture is an interpretative framework of some aspect of the world within a larger worldview. For example, quantum mechanics is a world picture, a description of how the world works at a particular level.

3.4.2 We may have several world pictures within one world view

World pictures are not exclusive entities. The quantum physicist will have one world picture for her science and another for her personal relationships. A worldview may be consistent with several different world pictures on the same subject. The Biblical doctrine of creation is consistent with both modern cosmology and the three-decker cosmology of the ancient world.

3.5 NON-MONOTHEISTIC CONCEPTS OF THE WORLD

3.5.1 Supernaturalism

Characteristics

Implies that events in the world are determined entirely by the interaction of supernatural forces. These may be independent entities or embodied in “natural” forces and objects. These entities may be neutral, hostile, or friendly towards each other and humanity.

Examples

Animism and spiritism, common in so-called primal cultures, and widespread through much of Asia and Africa, are good examples of supernaturalism. The spirits are not so much worshipped as feared and placated. Some more mystically inclined “deep ecologists” appear to argue for a return to such beliefs.
Consequences
Science is impossible under such circumstances. Indeed, it is both irrelevant and dangerous. Irrelevant because what matters in the world is not how the material world interacts, but the supernatural agents that inhabit it. Dangerous, because systematic inquiry may offend those spirits. This does not mean that cultures with supernatural worldviews lack empirical knowledge. Many have considerable practical expertise. Any understanding of relationships, however are likely to involve magic, rather than science.

3.5.2 Pantheism

Characteristics
God is nature, nature is God. Pantheists therefore worship nature as God, and see God as a personification of nature. In most cases however, the pantheist’s God is impersonal, not personal.

Examples
The ancient Greek concept of Nature as a divine, eternal, self-sustaining entity was pantheistic, as are some versions of Hinduism. Some “deep ecologists” are also pantheistic.

Consequences
Despite the reverence for the world that pantheism might appear to engender, in reality pantheism generally leads to a utilitarian attitude to the world. Pantheism does not encourage science, although as with supernaturalism, much practical knowledge may be collected. It does encourage a mystical or rationalistic contemplation of the world. Deductive, inductive, and empirical sciences might verge on sacrilege, because by investigating the world you are investigating the divine. However some pantheists, such as Einstein, would appear to approach studying the world with a sense of awe and would see science, at least “pure” science, as something like worship.

3.5.3 Naturalism

Characteristics
Naturalism is the belief that the physical world is all there is. Two kinds of naturalism can be distinguished, metaphysical naturalism, which states that matter is all there is, and pragmatic naturalism, which says that matter is all that matters. Metaphysical naturalism is atheistic, whereas pragmatic naturalism tends more to agnosticism.

Examples
Positivism is a good example of metaphysical naturalism. Pragmatic naturalism can be best illustrated by persons or groups who, while claiming to follow a non-naturalistic system, live and act as though material things were all that were important. Large-scale belief in metaphysical naturalism is historically rare. The most significant example is (or was!) Marxism. Pragmatic naturalism is, unfortunately, much more common.

Consequences
The consequences of naturalism for science are complex. Some scientists (like Richard Dawkins) promote such an approach. Marxist States strongly supported science and believed they were scientific. However no metaphysical naturalist system has survived for long enough to see whether it is a help or a hindrance to science in the long term. Pragmatic naturalism is more likely to see science as a means to an end, rather than worth doing for its own sake. Metaphysical naturalism is commonly confused with methodological naturalism, especially by
the “Intelligent Design” (ID) movement. Methodological naturalism is the
assumption in science that explanations for natural phenomena should first be
sought within the natural world, without automatic appeal to supernatural
causation or other intelligent agents. It does not exclude such agents.

3.5.4 “Scientific” Metaphysics

Physical scientists’ interest

Transcendent laws?
Although long out of fashion, in recent decades some cosmologists have
shown an interest in metaphysical questions. One area is the question
whether or not there are transcendent laws operating in the natural world
which science can discover, or if the scientific “laws” are merely useful
fictions.

Teleology
A second area is the development of the anthropic principle, the possibility
that the physical constants that run the universe appear fine-tuned for the
appearance of life and even intelligence raises the possibility of design.
This is a teleology far more profound than that of Paley. Teleology may
also extend from physics to biology, with the suggestion that organic
evolution is a consequence of those same laws, and that particular
patterns and outcomes in evolution may not be random, but deterministic.
This sort of biological teleology is again very different from that of Paley or
the ID movement.

Eschatology
If the universe has a beginning, possibly fine-tuned, then it may also have
a goal, and even a hope. This is despite the cosmologist’s vision of “freeze
or fry”. Speculations by people such as Tipler and Dyson, that humanity’s
descendants and inheritors might somehow survive the “Omega Point” or
even reverse entropy, take physics beyond the limits of science into
metaphysics.

Examples

Einstein
Albert Einstein was disturbed by the consequences of quantum mechanics
and is said to have once complained “God does not play dice”. “God” to
Einstein was a pantheistic God, at one with the universe. Such a statement
is an expression of what IS, based on what OUGHT, arising from a
particular worldview.

Hawking
Stephen Hawking has written on “The mind of God”. However his God is a
shorthand for the overarching principles that govern physical laws. In so
far as he has any theological concept of God it is a deistic one (see below).

Davies
Paul Davies has gone the furthest in developing explicitly metaphysical
themes in his writings on science. He appears to have moved from
agnosticism to deism as a result of the metaphysical consequences of
cosmology.
3.6 MONOTHEISTIC WORLD VIEWS

3.6.1 Deism

Moving from non-monotheistic to explicitly monotheistic worldviews, the first we should consider is deism. Deism is a degenerate form of Christianity, Judaism, or Islam, that rejects God’s action in the everyday world or on a personal level. Deists thus reject revelation, and, in the case of “Christian” deism, they are also Unitarian. Deists see God as the supreme watchmaker and the universe as a supreme mechanism. God is only active in the beginning and since that first moment of creation has left the world alone. The watch has been made and since then has ticked away by itself. The 18th and 19th century deists saw God as active in creating the world as a whole. However the discovery by geologists and astronomers that creation is an ongoing process over a long period of time invalidated this. Modern deists, such as Davies, would see God in fine-tuning the Big Bang. The world is a closed system and God either does not or cannot act in the world.

3.6.2 Semi-deism

Semi-deism also regards God as the watchmaker. The universe runs independently of God under normal circumstances according to natural laws. However semi-deists also see God as “intervening” in the world from time to time. These events are “supernatural” because they cannot be explained by natural mechanisms, and are miraculous. God is seen to be especially present in miraculous events to a degree He is not present in every day events. One image of God in a semi-deistic worldview is God as mechanic, constantly tinkering and fine-tuning the world, rather like a divine mechanic. Rather less flattering is the picture of God as magician, performing inexplicable wonders. Anything that is inexplicable is likely to be regarded as a sign of God’s direct action. “God of the gaps” thinking is a common outcome of the semi-deistic worldview. Semi-deists will however defend such gaps as long as possible as they are proof to them of God’s activity.

Semi-deists typically regard creation and origins as a miraculous event inexplicable by natural causes. In practice they view creation selectively. Most have no difficulty with the origin of individuals through natural processes. Some, such as Young Earth Creationists, regard the creation of the earth and universe as requiring supernatural activity, while nearly all regard the creation of life and species as supernatural. Why species and life should enjoy a special status that rocks, galaxies, or even individuals do not, is not clear among most Christians regarding God’s interaction with His world. It is also clear that many agnostics and atheists also regard semi-deism as the Christian position. However popularity does not necessarily make this the actual worldview of the Bible.

3.6.3 Theism

What is theism?

The word is variously used in the literature. To some it refers to any belief in any god, singular or plural, as opposed to disbelief, which is atheism. More specifically in our context, it refers to theism in the special sense, which is contrasted to deism and semi deism. Theism here means a worldview in which God is constantly active in the world as creator and sustainer. The distinction between “natural” and “supernatural” events, so important to semi deists, is irrelevant to a theist. God works continuously in the world, whether He does so by natural seeming or supernatural-seeming processes is a secondary issue. A theist need make no a priori assumptions about any act of God being achieved by natural or supernatural means, that difference is something that can be worked out from the evidence.
God as actor—interacting with nature

As with semi deism, several analogies have been developed to illustrate God’s interaction with the world. One is God as playwright. A playwright who also directs the performance creates a story, supervises construction of the stage, and directs the action. The play is truly their creation. In the process the playwright freely interacts with other people—actors, stage mechanics, etc.—to achieve the goal. In Christian theism God is also an actor in the play, through the incarnation, rather as Shakespeare is said to have acted in some of his own plays. Dorothy Sayers has developed this model.

God as artist

A second analogy is God as creative artist or novelist. The artist or author imagines and creates a world, a subcreation, entirely within their imagination. Characters within this world have their own reality but it is dependent completely on the ability of the artist or author to actualise it. This model has been developed by a number of people including Dorothy Sayers and JRR Tolkien.

God as sustainer

A third analogy is the TV Model, most cogently argued by Donald McKay. It describes God’s moment by moment sustaining of the universe by comparing it to a TV. Just as a TV picture is sustained by the signal and current, so the world is sustained by God. The world is separate from God, just as the TV picture is separate from the power station and transmitter, but it is not autonomous. All these images are metaphors, they illustrate some aspect of the theistic worldview. Each is incomplete, and people will differ in the degree to which they find them helpful.

3.6.4 Biblical Theism

Definition

Biblical theism means different things to different people, however there are several consistent threads. The triune God is both creator and sustainer. God is sovereign over all things, not just some things. God can act in the world through both natural and miraculous processes, He is no more or less present in one or the other. This God reveals himself through the book of His words and the book of His works. In the former God has spoken through His prophets but most clearly through His son, Jesus Christ, by whom, and for whom we are being and will be reconciled to God through the cross. Creation has a goal, that is that all things will be under Christ’s lordship in the new heaven and new earth.

Consequences

The main consequence of Biblical theism is Christian faith in which one is constantly moving from individual perception to interaction with God—from the I to the Thou. With respect to science this means that science is not an anthropocentric activity but one where the individual is constantly interacting with God the creator through his works. For the Christian this occurs in parallel with the interaction with God’s word and the individual’s personal faith. For the Christian in science the practice of science must be something that engages the whole person, not just a part isolated from the rest of him or her.

3.7 GOD’S INTERACTION WITH THE WORLD

3.7.1 Theistic world view/scientific world picture

The worldview of Biblical theism has several consequences for the scientific world picture. It affects what we think about the nature of causality and about the laws of nature.
3.7.2 Causality

First causes

God is the first cause of the universe as creator, the first cause that introduces novelty into the world, and the first cause of the sustaining of the world. God is the agent that makes these events possible.

Secondary causes – Mechanism

God may choose to achieve these events “directly” or supernaturally, or through the secondary causes, what we might call natural processes. How we distinguish between the two is not as easy as might appear, as the following section will discuss. Therefore it is best to acknowledge that God is creator and sustainer of and in all things, regardless of whatever mechanisms may or may not be identified for that action.

3.7.3 Laws of nature

Prescriptive?

People often speak of the “laws of nature” as if they actually existed. However what we have are rather particular descriptions of how the natural world works. If they are well supported they are called laws. However as scientific theories are in constant flux it is epistemologically dangerous to regard these as fixed prescriptive laws in an absolute sense, no matter how well attested we may think they are. If we think there are such prescriptive laws (however well we may or may not understand them) then as theists we must regard them as God ordained. The question then remains: can God over ride them as He chooses, or is He bound by them? If we say that God is bound by those laws we are potentially limiting God in the same ways as the deists did.

Descriptive?

Alternatively, we can regard the “laws of nature” as just descriptions of the way the world normally works. Because all things are enacted by God the sovereign creator and sustainer, the “laws of nature” are simply descriptions of the way that God normally works. They are not prescriptive in any way, any more than a regularity in the work of a novelist or painter prescribes him or her to always work in that style.

3.8 MIRACLES

What is a miracle?

Miraculous events occur sporadically through the Bible. They play a key part at specific times in the history of God – the Exodus (see Humphreys 2003)\(^1\) and the conquest of Canaan, the ministry of Elijah and Elisha, the life of Jesus and the early apostolic ministry. Many events in the lives of many Christians through history have also been described as miraculous. Miracles mean different things to different people. To some they are events which have no explanation. To others, such as the philosopher, David Hume, they are events clearly contrary to natural laws. Some regard “miracle” as a synonym for “magic”.

Problems with these definitions

Each of these definitions has its problems. If a miracle is an inexplicable event and this event is explained by some future scientific discovery, then “miracle” is only an excuse for our ignorance. If we define them as events contrary to natural

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\(^1\) Professor Colin Humphreys, Goldsmith’s Professor of Materials Science at Cambridge University, shows that there are scientific explanations for the plagues and he also provides a carefully argued case for the Exodus occurring at near the top of the Gulf of Aqaba and for the location of the true Mt. Sinai in Arabia.
law then we may rule miracles out a priori if we believe that natural laws prescribe all that can happen. It is also a position of some arrogance in that it assumes that the natural laws that we understand are the final story. If “miracle” is equated with the “magical” then any significance of the miracle beyond the curious may be lost in credulity.

3.8.1 Biblical Miracles

Definition

The Bible defines miracles somewhat differently to most people. In the Bible miracles are “signs” of God’s presence, care and salvation. They can also be signs that point to or illustrate a particular aspect or characteristic of God or lesson about Him. Miracles are “mighty acts” by which God preserves and saves His people. They are “wonders”, events that excite awe and worship of God.

Examples

There are a great many Biblical miracles of many different types. A list of well-known examples might include the arrival of Rebecca at the well, destruction of Sodom and Gomorrah, the crossing of the Red Sea (see Humphreys 2003), Elisha’s floating axe, the healing miracles, and the resurrection of Jesus.

Characteristics

Each share the common features in that they were significant actions by God in either the lives of the people concerned or the history of God’s people. In other ways they were very divergent. The arrival of Rebecca at the well in answer to Abraham’s servant’s prayer was “fortuitous”. There was nothing unusual in it except for the fact it occurred in answer to his prayer—and paved the way for the marriage of Isaac, and the continuation of the Abrahamic line. The Crossing of the Red Sea was a mighty act of God, but one that the Bible attributes to a “natural cause” an east wind that blew all night. This event has been successfully modelled for the northern end of the Gulf of Suez with a northeasterly wind of about 70 kmph blowing for 12 hours. However Professor Colin Humphreys (2003) locates the Exodus crossing near the top of the Gulf of Aqaba.

For the Biblical writers the explicable of the miracle did not diminish its significance as an act of God. No explanation is given for the destruction of the cities of the plain except fire and brimstone raining from heaven. However natural explanations can be conceived—volcanic eruptions, meteorite impact, explosion of venting natural gas, and so forth.

The healing miracles do not necessarily involve anything beyond what might occur naturally. What is miraculous about them is their timing and speed. Some miracles seem beyond explanation, Elisha’s floating axe head is one. Others involve something very special, the appearance of transcendent realities within the confines of the natural world. The resurrection of Jesus is the supreme example of this. The key thing to note is that while miracles differ in significance, their significance is not related to whether the event was fortuitous, explicable or inexplicable.

3.8.2 Miracles—Approach

Miracles in the context of Biblical theism

With the Biblical understanding of miracle as sign, wonder and mighty act we can then develop a context to understand miracles within Biblical theism. The approach includes principles to remember, traps to avoid, and questions to ask.
Principles to remember

Principles to remember are the fact that God is sovereign in and over all events. God is as present in miracles as He is in everyday events. What makes a miracle a miracle is its significance.

Traps to avoid

The second important thing to remember is to avoid particular traps. These include thinking that miracles can only be events that are inexplicable. Another trap is the reverse, thinking that explicable events are not and cannot be miracles. A third trap to avoid is thinking that particular modes of divine action, such as creation are miraculous and are inherently inexplicable. This is to use "miraculous" in Hume's sense, not in the Biblical sense.

What is the meaning and purpose of the miracle?

Because a miracle is defined by its significance in the history of God’s people, it is always important to consider the miracle and purpose of the miracle. This will keep us focused on the Biblical understanding of a miracle and its significance at the time and to us.

What is the cause?

Considering the cause of a particular miracle is therefore not particularly useful in most cases. However we should always be aware that the particular causation is not what defines a miracle. Therefore Christians should not be alarmed if it becomes possible for a particular miracle—such as the virgin birth—to be explicable by natural causes. All that has been discovered is the way in which God achieved that miracle.

Miracles today?

If God is constantly at work in His creation then there is no reason for Christians not to pray or to expect miracles to happen. However we should also be aware that miracles do appear concentrated into particular epochs of history, so they may not be the norm. However if we do pray for miracles we should also be aware that they might come in forms unlooked for. A miraculous deliverance from drowning may be in the form of a rescue helicopter, not just angels descending from above.

3.9 Some questions for discussion

- How can we tell when an unwarranted metaphysical conclusion is being made from science?
- What is so special about the species that many Christians insist on miraculous origins for them when they do not insist on miraculous creation of rocks and galaxies or individuals?
- How might a semi deist and a theist differ in their attitude to prayer?
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Chapter 4  RATIONAL INQUIRY

Science and Theology and their Limitations

Allan J Day
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4.1 **INTRODUCTION - SCIENCE**

4.1.1 *Perceptions*

The success of science over the last 400 years speaks for itself. It has come to dominate 20thC life, having spread from its origin in Western Christendom. The nature of science however is frequently misunderstood. *There are two extreme views.*

- **Science as objective, reliable knowledge**
  
  There is an emphasis on its objectivity. Science is seen as giving reliable factual information. This perception conveys the essence of Modernism – Triumphalism. Often science is seen as the whole of reality, the only route to reliable knowledge. This becomes the problem of deification.

- **As a subjective construct, a personal subjective view of the physical world.**

  In the late 20th Century, there has been a reaction against science. It is seen as producing many or most of the problems of civilisation: pollution, population explosion, global warming. There is the problem of its denigration and relegation to being one of many views about the natural world. There is an emphasis on its subjectivity. Science is seen as one of many relative views of the world. This is the essence of Post-Modernism.

4.1.2 *Need for some balance*

Neither of the above views, deifying or demonising science, are true. It is neither a panacea for our society ills, nor a culprit to be blamed for them. It is neither the source of all knowledge, nor the holy grail of certainty and objective truth. Unfortunately many scientists who are engaged in science do not have a clear idea of the philosophy of science, of how it works. Many fail to recognise the nature and limitations of science; or that objective and subjective elements are both important in its practice. We need to look therefore at what science is and how it works and to explore a little of the philosophy of science.

*Consider three Questions*

- **What is science and scientific knowledge?**
- **How do we obtain scientific knowledge?** What do scientists do?
- **What are the limitations of science?**

  The problem that arises is, does science explain anything, let alone everything?

4.2 **WHAT IS SCIENCE AND SCIENTIFIC KNOWLEDGE?**

4.2.1 *Definitions*

Science is knowledge that is limited by the object of its study and by the methods of that study. It might be defined as what scientists do as scientists, not as private persons. That is, a knowledge of the world obtained by scientific methods.

**Object of scientific study**

Science is knowledge *about the physical world.* There are other aspects of reality— God, aesthetic knowledge, morals etc.—which are beyond the scope of science.

**Domain of science**

Science is knowledge *derived in a particular way*— by the scientific method. It is knowledge expressed in a precise, coherent, detailed form. Science is
concerned with the **properties, mechanisms and formative history** of the physical world. There are other ways however of obtaining information about the world. Thus science is not **all** knowledge. For example, a Turner seascape is a perfectly valid view of the world. In scientific terms it is pigmented paint on canvas. It is not knowledge expressed in **everyday** language. e.g. "To love with all your heart" is a true but unscientific statement.

**Rational empiricism**

This term may be considered a general description of science. Some other terms for consideration, empiricism, perception, reality, realism, idealism, all need defining.

**Critical realism**

Critical realism perhaps best describes science which is a critical and rational approach to the way things really are. It is not truth, but a way of knowing truth.

**There are two aspects: Observation and experiment**

There is a real world to be observed—Realism cf. Idealism. Science is one way of knowing about this reality, by empiricism, perception. Science is thus not reality, but a way of knowing about reality

**Rational interpretation**

Science is concerned with the interpretation of data, thus there is a subjective element. It is not “what is”, but an interpretation of what is. Judgments are involved. It builds a model, an approximation of the truth. Thus science is “rational empiricism”, critical realism.

### 4.3 HISTORY OF SCIENCE

There are two threads of influence on modern science. See Chapter 1 for a more detailed consideration of these aspects.

#### 4.3.1 Greek rationalism

The role of reason or naturalism. This considers the world as self existent, self governing. Therefore knowledge about it can be derived by reason alone.

#### 4.3.2 Western “Modern Science”

This is a 16th and 17th Century development. The methodology of science—rational empiricism, observation and experiment—developed, in a climate of Christian thought, out of the Renaissance and Reformation It was significantly influenced by a Judeo-Christian understanding of creation. The world is separate, dependent and good. Thus Nature is perceived as ordered (therefore determinable) as well as contingent (not necessary). Therefore it must be observed to determine its nature. It is temporal, not divine and therefore it is open to investigation. Man has dominion as God’s steward, therefore science is an outworking of theology (Ps.111:2, Ps.8). Thus humanity has a mandate for exploring nature. The world is good not evil, therefore we can associate with it. 17thC scientists, as exemplified by the Charter of the Royal Society, saw it as their Christian duty to investigate God’s creation, “to think God’s thoughts after Him”.

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4.4 NATURE OF SCIENCE

4.4.1 Reductionist in methodology
It is concerned with measuring, systematising, reducing to laws; i.e. science has an analytical approach, to determine order. Basic science therefore is reductionist and mathematical.

4.4.2 Reliable
Its claims are checked and errors corrected. It is public knowledge capable of inter-subject verification.

4.4.3 Selective
Regarding the objects studied
Science is limited to what can be measured or observed. Thus beauty and morals for example are not part of scientific knowledge.

Regarding the way they are studied
Concerned with physical properties, behaviour, formative history. It is not concerned with origins, purpose, governance, but rather with mechanisms. For example, a gemstone. Science considers its composition, not its beauty. Regarding humanity, science considers its physiology, not its relationships or morality.

4.4.4 Communicable
General, objective (therefore it can be repeated). Library information is available for all. Today we would add the internet.

4.4.5 Dynamic
Builds on the past. This is always growing, an approximation of the truth, never complete.

4.4.6 Creative—“Eurekaism”
There is an element of accident, of intuition, in science and of personal input.

4.4.7 Metaphysical presuppositions
Science is based on non provable assumptions about its subject, the natural world. Presuppositions about order, that Nature is ordered not random. Science explores that order.

Intelligibility
That we can understand, comprehend nature.

Rationality
That Nature can be reduced to laws, equations etc.

Uniformity
That the same laws apply everywhere. e.g. gravity.

Worthwhileness of science.

4.5 METHODS OF SCIENCE
How do we obtain scientific knowledge? What do scientists do?
4.5.1 False impressions

False impressions exist re the dynamic nature of science. “Science gives the facts.” This is reinforced by the constraints of secondary and tertiary teaching. Textbooks and notes are required that give the “facts”. Some textbooks give a summary of present facts not a basis for consideration. e.g. Ganong as a textbook of Physiology. Post Graduate research dispels this illusion. There is of course an important objective element.

4.5.2 Scientific method

Objective elements, facts and interpretation—Induction

Baconian induction consists of observation, collection of experimental facts and the formation of a “Hypothesis” based on “the facts”.

Induction, hypothesis, deduction, confirmation

A further development is the combination of induction from experimental and observed facts and deduction from principles so determined. Theories are then conceived as objective explanations, verified by further experiment. However induction is not a firm basis for logical proof, nor can theories be absolutely verified. Not all facts can be collected so logically. Some may emerge that do not verify the conclusion.

4.5.3 What are scientific theories?

Some common misconceptions must be dispelled. Scientific theories are not established fact, but neither are they pure speculation. Theories are models to explain the data, not established facts. They make sense of the data. They are continually being modified however. It is part of the nature of science. They are not pictures of reality but interpretations of reality. They might be described as maps of the way things are. They need to be updated as does a map, but even if incomplete can be useful guides. They may also be influenced by subjective factors.

4.5.4 How can we prove a theory?

Verification principle?

It is virtually impossible to logically prove a scientific theory. We can never exclude the possibility of non consistent data. e.g. That all swans are black? Newton’s theory of gravitation was strongly supported by observations, yet some later observations contradicted it, and Einstein’s theory was required. Note that this new theory included the old theory, as still applicable in many, but not all circumstances. Popper suggested that a scientific theory must be capable of falsification, i.e. that although theories can not be proven they can be falsified and if that possibility does not exist, then the “theory” is not scientific. This principle although helpful is not without problem as a single criterion. (How much evidence is needed to falsify a theory?)

What is a measure of a good theory?

There is no single criterion. The following factors however are considered. Consistency with the data; explanatory value (ability to explain the way things are); coherence, unifying value; and falsifiability, Popper’s concept of the value of risky theories, i.e those readily falsifiable are worth noting. Predictive value. Simplicity—Occam’s Razor. Fertility, ability to generate experiment. Beauty. These together give a picture of the best explanation of the way things are.
4.5.5 Scientific Method—Subjective Elements

There are however considerable subjective elements to scientific method.

**Personal Knowledge - Polanyi**
All knowledge is obtained by observer or instrument observation. The importance of interpretation, bias, intellectual climate, i.e. the subjective overlay must therefore be considered. In any investigation there is a need for selectivity of facts from experiments. Thus what is observed is always selective; again a subjective input.

**Science is always a community activity**
Apprenticeship, the role of groups, the presence of criticism is always present. This implies competence, integrity and judgment. But it also often ensures the continuation of accepted paradigms within a society that may inhibit consideration of certain data.

**Science is theory driven**
Thus no new worker comes to science with a clean sheet. They are faced with the established wisdom, the current theory. Can it be supported, modified or rejected? "What are the questions being asked?" These are prominent approaches to science. Not simply a collection of objective data and a postulated theory to explain them. This is a caricature of science in action.

4.5.6 Paradigm shifts – Kuhn

Kuhn has brought a new approach to scientific understanding with his concept of science proceeding by paradigm shifts. Intuitive as well as objective knowledge is important. The “eureka” principle. Creativity, flashes of genius. Progress often occurs in giant steps: e.g. Einstein's relativity, antibiotics, structure of DNA. Most scientists however are concerned with refining the current paradigm, not with a shift. This therefore may inhibit new revolutionary shifts. However the past is always important. New insights: data cause a revision not a replacement of the past picture. This represents the dynamic nature of science. Thus science is not just “the facts of science”, “the truth”, but has a significant subjective "interpretative element” and such interpretations are being continually reviewed in the light of the data and through critical evaluation by the scientific community. However while science is influenced by the subjective overlay, it is not *determined* by the observer. Science is not just a construct unrelated to the way things are.

4.5.7 Thus one can conclude that science is “motivated belief” not "objective truth”.

There are however good “grounds” for such belief. It is the explanation of the way things are in nature. "Critical Realism" i.e. it is possible to know the truth about the ways things are by science. Science certainly works as the last 400 years testifies. *However let us be aware of its limitations.* It is the search for truth, never absolute truth, and then only the search for “scientific truth”, not the search for the whole of truth. We need a bit of humility in the pursuit of science.

4.6 **LIMITATIONS OF SCIENCE**

4.6.1 **Limited in its domain**

It is knowledge derived in a particular way, not all knowledge. But science is not limited in its scope within this domain. A “God of the Gaps” is rightly excluded by scientific advance. Such an explanation is an inappropriate response to scientific ignorance. The proper response to gaps in *scientific* knowledge is not to postulate
a divine explanation, but as Coulson has indicated to do more and better science. Scientific history is littered with examples where this would have been excellent advice e.g. life, DNA, development of species, evolution, creation, big bang. There is a sense in which there is no place for God in scientific explanation. Cf. Laplace’s comment to Napoleon.

4.6.2 **Scientific knowledge is not the only sort of knowledge**

It is not a substitute for religious knowledge. There are areas of truth that are beyond the methodology of science. We cannot “measure” morality, good or evil. Science has no moral insights. Science can say nothing about relationship, knowing a person, or beauty, or appreciating a sunset or landscape or a painting. These involve aesthetic or moral knowledge.

4.6.3 **Science only asks particular sorts of questions**

Questions about mechanisms, not meaning. Of how, not why. e.g. oxygen usage in exercise, SOS messages or a kettle boiling may have a scientific explanation or a non scientific one. Some questions may be more relevant in different circumstances. How do I come to be here? As a scientific question the appropriate answer is evolution i.e. a process, a mechanism. Why am I here on the other hand is a theological question and the answer is related to God and purpose.

4.6.4 **Science describes truth, does not prescribe it**

Laws are descriptions, not forces, not deterministic. Thus evolution is not a force but the description of a process or mechanism. Science doesn’t determine what happens in nature, just describes it. Methodological reductionism is intrinsic to science, but ontological reductionism is a metaphysical entity. Theories and laws may need modification as more information emerges.

4.6.5 **Science is concerned with secondary causes not primary causes.**

Science describes an object fully at one level, but has nothing to say about ultimate or primary causes; e.g. a house may be describable in terms of the primary cause (architect/design) or of the building materials. Or a cake in terms of the cook, or the ingredients and the cooking process. To describe the processes, do not exclude the cook.

4.6.6 **There are different levels of explanation even within science**

Physics, chemistry, biology, psychology, sociology and theology all give different, but not conflicting views of humanity. This can be illustrated in many areas. e.g. A house can be explained in terms of bricks and mortar, and of a builder and architect. Steam from a kettle may be explained in terms of physics or because we wish to have tea or make a protest against some restriction. Thus “nothing buttery” is not a logically valid position. It is simply not true that we are “nothing but atoms and molecules”. (See Mackay, 1988; Holder, 1993.)

4.7 **THEOLOGY AND ITS LIMITATIONS**

4.7.1 **Introduction**

**Theology**

In today’s world science is dominant and popular, while theology seems to be receding and unpopular. Again there are some stereotypes, some perceptions that need to be redressed.
Perceptions

That theology is concerned with the immaterial, the irrational, myth. Therefore, it is maintained, there are no rational or objective grounds for religious belief. Therefore its study is an anachronism. This view is often promoted by popular scientific writers such as Dawkins, whose response to the development of the Starbridge lectureship at Cambridge is expressed in his letter to the Independent "What has theology ever said that is the smallest use to anybody...?" (quoted in Holder, 1993, pp. 15-16). The Oxford response was the creation of the Chair in the Public Understanding of Science, financed by Microsoft, provided it was given to Dawkins.

Outdated, superseded

Part of a medieval world, where explanation was in terms of magic and myth.

Not supported by evidence

Dawkins observes that "Science shares with religion the claim that it answers the deep questions about origins, the nature of life, and the cosmos. But there the resemblance ends. Scientific beliefs are supported by evidence. And they get results. Myths and faiths are not and do not". (Dawkins, 1995, p. 33)

Doesn’t ask meaningful questions

It is interesting to see this aspect developed by Dawkins in his response to the Duke of Edinburgh in the meetings arranged by the Duke to discuss science.

None of these contentions are true but they represent a discarding of theological knowledge by many as being non knowledge. As such they are of course an example of logical positivism.

Consider three questions

What is theology and is it a legitimate approach in today’s world?

How does it work? Methods?

What are its limitations?

Theology must interact with contemporary culture. Compare the pursuit of Theology with that of science.

4.7.2 What is theology and theological knowledge?

Definition - Rational pursuit of the knowledge about God

Object of theology is God

Thus knowledge of God and his relationship with the physical universe i.e. with nature, humanity etc. Presupposes a reality beyond the physical world, and that God can be known by theological method. Our experience of God therefore is not just a construct of our minds but is a picture of reality—the way things actually are.

Theology is a human activity

However the subject matter of theology, unlike that of science, transcends us, therefore we are dealing with mystery, transcendent realities.

God can only be known as He reveals himself

It might be argued that theology must have revelation as well as reason as its source of information.

Revelation
God’s revelation to us, i.e. God taking the initiative, communicating with us. God reveals himself basically in two ways by:

- **General Revelation**
- **Special Revelation**
  In Scripture cf. 2 Tim. 3:16, 2 Peter 1:20, 21. Such revelation is neither irrational nor illogical, unless one presupposes “there is no god”. Thus like science (and atheism) theology has its presuppositions.

### 4.7.3 Presuppositions

There is a God, Heb. 1:1, Gen. 1:1. He reveals Himself (in Christ).

Atheist presuppositions are no more rational, nor provable.

History indicates the interaction with culture and a variety of world views, which is part and parcel of the practice of theology. See Chapter 1 for a fuller development of this theme.

### 4.7.4 Plato

Created the concept of a divide between the real spiritual world of images and the world of matter.

### 4.7.5 Aristotel, Aquinas

Thomas Aquinas sought to amalgamate Aristotelian philosophy with Christian theology in his 13th C. synthesis. Such an approach was useful, but it needed to be reviewed as theology came to grips with the modern world. In the Thomist synthesis, scientific and theological explanations were integrated. There was an interdependence of natural philosophy and theology. Causation was associated with the efficient cause, the primary cause. Essentially primary and secondary causes were part of a total unity.

### 4.7.6 Renaissance

The renaissance saw a divorce of scientific explanation and theological explanation. Francis Bacon introduced the concept of the Two Books, the Book of the World (Nature) and the Book of the Word (Scripture). Thus there was generated an independence for science which blossomed in the Enlightenment and in the development of a secular science. This left apparently no role for theology.

### 4.7.7 19th Century - Theology in crisis

Schleiermacher, and Kant sought to provide a subjective, existential role for theology, concerned primarily with morality and experience. Thus there arose a divorce of science from theology. A divorce from Dogma to become Pietism. A divorce from Natural theology to become Experience

### 4.7.8 19th and 20th Centuries

In the 19th and 20th Centuries we see some inappropriate relationships developing, with science apparently conflicting with theology or seen as being pursued entirely in isolation from it. The issues of geology, of Darwinian evolution and of Freud’s psychology etc. see theology often inadequately coping with a secular scientific world view. Is there a place for “supernaturalism”, miracles, prayer etc.?
4.8 NATURE OF THEOLOGY

We need to ask therefore what is the role for theology. It might be suggested that it asks "Why", "Who" questions, questions of purpose and of ultimate control. Questions such as "Who am I?", "Why am I here?" These are essentially questions about basic reality, of hope, of life and death and their significance, of morality in relation to nature. These are more overarching questions.

Questions about God, Humanity and the world.

It is concerned with the transcendent, aspects beyond physical reality, questions about origins and governance. We are not self existent or self governing. These are not scientific questions but are nevertheless meaningful. They may however interact with current science and its implications.

4.8.1 How does theology work?

Who are the theologians?

Theology is an activity for all, not just an academic discipline, i.e. to engage in the pursuit of the implications of contemporary culture for our understanding of God etc.

Theological method

Theological knowledge may be obtained by using reason to lead to faith as in Aquinas, by examining the data, forming models and testing the explanatory power of these models. In some respects it is not unlike the bottom up thinking of science. There are important differences however. The sources of data are somewhat different, but there is nevertheless an objective element.

4.8.2 Natural theology

Nature forms the basis of information about God—the God of nature. The argument from design, the teleological argument is of this sort. As is the argument from causation, the cosmological argument. The arrival at an understanding about God, about faith is part of the Aquinas system. Reason then leads to faith. It has clear limitations as a proof of God however. Natural theology has been given a new exposure in the late 20thC with the New Natural Theology. Evidences from physics and cosmology have suggested to many a theistic explanation as the most appropriate explanation of the laws of nature. Davies, for example, has written extensively about this aspect as have others. The Anthropic principle or Goldilocks effect will be discussed later. One must be aware however of the limitations of natural theology, both as a proof of God and as a means of discovering a personal God.

4.8.3 Scripture

Both the Old Testament in its record of the words and activity of God in relation to Israel, and the New Testament with the record of the gospels, bring content to theology. We are not dealing with credulity or blind faith. There is a basis for theological knowledge.

4.8.4 Experience

This may be the personal experience of individuals in their encounter with God or the community experience of the church, of tradition.

4.8.5 Theological “theories”

Theology of necessity must have its models, its symbols. Models and metaphors are necessary to describe God: as Trinity, as a person, as a father. All of these
are an attempt to make sense of the data. These models may need to change with time. There are thus many analogies with science. Reason is also important to interpret the data and translate it to our own cultural background.

### 4.8.6 Verifying the "theory"

In verifying the truth or otherwise of a theological theory we need to consider all the data from nature, scripture, experience, and determine its coherency. Does it make sense? Is it consistent with the data, with the way things are? Thus with theology as with science, epistemology mirrors ontology. Experience, whether scientific or theological, must make sense of the picture and indicate the way things are. Thus one can conclude that theology is “motivated belief” not just "subjective perception". It has three aspects—presuppositions, content, belief.

### 4.9 WHAT ARE THE LIMITATIONS OF THEOLOGY?

#### 4.9.1 Limited human understanding

We are finite and sinful. Theology is a human exercise. Therefore humility in pursuing theology is appropriate. This is indicated in two areas particularly. In interpretation, e.g. the interpretation of Genesis; and in natural theology, as science is not the way to God.

#### 4.9.2 Limited domain

Theology is not the appropriate source of scientific knowledge and cannot replace the scientific knowledge of nature. God is not a *God of the Gaps*.

### 4.10 CONCLUSIONS

Theology and science have many similarities in their methodology. Science is not just objective truth and theology a subjective construct. There are presuppositions, content, and a belief system in both. However their subject matter differs. There is a need to recognise the limitations of both. Both ask meaningful questions and provide valid, if incomplete answers, in their respective domains, contributing to our total view of reality.
4.11 REFERENCES

MacKay, D, 1988, The Open Mind and other Essays, IVP, Leicester.
Van Til et al., 1990, Portraits of Creation, Eerdmans, Grand Rapids, Chapter 5.
Van Til et al. 1988, Science Held Hostage, Eerdmans, Grand Rapids, Chapters 1,2 and 4.
Chapter 5  WAYS OF RELATING SCIENCE AND FAITH

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5.1 **INTRODUCTION — MODELS**


1. **CONFLICT** — Scientism, Creationism
2. **SEPARATION**
3. **COMPLEMENTARY** — Dialogue, Consonance
4. **INTEGRATION** — Assimilation
5. **REJECTION** — New Age

5.2 **CONFLICT**

In this model it is suggested that *science and faith provide alternative explanations* to origins and therefore that they are in competition with each other. Thus we must reject either faith or science.

5.2.1 **Perceptions**

This is the common perception in the community, in schools and in many parts of the church — that science and Christian belief are at loggerheads. It is the view that is commonly portrayed in the media either implicitly or explicitly, that any supernatural view of origins is outdated. Science is then seen as superseding faith. This leads to a polarisation of views. Thus it is maintained that one cannot be a scientist and a Christian, one cannot believe the bible and accept the modern scientific findings about cosmology, biology and psychology. Jayne’s (16yrs) response e.g. is typical of the view of many secondary students today, *"Genesis says the world was made by God, but we know it was made by the Big Bang".*

It might be repeated and reversed or applied to other related areas. *"The bible tells us that humans were made by God, therefore evolution cannot be true."* Thus the position of conflict is reinforced. These perceptions are fueled from two contemporary sources, both of which formally espouse the conflict view, Scientific naturalism or “Scientism” and Biblical literalism.

5.2.2 "**Creation Science” — History of the conflict**

*What is the genesis of this perception and is it true?*¹

Much is based on a false reading of history.

Galileo? The conflict was about the centrality of the sun, not a science-faith conflict.

Darwin? The conflict was about a static cosmos and the struggle for cultural supremacy in 19th C. England, not a science-faith conflict.

White’s *History of the Warfare* and Draper’s *History of the Conflict*, both now discredited, did much to promote the conflict view. Historical revision has addressed this aspect. Biographical data also fails to support the conflict view. Many scientists are Christian.

In the 17th C, the rise of modern science was influenced and driven by men with a positive Christian faith, men such as Bacon, Boyle, Newton and Kepler, as well as many others prominent as founding fathers of science. In the 19th C, the response to

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¹ See Chapters 1-3.
Darwinism was mixed, with many prominent Christians, such as Gray, Wright and Warfield being supportive. The conservative theological response was to accept Darwinism with some reservations. In the 20thC, many contemporary scientists are committed Christians. Therefore we can reject the conclusion of a historical conflict although the historical interaction has often been complex. Let us look at the contemporary picture, the heritage of the 19thC polarisation and of its misconceptions about science and faith. (See Russell, 1985, 1989; Moore, 1995; Livingston, 1987, Berry, 1981).

5.2.3 Scientific Naturalism, Reductionism, Scientism

Scientific Fundamentalism argues for the priority of science as the saviour of society, as the only valid source of information. It is claimed that everything is explained by science. Religion is therefore redundant, outmoded, unnecessary.

Publicists

Dawkins, Crick, Atkins, Sagan — all well known scientists, but also aggressive atheists using science to support their “belief system”. Richard Dawkins in The Blind Watchmaker (p 147) states that

*The basic idea of The Blind Watchmaker is that we don’t need to postulate a designer in order to understand life, or anything else in the universe.*

In the River out of Eden (p. 37), Dawkins indicates that “science shares with religion the claim that it answers the deep questions about origins, the nature of life, and the cosmos. But there the resemblance ends. Scientific beliefs are supported by evidence. And they get results. Myths and faiths are not and do not.”

Peter Atkins in The Creation (1981) (pp. vii-viii) states,

*My aim is to argue that the universe can come into existence without intervention, and that there is no need to invoke the idea of a Supreme Being in one of its numerous manifestations.*

Description

There are a number of descriptive terms

Scientism

Makes three claims:-

1. **That God is unnecessary**
   
   It considers that God is an alternative explanation to science and is now no longer necessary. It has a mistaken view of God as a “God of the Gaps”. **This is an inadequate view of God.** “To the theist God is the cause of everything but the explanation of nothing.”

2. **That God is incredible**
   

3. **That God is objectionable**
   
   The supernatural is seen as an unacceptable replacement for the natural—but the natural is also the work of God. These are all conclusions of scientism. Science itself cannot draw these conclusions. They are outside its domain, beyond its limits. Science in this approach has become a world view—a way of looking at the world—the spectacles by which we view all
of reality— a philosophy or a belief system. The assertion that science does away with God etc. therefore depends on the presupposition that science is all there is - on assumptions regarding the validity of a particular philosophical position. Scientism leads to Reductionism, “Nothing Buttery” etc.

**Logical Positivism**

That science provides a complete explanation of the world. There is nothing beyond scientific knowledge. Nothing is real if it can not be observed by the methods of “objective” science. Bertrand Russell defines Logical Positivism as follows, “Whatever knowledge is attainable, must be attained by scientific methods; and what science cannot discover, mankind cannot know”. Science is considered the only valid pathway to truth, therefore other sources of truth are excluded. Non scientific knowledge is non knowledge. Beauty, morality, religion are not admissible. Scientific explanations are therefore the only valid explanations. Metaphysics is excluded, only physics (science) matters.

**Reductionism**

Implies that everything is explained by science. Reality - the way things are- can be reduced to scientific knowledge. We must distinguish between Methodological Reductionism - which is integral to scientific investigation, and Ontological Reductionism - which is not science but philosophy.

“Nothing buttery”

The proposition that I am nothing but atoms and molecules. Cf. ink on the page with the message. The former does not exclude the latter.

**Evaluation of Logical Positivism, Reductionism, Scientism.**

Scientists must be careful to stick to science and not make naive philosophical statements in the name of science. There are many ways of obtaining valid knowledge. Some lie outside the domain of the scientific method. To deny the validity of non scientific information is to deny aesthetic, moral, religious knowledge, or personal private knowledge. Examples abound.

In viewing a painting, aesthetic knowledge may be more relevant than scientific. In personal relationships - personal knowledge is more relevant than scientific. Hummel gives a useful analogy of ways that a landscape might be viewed by different people, by Beethoven, Einstein, Constable, or King David. An SOS may be viewed by its physical properties or by its message.

**Scientific questions are not the only sort of questions.**

How and Why questions are also valid and important.

**Examples**

The sight of a kettle boiling may give rise to many answers to “why?”. There are different causes for the one event. Four different causes need to be recognised. They are the agent, constituents, mechanism and purpose. Science is concerned with the constituents and mechanisms only, not the ultimate cause or agent or the purpose. My three grandchildren gave three explanations to a question about the rain. Why is it raining? One suggested a scientific answer, the clouds etc., the second suggested the agent, God, and the third the purpose, to water the plants. All were correct. They were not alternative but rather complementary answers. Science answers scientific questions but not all questions. Theology answers theological questions not scientific questions.
Scientific explanations and theological explanations are not alternatives.

This is to imply God is a possible "mechanism". Cf. Atkins who considers the theological answer is one of "The Lazy Creator", the soft option.


"1. Genesis says the world was made by God, but 2, we know it was made by the Big Bang."

Statement 1 is true or false on theological grounds. Statement 2 is true or false on scientific grounds. The two statements are not alternatives. We can believe both to be true without conflict. They answer different questions. There are different causes, and different methods are needed to answer these questions. (See Hummell, 1986).

Scientists have always been among the first to recognize this view. Sir Peter Medawar, a Nobel laureate for his work in immunology, has stated the situation clearly.

"There is no quicker way for a scientist to bring discredit upon himself and upon his profession than roundly to declare - particularly when no declaration of any kind is called for - that science knows or soon will know the answers to all questions worth asking, and that questions that do not admit a scientific answer are in some way non-questions or 'pseudo-questions' that only simpletons ask and only the gullible profess to be able to answer." (Medawar P, 1984, The Limits of Science, OUP)

5.2.4 Biblical literalism (Creationism)

Considers the Bible to be the source of scientific information about origins. Presents a particular biblical interpretation of origins as a basis for a scientific understanding of creation and rejects the views of contemporary scientists. Thus creation science starts from a biblical presupposition. We must decide whether it represents authentic Christianity and/or authentic science.

5.2.5 History of Biblical interpretation of Genesis in the past

Augustine of Hippo and the Church Fathers

Augustine recognised the problem of the 4th day and the second account of Genesis and considered Gen 1-3 to be non-literal or allegorical.

Galileo and the Church

Recognised the problem of heliocentrism and maintained that the Scripture does not teach science.

Geology and the age of the earth

Archbishop Ussher’s date of creation (4004 BC) was discarded with the development of modern geology and information about the age of the earth.

Concordance and the Scriptural geologists

In the 19thC many Christians sought to fit the geological account to the bible account. The two most prominent concordant theories were the Gap theory and the Day age theory. Others sought to fit science to the bible by suggesting the special creation of a ready made cosmos that fitted the scientific findings e.g. Adam’s being created with a navel and trees with annual rings denoting age.

Darwinism and special creation

Darwinism was not consistent with the creation of individual species as suggested by a literal reading of Genesis 1. Despite this history there are those who still maintain the scientific accuracy of Scripture with respect to creation.
**Fundamentalism and its 20thC history (See Chapter 3.)**

Most of the early anti evolution campaigners accepted an old earth and some form of “Scriptural geology”. However some of the leaders of the Fundamentalist movement accepted Darwinian evolution, e.g. Warfield. Espousal of scientific inerrancy, and a strict biblical literalism, however, have characterised the development of the Creation Science Movement in the later part of the 20thC. It has been marked by the legal struggle to prevent the teaching of evolution in schools.

**1925 Scopes trial in Tennessee**

This saw the ultimate reversal of the statutes prohibiting the teaching of evolution in schools.

**1957 Sputnik and its effect on US education**

It promoted a more active pro evolution stance in biology teaching.

**1961 Morris and Whitcomb: The Genesis Flood**

Associated with the development of the “Creation Science Movement” and the call for equal time for evolution and creation science teaching in schools.

**5.2.6 Creationism: Creation Science**

The following definition was given by the “Creation Science” movement to the Arkansas court in connection with the case for consideration of equal time with evolution in school curricula in 1981 (Creation Science 1981 Arkansas legislation Act 590).

"Creation-science" means the scientific evidences for creation and inferences from those scientific evidences. Creation-science includes the scientific evidences and related inferences that indicate: (1) Sudden creation of the universe, energy, and life from nothing; (2) The insufficiency of mutation and natural selection in bringing about development of all living kinds from a single organism; (3) Changes only within fixed limits of originally created kinds of plants and animals; (4) Separate ancestry for man and apes; (5) Explanation of the earth's geology by catastrophism, including the occurrence of a worldwide flood; and (6) A relatively recent inception of the earth and living kinds.”

The application for equal time was rejected on the grounds that Creation Science was a religion, not science. It is not authentic science. A US Supreme Court resolved that an "injunction will be entered permanently prohibiting enforcement of Act 590. It is ordered this January 5, 1982”.

In 2000, the Kansas Act, which precludes mandatory assessment of evolution in biology examinations, was rejected.

**Description**

Creation Science (Whitcomb and Morris, The Genesis Flood, 1961) has resurrected some of the outdated theories of science, abandoned by the professional scientific community, some 150-200 years ago. They involve a special role for catastrophism and the role of a universal flood. The ideas originated in a vision to the prophetess of Seventh Day Adventism, Ellen White, and are promulgated by the geology of McCready Price. They provide “pseudo scientific” support for a literal interpretation of Genesis and aggressively promote this position as Christian orthodoxy. Creation Science has proved a highly successful publicity exercise (particularly in North America). Proponents do not form a part of the accepted professional scientific community, do not engage in serious scientific research nor debate the issues on the basis of established
scientific method. The approach is rather polemic and publicist, actively, and successfully campaigning, to promote a particular interpretation of Genesis and to introduce legal constraints on the education system.

**Content**

Accepts that the findings of modern conventional science conflict with a literal interpretation of Genesis, and therefore present an “alternative science” - “creation science”, widely judged to be non-authentic science. See Chapter 4. Nature of Science.

There are two main aspects.

*Young Earth Creationism*

Maintains that creation occurred less than 10,000 years ago in 6 x 24 hr days corresponding to the six days of Gen 1. i.e. adheres to a young earth - contrary to the findings of current cosmology.

*Flood Geology*

Geological and paleontological findings are explained by a universal flood. i.e. contrary to the findings of modern geology. Their position is based on a particular literal interpretation of Genesis, that gives little attention to genre or to the contemporary ANE culture. The “findings” of creation science are required to fit this presupposition. Science thus becomes not an unqualified search for truth, but rather a “folk science” with an interpretative axe to grind. This often leads to a lack of integrity and intellectual honesty which brings legitimate criticism from the scientific fraternity.

*Creation Science*

Confuses biblical interpretation with biblical authority, the science of origins with the doctrine of creation, secondary causes and first causes, evolution and evolutionism.

*It has the following misconceptions about science and faith:*-

- That the bible is a scientific textbook whereas it presents eternal truths in the language of the contemporary culture, cosmology. The genre needs to be considered.
- That the doctrine of creation is about “How” rather than “Why”.
- That creation is only about beginnings, not about sustenance.
- That the pursuit of science in relation to origins has been usurped by secular scientists (Plimer, I, 1994, Telling Lies for God - Reason vs. Creationism, Random House).
- That God’s actions are not manifested in the natural (in biological evolution and Big Bang cosmology) but only in the supernatural.

**Evaluation**

It must be asserted that the Bible speaks of ultimate causes, not immediate (scientific) causes. Therefore there is no conflict. Different questions are being raised. It must be recognised that there are many possible interpretations of the creation accounts. One particular literal account cannot be made a mark of orthodoxy or a basis for (pseudo) science. Proper interpretation on the basis of good exegetic principles taking into account the genre, purpose and context of the passage is an appropriate approach to the meaning of a passage. When this is done there is no need to assert that the bible is in conflict with modern scientific findings regarding the age of the earth or the origin of humanity. They address different questions.
Both Scientism and Creationism perpetuate the myth that science and faith are in conflict.

5.3 SEPARATION, INDEPENDENCE, CONTRAST

In this model the differences in approach, method and language between the scientific and theological search for truth are emphasised. It seeks to build walls between Science and Faith. It claims that Science and Faith provide different answers to the same questions.

5.3.1 Different methods

Science is empirical and experimental, dealing with objective data. It is repeatable and predictable. Theology is concerned with personal experience and revelation. It is subjective. It has nothing to say in the scientific realm. Both approaches however are considered valid approaches to truth. But it is maintained that they give a different picture of reality. Not one in conflict but a different view.

5.3.2 Different languages

Science deals with concrete entities whereas theology speaks in the language of metaphor.

5.3.3 Different domains

Science investigates nature and the finite, whereas theology investigates God, the spiritual realm and the infinite. These contrasts reflect the separation of science and theology in the 19th century, and reflect to some degree the antagonism to the introduction of critical studies of the biblical documents. They also reflect the neo-orthodoxy of Barth and Bultmann. However while it is important to recognise the differences between the two approaches, it is also necessary to concede that the above is too rigid. Theology is after all “The Queen of the Sciences” - reasoned belief - the search for truth. Its methods and language have important parallels to science.

On the other hand, in the 20th Century, science is now understood to be much less objective in its methods, language and even content (see Chapter 4). Truth is unitary- not fragmented. There is not a separate truth about nature and another unrelated truth about God. Both form a complete and integrated view of reality. As Augustine observes, ”The search for truth is the search for God - for God is truth”. Science explores the truth about nature- the creation of the universe by God”. Theology explores the truth about God - the God of creation. One cannot divorce the two.

5.4 COMPLEMENTARITY, DIALOGUE, CONSONANCE

In this model Science and Faith are seen to present complementary answers to the same questions. They are seen to be in dialogue. There is seen to be one truth, common truth, but there are two faces of this truth. There are two Books: that of the World, and of the Word, as suggested by Francis Bacon. General revelation is explored by science, the truth about nature. Special revelation is explored in Scripture and experience, the truth about God. These represent complementary views. They must be in dialogue, interact with each other and complement each other. There are many interacting facets and boundary questions.

5.4.1 Boundary questions

Theology undergirds science. In many ways one cannot separate science and faith.
Theology provides the presuppositions of science. Those of order, of contingency. It also provides purpose - the teleological dimension.

On the other hand scientific investigation raises non scientific questions that are important, but outside the domain of science to address. These include metaphysical questions e.g. the strong anthropic principle, the source of the laws of physics. Thus science describes but does not explain, whereas theology is needed to give meaning to science and to the world it describes. They also include ethical questions such as the use made of science. The source of values used in science comes from outside science. For example, ecological, bioethical questions such as are raised by genetic engineering.

5.4.2 Similarities in methodology

This has already been addressed in Chapter 4.

Science is “motivated belief”.

It is based on presuppositions that are not provable. It has content that arises from observation and experiment. It develops models that best explain the “way things are” - interpretations of science - theories. Science is thus not just objective facts, but governed by presuppositions and beliefs.

Theology is “motivated belief”.

It also is based on presuppositions that are not provable. It also has content that arises from scripture, tradition and experience i.e. there are rational “grounds for faith”. It also develops models and beliefs that best explain the “way things are”. Theology is not irrational, myth, or blind faith but based on content. Theology is not fixed, but open, exploring by reason the “facts about God”. Thus the two approaches can best make sense of the way things are. Science needs theology and theology needs science to make sense of the world. Polkinghorne develops these concepts well in his books.

5.5 INTEGRATION (ASSIMILATION)

Seeks to interrelate science and faith in such a way that science modifies faith and may be seen to assimilate it. This attempts to develop not just a new natural theology but a Theology of Nature, a Doctrine of Creation in the light of modern science. This aspect is perhaps beyond the scope of this book.

There are two dimensions:

Exploring what nature reveals about God

Awe, Wonder, Meaning. Science and its questions. Theology gives meaning to nature.

Effect of contemporary science on theology

There are many contemporary issues such as quantum uncertainty or indeterminism (see discussion in chapter 2) and chaos theory (see also chapter 2) that raise questions regarding God’s action in the world.

5.5.1 Is there a new natural theology?

Science is evolutionary, time related, open, non-determinist. What does this imply for our understanding of God, humanity and nature? This leads on to a consideration of process theology and panentheism - God as open, self limiting, immanent, at one with nature, and the world is envisaged as God’s body. Humanity is seen as a unity with nature, oneness with God. The world is seen in ecological oneness, having an eschatological destiny. These problems need exploring, but threaten an understanding of orthodoxy as revealed in Scripture.
The following issues need addressing.

- **God as changeable.** Limited, developing - process theology. But what about transcendence and the sovereignty of God?
- **Humanity - as part of creation.** What about the image of God and humanity as the pinnacle of creation?
- **The world as organism.** Is there a return to naturalism, even pantheism?

### 5.6 REJECTION — NEW AGE CONSIDERATIONS

Post modernism rejects both science and faith - substituting a pseudo-science and a pseudo-faith. There are two aspects:-

**Alternative science**

Relativism, subjectivism, science as one of many views. Rejects an ordered world, determined and exploriable by science and verifiable by science. Substitutes a magic, mystic, medieval world.

**Alternative faith**

Rejects a theistic creation and a monotheistic understanding of nature. Substitutes a monistic view - pantheism, naturalism e.g. Gaia and ecology, Nature as an organism.

### 5.7 CONCLUSIONS - SCIENCE AND THEOLOGY ARE COMPLEMENTARY

The conflict picture is inadequate both historically and philosophically. Science informs while theology raises “why” questions. Reductionism does not account for everything. Brings input into Scriptural interpretation. See the section on Complementarity. Raises implications for our understanding of God and humanity. How autonomous is the physical world? How autonomous are we?

Theology expands, science explains. Science alone does not consider purpose. Scientific discoveries raise ethical questions regarding how the knowledge should be used but does not answer them.
5.8 REFERENCES

Bube, R, 1995, Putting it All Together- Seven Patterns for relating Science and the Christian Faith, University Press of America, Lanham.
Peters, T, 1996, Theology and Science, Where Are We?, Zygon 31(2).
Polkinghorne, JC, Multiple works as listed in Introduction
Chapter 6  COSMOLOGY, CREATION AND THE BIBLICAL RECORD

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6.1 INTRODUCTION

During the past two centuries, physics has been extraordinarily successful. As an emerging discipline in its own right it was well established by the end of the 19th Century, known very often in those days as Natural Philosophy. During that time physics has underpinned much of modern technology including electricity, the steam engine, the internal combustion engine, electronics, automation, computers and modern information systems. Physics is the primary scientific discipline, it depends on the use of mathematics as both a tool and a language and it remains the fundamental science directed to understanding the processes of nature. Physics makes particular use of symmetry principles which are essential and provide an economy of logic.

Much of what will be said about 20th Century physics can be found in Quarks, Chaos and Christianity by Polkinghorne (1994), in other books by Polkinghorne and several of the other titles listed in the references. Polkinghorne has articulated two very important principles:- First he notes the amazing fruitfulness of the world both cosmologically and biologically. Then he states (Polkinghorne, 1994, p.43)

the 'evolving world is to be understood theologically as a world allowed by the Creator to make itself to a large degree'.

That is, creation is a continuous process and we do not live in a clockwork universe. Secondly, he reminds us that there are different categories of statements and we should differentiate between e.g. theological and scientific statements.

For the moment it will suffice to realise that physics provides a consistent understanding of the physical processes that occurred in the early universe and up to the present time. We understand that the age of the universe is about 13.7 billion years. We have a good picture of the conditions required for the production of hydrogen, helium and lithium and the formation of the rest of the 92 elements, the subsequent evolution of galaxies, stars, supernovae etc., and the formation of our own solar system and similar entities elsewhere in the universe. The question for Christians in particular is what impact should this new understanding of our world that has come from physics have on our theology of Creation? We shall need to heed Polkinghorne’s warning that science and theology use different categories.

6.2 BIBLICAL DOCTRINE OF CREATION

"I Believe in God the Father Almighty, Creator of Heaven and Earth” from the Apostles Creed was originally prepared as a statement against Gnosticism. In Polkinghorne’s Gifford Lectures, published as Science and Christian Belief, each chapter is based on a statement from the Creed.

6.2.1 Aspects

Creation Originans

The understanding of creation as the beginning of space and time. Such an understanding has been a basic understanding of theology. Augustine perceived the cosmos to be created not so much in time but with time. Before creation, only God existed. The 20th century has seen a remarkable change in the scientific level of understanding of the creation of the universe based on new understandings in physics. This has called into question the literal interpretation of Genesis and how God acts in the world – then and now. It is necessary to move well away from the notion of the watchmaker God (Deism) who wound up the clock and left it to run by itself. Thoughtful Christians would not hold that view today. As scientific knowledge has developed those who have sought to deny the existence of God have found in scientific arguments a reason for their position. We shall argue in this chapter that the existence of God is not dependent on how much we know about the world.
Creation Ex Nihilo - Creation out of nothing

We can still affirm creation by the will of a transcendent God. The theological and biblical concept is of creation ex nihilo: God bringing into being, that which had no being. The notion of ‘ex nihilo’ creation has been a hard doctrine to grasp for those who can only understand something as being made out of something that already exists. Before creation only God existed. It leads inevitably to the question who made God as if he were of the same substance as our universe, and ourselves. We shall see that the origin of the universe at a singularity in space-time does not require any prior matter.

Creation Continua - General Providence, Sustenance

God’s immanence leads to a theology of providence which holds that God is involved in the universe always and at all times. We are not able to say how that occurs.

6.2.2 Genesis input

Gen 1:1

The fundamental presupposition of the Bible is of creation ‘ex nihilo’, out of nothing but not out of chaos, although the basic motif of Gen. 1 is of God bringing order out of chaos. The beginning statement of Genesis is the primary faith statement regarding our attitude to God as Creator.

Genesis 1:1-2:4a

Two accounts are given, the first in Gen. 1:1-2:4a. The six day framework paints a picture of creation by command. “God spoke and it was done.” Those of us who adopt the modern cosmology see the Genesis 1 account as a literary device establishing the nature of God and of his creation. It is set in the context of Ancient Near East (ANE) cosmology, but should not be seen as a scientific account, nor the days as six actual 24-hour days.

Genesis 2,3

The second creation account is set in a much more narrative and anthropomorphic style. Fundamentally, Genesis chapters 2 & 3 emphasise the relationship between God and humanity. In particular, Gen. 2: 7 indicates the special relationship between us and the universe – we are made from the same stuff as the rest of the universe, in fact from the remnants of burnt-out stars.

6.2.3 Not just in Genesis

The role of God as creator is a recurrent theme throughout both Old and New Testaments and provides us with a picture of the nature of God as an object for worship rather than as a “mechanism” for creation. Scripture texts referring to creation have no explanatory power in the sense of modern science and have a different on-going purpose, to call us to worship.

Psalms

Psalms 8:3-8; 19; 104:10-14, 24-29, 147:8-9, 148:5-6. Many of the Psalms express the wonder of the created order. It is a response of gratitude to the God to whom all is attributed. It is the language of faith and of worship. God’s actions in both creation and sustenance (making the grass to grow etc.) are affirmed.

Wisdom

Job 9:5-12; Job 38:39-40; Proverbs 8 and Ecclesiastes 12. Passages from the Wisdom Literature of the Bible affirm the role of God as Creator. It is to God as creator and sustainer that Job is referred in his problems.
Prophets
Amos 5:8, Isaiah 42:5-9, 66:22. Again God as creator forms an important emphasis. It is the God of creation that is the God of Israel, to whom they are responsible.

New Testament
The prologue to John’s Gospel (John 1), the great statement of Colossians 1:15 and the quote from Paul’s Areopagus sermon in Acts 17:24 stand as the great New Testament statements that affirm God (as Trinity) as Creator (and sustainer).

6.2.4 Theological affirmations
The doctrine of Creation is summarised in a number of affirmations, none of which refer to the way in which the cosmos originated, or the scientific mechanisms of cosmology. John Thompson (2007) comments regarding Genesis 1-3,

“That whatever one’s view of the literary nature of these chapters reasonable agreement could be reached as to what were the basic assumptions which find expression here. One man may affirm that these chapters should be read quite literally denying all use of metaphorical or symbolic language. Another may affirm that the chapters are in the style of poetry, being full of symbolic language, figures of speech and artificially constructed literary forms. But whatever view is adopted in regard to the literary nature of the chapters, the definition of the central affirmations should be approximately the same, for they represent beliefs about the nature of God of man and of the world”.

These affirmations may be listed as under:-

Creation is separate from God
All that is created is not God, that which is not created is God. This is clear from Genesis 1.1 and throughout Scripture. The Biblical writers avoid the trap of pantheism. (See Chapter 3.)

Creation is contingent, dependent on God
The biblical writers all agree that creation depends on God. God is the only “necessary” being i.e. one not dependent on anything else. Creation is dependent on God for both its origination and its continuance, for its order and its beauty.

Creation is good
Our experience affirms the statements following each day in Genesis 1 ‘and God saw that it was good’. When we see a beautiful scene, a beautiful sunrise or sunset or in the scientific lab when one realises the intrinsic beauty of an atom or a molecule, we are affirming that it is good. Nevertheless we shall have to contend with why not everything is perfect: some are born with genetic disorders, there is evil operating in the world, and the fall from which humanity (if not the whole creation) needed to be redeemed.

Therefore there can be:-

No polytheism
That is a multitude of gods. Christianity, Judaism and Islam are all monotheistic religions. Christianity goes further as trinitarian with the Trinity as a model of how the Christian church has tried to grapple with the nature of God given the revelation in Christ and the role and work of the Holy Spirit.
No monism, pantheism
That God is identical to the universe, the universe and God being one, or the universe being divine or god.

No dualism re good/evil
That is the presence of two distinct principles of good and evil, with a struggle for supremacy. None of these theological affirmations (of monotheistic creation) are at odds with modern science. Indeed many of them form the basis of modern science (see Chapter 1). Other concepts of God associated with Eastern religions or with supernaturalism, associated as they are with either a circular and eternal universe or a disordered, unpredictable universe, are much more at variance with a scientific world picture. (See Chapter 3).

6.2.5 Misconceptions
Several misconceptions which lead to difficulty in the science faith debate need to be laid to rest.

Genesis 1-3 is not history
The early chapters of Genesis are not history in the modern sense. In Gen. 1-11, the so-called Genesis Prologue, we are dealing with what has variously been called “myth”, “saga”, “protohistory”. Genesis 1 and the second creation account in Chapter 2 are not historical or literal statements. They remain valid for us today at the start of the 21st century precisely because they are the story of the universe, expressed in a non literal form.

Genesis 1-3 is not science
These stories are set in the ancient near-east in the context of a three-decker universe. The cosmology implied appears quaint to us at the beginning of the 21st century. Yet as modern people we have no difficulty relating to it and seeing our own response in awe at the creation as we experience it or to realise that Genesis 3 describes the journey all of us have taken.

Genesis 1-3 is, rather, a theological statement about the nature of God.
The primary purpose of the Genesis accounts of creation (Chapters 1 & 2) is to attribute all we see around us, the whole universe, as being due to the will of God. It addresses the relationship between human beings and God and the world.

6.2.6 Importance
The importance of creation lies in its being foundational to Christian doctrine. Genesis 1 & 2 establish God as Creator and Sustainer of the Universe. This is the Christian God. We also find the universe to be a fundamentally good place and we depend on its functioning for our survival. For example we depend on weather and successful growth of crops somewhere in the world, otherwise we'd not survive. Creation and science are integrally bound together.

A basis for Christian worship
We have already referred to the place of the Psalms, in particular those that affirm the origin of our world, in worship. In many respects Gen. 1 might be considered a hymn of praise to the God of Israel who creates effortlessly by a word. Israel were not primarily interested in the scientific details of origins, but rather who their God was —“The Creator of heaven and earth” — not just some tribal deity.
6.3 SCIENTIFIC PICTURE OF ORIGINS

6.3.1 Developments in physics up to 1900

The 19th century physicists held a deterministic view going back at least to Newton; and the equations they discovered appeared to support that idea. However, the elegant developments of thermodynamics and statistical mechanics by Boltzmann and Gibbs left open issues that ultimately required the ideas of quantum physics and the results of statistical outcomes. Newton’s great contributions of the 17th century remained paramount in mechanics and astronomy. The world seemed to be well ordered.

Towards the end of the 19th century, physics appeared to have reached its zenith. It was rounded off through Maxwell’s equations of electromagnetism and the prediction that there should be electromagnetic radiation. There was a great deal of optimism that physics was more or less complete. The prevailing view was of a deterministic universe and there was nothing in the physics of the day to suggest otherwise. That changed dramatically in 1900 with Planck’s quantum hypothesis which successfully tidied up outstanding problems with electromagnetic radiation.

The 19th century heralded many discoveries in physics as the new knowledge that was going to do away with the need for God. Something like this happened in response to Darwinism. As a re-run of the same tape, many herald the developments in genetics and molecular biology as being able to do just that. Paul Davies, not a Christian, acknowledges that there are still a lot of scientists who are Christians — and that surprises and continues to embarrass him.

6.3.2 Nature of physical laws

Physical laws are descriptions of physical events, defined after usually much painstaking data gathering. They are not what make things happen! The underlying mathematical form in which the ‘laws’ are expressed leads people like Paul Davies to speculate about what lies behind them. God?

6.3.3 The revolution in 20th century physics

The turning points were Planck’s quantum radiation theory in 1900 and Einstein’s famous paper on Special Relativity in 1905. These have changed the way we think about the world far more dramatically than could have been imagined 100 years ago. The linking of space-time and the fact that observers in different frames of reference would view the same events differently marked the most significant paradigm shift in human thought since Newton, notwithstanding Darwin’s contributions to biology. It has not stopped there in the 20th century and while physics may have been more recently overshadowed by developments in biology, the level of understanding of our world and of cosmology is remarkable and one of the great developments in human history. Quantum mechanics not only changed our view of atoms, molecules and solids, but continues to raise important metaphysical questions about the role of indeterminacy (or chance) in individual events, and the limits to the measurement process itself. In our day we are very aware of the rise of clever and accessible technology. The notebook computer on which this chapter was prepared is, in some sense, a miracle and yet even now we are apt to take it for granted. The modern PC and notebook computer required a basic understanding of quantum mechanics and solid state physics and a few Nobel Prizes along the way.

Modern physics from Newton to the present day depends on mathematical equations to clothe its ideas. There is a relatively small but finite number of basic equations that define the whole of physics and by means of which we produce the cosmology of the Big Bang. These are Newton’s law of gravitation (17th century), Maxwell’s equations of electromagnetism (19th century), Einstein’s equations of...
special and general relativity, the Schrödinger equation in quantum mechanics and the equations of quantum field theories, all of which belong to the 20th century. Are these equations invented or discovered? We don’t know but what we do know is that they form the most consistently tested theoretical basis of anything known in human history. The reliability of the mathematical description is quite remarkable and there is the ring of truth about them! Paul Davies is quick to acknowledge that fact. Davies also comments, as have others such as Dirac, on their intrinsic beauty. Thus there is an important aesthetic quality about the mathematical statements of physics that has sometimes been used as a guide to theoretical physicists.

6.3.4 The rise of quantum mechanics

Planck’s radiation theory - the birth of quantum physics (1900)

The birth of quantum physics was Planck’s theory of electromagnetic radiation. Planck introduced the idea of quanta of energy – whether visible light, gamma rays or radio waves or any part of the electromagnetic spectrum – which solved the dilemmas of the previous century. Even though quantum physics went through two further phases of development viz. the Bohr model of the hydrogen atom (1912-3) and the independent discoveries by Heisenberg and Schrödinger of quantum mechanics in 1925, Planck’s theory remains correct today. It is still used to measure the temperatures of the surfaces of stars, to determine the microwave background from the remnant of the Big Bang and to work out the properties of solar collectors!

Quantum mechanics

Quantum mechanics is based on the idea of a wave function to describe the way e.g. an electron is spread out in its orbit about the nucleus of an atom. The quantum mechanical picture of the physics at the atomic and molecular scale is very accurate. Theory and experiment have been tested to great precision. It turns out that at its heart, in quantum mechanics there is an intrinsic level of uncertainty (or indeterminacy), and this has opened up the debate about chance and determinism. It is Heisenberg’s famous uncertainty principle that limits our knowledge of systems at the scale of atoms or smaller. While measurements of individual events lead to a scatter of data, on average one always gets the same answer. An example is the emission of light by atoms of, say, hydrogen. The spectral lines (‘colours’) are always the same whenever one makes the measurements but we cannot predict where the light from a particular atom will sit on the particular spectral curve. A battle raged between Bohr (and his Copenhagen School) and Max Born in Germany about how to interpret the wave function of quantum mechanics. Matter has a wavelike character at some times and at other times a particle-like nature. It depends on what experiment one is doing. In the end it was Max Born who recognised that quantum mechanics deals in probabilities. Nonetheless, we still recognise the need to hold the wave and particle pictures in tension. The majority of physicists find there is no conflict. In electron diffraction, important in probing the structures of solids, the electrons must be thought of as waves. In an electron accelerator in high energy physics, the particle picture is what is needed.

Heisenberg indeterminacy

The uncertainty principle leads to the insight that the very making of observations influences the outcome. The most familiar statement is that it is impossible to know where an electron is and at the same time to know how fast it is moving. The point is that measurements always use photons of electromagnetic energy (which might be X-rays, visible light or microwaves) and they interact with the very object one is measuring. Thus quantum mechanics spells the end of the deterministic universe.
The four forces in Nature and ultimate structure

An alternative way to summarise physics is through the four different forces in nature which imply the finite number of equations referred to earlier. They are:

- **Gravity** which holds up to astronomical distances. It is believed to operate through particles called gravitons which have not yet been detected.

- **The electromagnetic force**: that force which holds atoms together. The force between electric charges is mediated by photons, which are the quanta of electromagnetic radiation (including light). This is the force that holds atoms together and underpins chemistry and biology.

- **The weak nuclear force** which gives rise to radioactivity. Under the conditions in the early universe after the Big Bang, the weak nuclear force and the electromagnetic force were first of all the same but later became distinct through what is called symmetry breaking.

- **The strong nuclear force** which acts on trios of quarks to form protons and neutrons. It should hold together neutrinos! This force is mediated by elementary particles called gluons!

6.3.5 Einstein’s Special and General Relativity

**Special Relativity**

Einstein’s Special Relativity (1905) is based on two assumptions: the speed of light is constant for all observers, and, the laws of physics are the same to observers moving at a constant speed relative to one another. This led to the ideas of length contraction and time dilation. That is, an observer seeing a moving object pass at a constant speed measures a characteristic reduction in its length (Fitzgerald contraction) and says that the clock in the moving frame runs slow (time dilation). The latter leads to the Twin Paradox. If one twin stays on earth and the other twin travels for 20 years in a space ship at a constant speed relative to the earth, when he returns, he will be younger! Is this true? About 20 years ago, two Boeing 707’s equipped with atomic clocks (with an accuracy of 1 part in about 1 billion) flew around the earth in opposite directions. The differences in the time recorded by the atomic clocks on both aircraft based on their relative speeds fitted Einstein’s equation exactly! The decay of cosmic rays entering the earth also confirms this time dilation! For objects travelling close to the speed of light, things look very different to someone observing from say the earth. Thus we must abandon the distinction between our three space coordinates and add time as a fourth dimension. Thus we speak of space-time. In Special Relativity, gravity enters as in Newtonian or classical physics – the force between point objects (or spheres) varies as one divided by the square of the distance between them.

**General Relativity**

In General Relativity (1916), gravity leads to the curvature of spacetime. It is a very different perspective. This means that a beam of light passing near a massive object such as a star, is bent. Light travels in straight lines but if the space is itself warped, then the light can be shown to have been deflected. This has been observed for light from objects in space. It is also used in what is known as gravitational lensing, used to observe very distant objects which lie behind massive objects such as black holes. Of course if the light gets too close to a black hole it will be sucked in and disappear! General relativity calculations are accurate to 1 in 10^{14} (limited by the accuracy of earth clocks). General relativity predicts the occurrence of black holes under some circumstances and in its original form predicts the expansion of the universe from a Big Bang. We shall consider cosmology later.
The Search for a Theory of Everything

The search for a Grand Unified Theory (GUT) or Theory of Everything (TOE) is part of the quest undertaken by people like Stephen Hawking and others. Thus far it has only proved possible to unify the electromagnetic force and the weak nuclear force, relevant in the early universe. Steven Weinberg, in a lecture to the American Physical Society Centenary Meeting in Atlanta (March 1999) spoke of a further unification that includes the strong nuclear force. However, without a quantum theory of gravitation, which does not yet exist, it will not be possible to achieve a GUT. Hawking believes that if a GUT is achieved, there will be no need for God for we will know the ‘mind of God’.

6.3.6 Chaos theory – a complete surprise!

There is a new class of phenomena discovered only recently. Even in ‘classical physics’ there are some processes for which the equations lead to two different outcomes. This surprising result occurs within ‘deterministic’ classical physics! An example often quoted concerns the butterfly in Gabon that flutters its wings leading to changed weather patterns over Asia! Different initial (or starting conditions) lead to different outcomes.

6.3.7 Cosmology - origin of the universe

Harvard astronomer Edwin Hubble showed in 1929 that the galaxies are all moving away from each other and he was able for the first time to address the immensity of the universe. There are known to be more than 100 billion galaxies, each of which contains perhaps 100 billion main sequence stars like our sun. The clear implication is that there was a beginning, now called the ‘Big Bang’ and that since then space has been expanding. His observations were based on the redshift of the light received from galaxies which confirms they are moving away from us. Cf. Steady State Theory.

Einstein’s Theory of General Relativity was shown early on to lead to an expanding universe and one, therefore, with a beginning. This did not appeal to Einstein who added to the equations of General Relativity what he called the cosmological constant in order to stop the expansion. Fred Hoyle and others after WWII until the mid-60’s pushed a Steady State model of the universe – without beginning and without end, in spite of the generally held view of the Big Bang and an expanding universe. Recently Hoyle, Geoffrey Burbidge (an astronomer) and Hoyle’s erstwhile student, J V Narlikar (back in Pakistan) have tried to revive their theory. The reason for this is that the idea of a beginning is awkward if you are an atheist!

Evidence for Big Bang - Hubble red shift

Light observed from distant galaxies is red shifted. This means the characteristic spectral lines (or colours if they occur as visible light) have smaller wavelengths than in the laboratory. This correlates with the speeds with which they are moving away from us. Hubble introduced a famous constant, the Hubble Constant whose value is not known precisely. If you divide the Hubble Constant into 1, you get the age of the universe. Since the universe is expanding, an observer on earth would say clocks ought to run more slowly in distant galaxies. Supernova explosions have proved helpful in this regard.

Big Bang cosmology—nature of the cosmos

Several features of the universe can be derived from big bang cosmology. They can be summarised. The universe is

- **Very large** - 100 billion galaxies, 100 billion stars in each
- **Very old** - 15 billion years
Temporal - Finite - Time and space both begin at the initial singularity.

Standard cosmology - an expanding universe

The universe began at a singularity, a point of infinite density. Originally there was no space, time or matter! Hawking and Penrose suggested in the 1960’s that there was probably a definite origin of the universe. This required the existence of black holes to provide sufficient mass to account for the rate of expansion of the universe. Their ideas were in contrast to the steady state models of Hoyle, Bondi and others popular at the time. The universe had a simple beginning: it was hot, there was a soup of fundamental particles which have strange names — quarks, leptons, gauge bosons (gluons, W/Z bosons and photons). Before $10^{-11}$ seconds (one hundred billionth of a second) had elapsed, the energy density in the hot particle soup (thermal plasma) was greater than the density of matter. As the universe expanded it cooled. The next level was the development of microstructure: quarks were confined and formed neutrons and protons after $t \sim 10^{-5}$ secs (one hundred thousandth of a second) had elapsed. There was further formation of neutrons and protons, some nuclear fusion of protons to give deuterium, the two forms of helium($^4$He, $^3$He) and lithium from about 1/100 of a second to 200 secs. Atoms were formed somewhat later at about $10^{13}$ secs (3000 years). Large scale structure formation occurred very much later when the matter density exceeded the radiation density at about $t=10^{11}$ sec (100 billion seconds). Gravity acted to form what are referred to as inhomogeneities— galaxies, clusters of galaxies, and superclusters.

Many universes or a particular universe

There has been a good deal of speculation about other worlds, other universes. We may speculate though it is doubtful that it is very fruitful to do so. We have to deal with the fact that there is something and not nothing, that we and other life forms live and life can be sustained on this particular planet. Polkinghorne reminds us that the emergence of any particular form of life is always a possible outcome of evolution but that the world in becoming, in going on creating itself, has a certain unpredictability about it.

Question marks!

There are some outstanding problems, not least of which is the search for dark matter. There is not enough mass in the visible parts of the galaxies to account for the rate of expansion of the universe. This is where Stephen Hawking made his name by postulating and describing black holes— small ultra-high density objects (collapsed neutron stars). Black holes have been observed indirectly, originally by Nobel laureates, Hulse and Taylor, from a binary pulsar – a pair of neutron stars orbiting one another, one of which is dark (deduced to be a black hole). This was inferred from the pattern of rotation of the visible star. If the density inhomogeneities had not occurred, there would be no stars, galaxies, planets, indeed no universe as we know it. Then there is the absence of antimatter.

In 1928, the English physicist, Dirac, predicted that in addition to matter there should be anti-matter. In the early universe matter and anti-matter would have been present in roughly equal amounts but early on the balance tipped towards matter! Anti-matter particles are found in cosmic rays and they can also be produced in accelerator experiments.

Time relations - the nature of singularity, the first $10^{-43}$ secs

This very short time is known as Planck Time. Physics can say nothing about what happened before that time elapsed. But we don’t then jump in and attribute that to God; that would be to return to the God of the Gaps idea where God exists only in the gaps in our knowledge.
Weinberg (1977) in The first three minutes explains how protons and neutrons were formed in about the first second after the Big Bang, and how Hydrogen and Helium (in the ratio of 3:1) were formed from protons and neutrons after about 3 minutes.

**Sequence of events**

The following sequence is adapted from Wilkinson (1997, p. 39 Fig 3:2.

**Big Bang sequence from singularity to the present**

- Today 13.7 Billion yrs
- Planets formed 10 Billion yrs
- Galaxies formed 1 Billion yrs
- Atoms formed $10^5$-$10^6$ years
- Nuclei formed 3 minutes
- Quarks to Protons and Neutrons $10^{-4}$ secs
- Weak nuclear and electromagnetic forces separate $10^{-10}$ secs
- Strong nuclear force separates $10^{-35}$ secs
- Planck time $10^{-43}$ secs
- Big Bang singularity time $=0$.

**Hydrogen to Helium ratio and relative abundances of elements**

It has been possible to calculate the relative abundances of the lighter elements to very high precision. The relative abundances of hydrogen (H) (including deuterium or heavy hydrogen, D), the two isotopes of helium ($^3$He, $^4$He) and lithium ($^7$Li) are key factors in confirming the correctness of our understanding of the events following the Big Bang. Hydrogen is 100,000 times more abundant than deuterium and three times more abundant than helium.

**2.7 K Residual Microwave Radiation**

One experimental result in 1963 changed everything. Working at the Bell Telephone Labs in the USA, Penzias and Wilson observed the background radiation from the early universe with a radiation curve suggesting a temperature about 2.728K (degrees absolute, cooler than liquid helium). This was crucial evidence but there is more! This radiation comes from the early universe, from the period when electrons and nuclei formed atoms ($10^{13}$ sec or 1000 billion seconds after the Big Bang). This had been predicted in the early 1940’s by Alpher, Bethe and Gamow, who also explained how hydrogen produced helium in the Big Bang.

**Lumpiness of space**

In 1992 using careful satellite data, one remaining puzzle in the jigsaw was solved. The cosmic background is not exactly the same in all directions, something we call anisotropy. There are temperature fluctuations of about 3 parts in 100,000 which imply density fluctuations required for production of the light elements and the formation of galaxies. It is sometimes referred to as the lumpiness of matter.

**Destiny of the Universe - Scientific Eschatology**

There are only two options in Big Bang cosmology. Either the universe will stop expanding and then turn in on itself (The Big Crunch) or go on expanding forever. Our earth will burn up and become a Red Giant in about 7 billion years so the cosmic history of mankind for instance will not be forever on this planet! The
future of the universe depends on the nature of the balance between gravitational attraction, which depends on mass and distance, and of expansion resulting from the energy of the Big Bang. Thus there are two extreme possibilities but predicting the outcomes is difficult since the mass of the universe is not known accurately.

Our cosmological destiny can be summarised as follows:-

**Either, continued expansion and Heat Death**

Our sun has about 7 Billion years left! So our local system won’t last forever in any case even if the universe were to go on expanding forever.

**Or, the Big Crunch**

Gravitational collapse to a singularity being the reverse of the Big Bang!

### 6.4 THEOLOGICAL IMPLICATIONS OF BIG BANG COSMOLOGY

We can respond to scientific cosmology in a variety of ways.

**Implications for both Creation and Eschatology**

Creation - What has the Big Bang to say about Creation? Eschatology - What has the Big Crunch to say about Christian Hope?

**Three approaches:**

#### 6.4.1 Science is wrong - Creation Science approach

Creationists believe that historical science such as cosmology can only be discerned by a literal understanding of Scripture and hence scientific cosmology must be wrong. The so-called creationist idea of a literal six day creation in 4004BC is simply not in accord with the facts as we now know them. The consistency between the cosmological, geological and biological stories of the universe make nonsense of theologies based on out-of-date cosmologies. An important principle is the need for consonance between different types of explanation of reality, creation included.

#### 6.4.2 Science and Religion are separate and unrelated and should be kept so

This is one of the four categories Ian Barbour notes regarding how Science and Religion have often been thought about (See Chapter 5). Surely when theology is seeking to reflect on the meaning of the universe and of creation, and science is speaking about the same things from its own point of view, it makes sense to look for proper connections between them. Indeed it is becoming fairly obvious that theology and science are increasingly asking the same kinds of metaphysical questions, the most fundamental one being why we are here at all.

#### 6.4.3 Consider the implications of modern cosmology in relation to a consideration of creation

This does not mean adapting the theology to the latest scientific theory, but rather to critically examine it in the light of current scientific concepts. When we say that the cosmological, geological and biological stories form a consistent picture of the physical world, we are not implying that they are complete, or that they will not face some changes in the future. What we are saying is that they have such a degree of internal consistency to give us confidence that they do in fact faithfully report reality. Theologies, particularly relating to creation, that ignore or avoid the findings of modern science are of little value and give no credibility to the Faith.
6.5 THEOLOGY AND THE PHYSICISTS

John Polkinghorne, writing as a Christian, has articulated an enlightened view of Natural Theology. We must also credit Paul Davies, not a Christian, with honestly grappling with Natural Theology. The question is how far one can go in finding evidence for God from the world around, from our cosmology, geology and biology. There are as many answers as people asking the questions.

Davies sees in the beauty and simplicity of the equations of physics, a mind, a purpose. God? He remains however essentially a Deist seeing in nature a “mind” behind the equations. However, if one starts from the viewpoint of faith the matter can be turned round the other way. The beauty and apparent simplicity is what we might expect with a bit of experience. It is not only the equations of quantum physics and relativity that have an intrinsic beauty and simplicity; so too have the equations from 19th Century physics such as Maxwell’s equations of electromagnetism.

We should not minimise the attempts that Paul Davies, Stephen Hawking and others have made to raise some of the big questions about reality. They have confronted the question of whether there is a God. Their current views are however that knowledge of all of the necessary equations of physics to explain the universe would do away with the Christian understanding of God. Van Beukel gives a readable and useful critique of the much of what Davies and Hawking have written. Big Bang Cosmology has certainly created considerable interest from secular scientists wishing to talk about God.

Some widely discussed approaches are given in the following publications:

Paul Davies, *The Mind of God.*

Hawking, *A Brief History of Time.*

The latter is better than some critics allow and its difficulties lie in the difficulty of the concepts. In many respects Hawking is an excellent communicator with the capacity to ask relevant and important questions. His speculations however should not be confused with his hard science.

*Tipler, The Physics of Immortality*

Tipler considers religion as a branch of physics and speculates on an immortality (bearing little resemblance to that of Christian hope) derived from an extension of physical laws. Tipler’s concepts it must be emphasised while remaining highly speculative and even considered to be science fiction and not generally taken seriously as scientific considerations1.

*Capra, The Tao of Physics*

Seeks to equate the uncertainties of modern physics with the mysticism of Eastern Religions. Again a work of speculation, drawing on concepts that many scientists would question

6.6 RESPONDING TO COSMOLOGY

6.6.1 Negative responses

A view particularly from fundamentalists, that God and the Big Bang are alternative explanations and therefore one must be rejected. This is simply a

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1 James Garth has drawn the authors’ attention to the fact that serious consideration of Tipler’s views has been given by writers such as David Deutsch, Wolfhart Pannenberg and William Dembski. Conversely, his views have attracted strong criticism by others such as George Ellis and Michael Shermer.
rejection of God as a God of the Gaps and such a concept is foreign to the God of Christian Theism.

**Hoyle**

Fred Hoyle was a long avowed atheist\(^2\). He was responsible for the term “Big Bang” as a term of derision regarding a universe with a beginning. It is also somewhat ironical that his prediction of the so-called carbon resonance whereby carbon nuclei could be produced in stars from the fusion of three helium nuclei has proved to be one of the cornerstones of Big Bang theory and does not support his own Steady State Theory.

**Atkins**

Representative of secular humanists who attempt in popular books to use cosmology as a defence for atheism. Atkins P The Creation 1981 states *My aim is to argue that the universe can into existence without intervention, and that there is no need to invoke the idea of a Supreme Being in one of its numerous manifestations.*

**Weinberg**

Well known both as a Nobel Laureate and for his excellent book, ‘The First Three Minutes”. He also however adopts an atheist stance, failing to understand the doctrine of Creation - why is there a universe at all?

### 6.6.2 Positive Responses

Cosmology provides a picture of a finite (created) universe having a beginning and an end. This would seem to be much more in keeping with a biblical doctrine of Creation. It is valid to ask, 'Are scientists now coming to the same view as the theologians?’ Consider the widely quoted statement from Jastow(1978, *God and the Astronomers*. p 116),

> "At this moment it seems as though science will never be able to raise the curtain on the mystery of creation. For the scientist who has lived by his faith in the power of reason, the story ends like a bad dream. He has scaled the mountains of ignorance: he is about to conquer the highest

\(^2\) In his recent book ‘God Actually’, Roy Williams makes the claim that prior to 1959, Hoyle had been an agnostic, and that he ‘converted’ to Design based on the apparent ‘fine-tuning’ of the nucleosynthesis process that produces carbon within stars. The "Hoyle History" website ([http://hoylehistory.com/famous-hoyles/fred-hoyle/](http://hoylehistory.com/famous-hoyles/fred-hoyle/)) provides a slightly different history: it claims that Hoyle was reportedly an atheist for most of his early life, but changed to agnosticism based upon the implications of the aforementioned apparently ‘finely-tuned’ processes.

Hoyle's own words seem to indicate that his beliefs were, at least, put under some tension by the implications of his work: "I do not believe that any scientist who examined the evidence would fail to draw the inference that the laws of nuclear physics have been deliberately designed with regard to the consequences they produce in stars. If this is so, then my apparently random quirks have become part of a deep-laid scheme. If not, then we are back again at a monstrous sequence of accidents." And again; "Would you not say to yourself, "Some super-calculating intellect must have designed the properties of the carbon atom, otherwise the chance of my finding such an atom through the blind forces of nature would be utterly minuscule.” Of course you would . . . A common sense interpretation of the facts suggests that a superintellect has monkeyed with physics, as well as with chemistry and biology, and that there are no blind forces worth speaking about in nature. The numbers one calculates from the facts seem to me so overwhelming as to put this conclusion almost beyond question."

The authors are indebted to James Garth for drawing their attention to this fuller insight into Hoyle’s views.
peak: as he pulls himself over the final rock, he is greeted by a band of theologians who have been sitting there for centuries.”

Pope Pius XII declared in 1951 that the big bang was compatible with the Christian Doctrine of Creation.

"Everything seems to indicate that the universe has in finite times a mighty beginning.” He went on to claim that prejudiced scientific thinking indicated that the universe “is a work of creative omnipotence, whose power, set in motion by the Creating Spirit, spread out over the universe”

Both of these statements need to be critiqued. It is inappropriate to tie theology to a particular scientific theory or to imply that the “originating” God of the big bang is the God of creation ex nihilo. God as Creator is just as consistent with the eternal steady state concept.

To make things even more complicated and challenging, Hawking has suggested a non-beginning big bang scenario (Hawking, 1988, A Brief History of Time, Guild Publishing, London, pp127,128)

In 1981 I attended a conference on cosmology in the Vatican. At the end of the conference the participants were granted an audience with the Pope (John Paul II). He told us that it was all right to study the evolution of the universe after the big bang, but we should not enquire into the big bang itself, because that was the moment of creation and therefore the work of God. I was glad then that he did not know the subject of the talk I had just given at the conference - the possibility that space time was finite, but had no boundary, which means that it had no beginning, no moment of creation. I had no desire to share the fate of Galileo....... Hawking (1988), pp, 156,157, states,

So long as the universe had a beginning, we could suppose it had a creator. But if the universe is really completely self contained, having no boundary or edge, it would have neither beginning nor end: it would simply be. What place then for a creator?

6.6.3 Anthropic Principle

The development of conscious beings able to speculate about origins is the result of a very finely tuned universe. The anthropic principle is really about the fine tuning of the universe, the essential fitness of the world as we know it and have learned about it. It does matter that the electromagnetic force and the gravitational force are inverse square laws and depend on one over the square of the distance between the charges or masses (1/d²). If, however, the electromagnetic and gravitational laws depended on 1/d¹.999999 or 1/d².000001, say, the earth would be too hot or too cold to sustain life, respectively. It might be possible to construct a world that could exist, but it is unlikely to be able to sustain any life forms at all as we recognise them. Worthing (1996, p. 46) gives a most adequate account of both the Weak and Strong forms of the Anthropic Principle.

Weak Anthropic Principle

This is simply a statement of fact based on a retrospective look at the history of the universe. With reference to a book by Barrow and Tipler, he notes for example that the universe must be that age that it is to allow sufficient time for evolution of beings like us to ask the question concerning its age.

Strong Anthropic Principle
Whilst there are several different versions of the Strong Anthropic Principle, we note that they all to some degree note the fitness of the laws of physics for the existence of the universe as we find it in the structure and behaviour of stars and galaxies, for example. The Strong Anthropic Principle has also been used as an argument for design, for a new Natural Theology and the idea of multiple universes. Some of this is rather speculative and the technical details beyond the scope of this course.

6.6.4 Hawking and Creation?

No beginning!
The problem of the first few instants where the laws we know and understand break down. Clearly the initial singularity poses a problem for atheists but in our view, not for Christians. It is not so much that the laws of physics break down, we don’t know what laws operated up to the Planck time.

6.6.5 Quantum Gravity

Forces between electric charges are thought to be communicated at the speed of light by photons. To account for the gravitation force in the same way, gravitons travelling at the speed of light have been postulated. Getting the theory in place has not been possible. So a theory of quantum gravity does not yet exist.

6.6.6 Seeking a Theory of Everything

Attempts to combine the laws relating to Gravity, Electromagnetism and both Strong and Weak Nuclear Forces into a TOE or Theory of Everything has been referred to elsewhere.

6.6.7 Hartle/Hawking Speculation, No Boundary models - No singularity

While cosmologists such as Hawking recognise the evidence pointing towards the Big Bang which implies a definite beginning to the universe at a singularity in both space and time, they also want a way out. In more speculative frame of mind, Hartle and Hawking have proposed a model in which there would be no boundary to the universe and no sharply defined singularity. The details get rather complicated and are beyond the scope of this chapter. A discussion of these issues are given by Worthing (1996, p 53) in which he points out that the God Hawking gets rid of is the God of the Gaps that we have rejected earlier anyway. We may say that scientific explanations do not, of themselves, answer the ‘why’ questions about why we are here in the first place.

6.6.8 Who is the Scientists ‘God’?

There are several concepts used both to dismiss or to affirm the God of the Gaps. That is, God is the explanation for what we don’t know. Suppose we were able to know everything that could be known. Then what? Would God be reduced to nothing? The God of the Gaps is not the God of Old and New Testaments. The issue can be settled by realising that

‘God does not equal our ignorance’

To acknowledge mystery regarding the nature and character of God is necessary, but God does not equal Mystery either.

A remark by the late Charles Coulson (1955) has been quoted often e.g. by Polkinghorne (1986, p 60),

"when we come to the scientifically unknown, our correct policy is not to rejoice because we have found God; it is to become better scientists".
Platonist force

Many scientists conceive God as an impersonal force, the mind of the universe, the source of the laws of physics or even as the laws themselves as something outside nature. It was in this sense that Einstein could say that “god does not play dice” or that Hawking could talk about finding the mind of god. His Brief history of time concludes with this pregnant thought:

However if we discover a complete theory it should be understandable in broad principle by everyone, not just the scientists. Then we shall all, philosophers, scientists and just ordinary people be able to take part in the discussion of why it is that we and the universe exist. If we find the answer to that it would be the ultimate triumph of human reason, for then we would know the mind of God.

Hawking, Brief history of time 1988, p. 193

6.6.9 Is creation 'ex nihilo' consistent with modern cosmology?

Modern cosmology starts with the so-called Big Bang at which physicists call a singularity in space and time which represents the beginning of space and time—a creation ex nihilo. The implication scientifically is that space and time were created at the singularity about 13.7 billion years ago. The physics of the very earliest times are not known however, but it is certainly true to say that science and theology find no contradictions. Even if the no boundary speculation of Hawking is true, as discussed above, the theology of creation is concerned with why there is something rather than nothing. Theology and science concur, but are asking different questions.

6.7 IMPLICATIONS FOR GOD’S CONTINUING ACTIVITY—THE GOD OF SPECIAL PROVIDENCE

6.7.1 How does God interact with the world?

We have explained that the scientific evidence supports a dynamic evolving universe. Stars continue to be born and to die and the processes by which that happens are well understood. The universe is not static or fixed! It arises from an interplay of chance and necessity, of being and becoming. Furthermore it is understood that the universe appears to be an open system. It is still becoming, 'going on creating itself' (See Polkinghorne 1994, p.43).

6.7.2 The problem of natural evil

The creation as we see it with its “natural” imperfections expressed by such things as earthquakes and the biological consequences of natural selection might be seen as a dynamic creation “becoming” (not being) as it were— the best of all possible worlds. We perhaps should look at creation (by God) as being on the way, dynamic not static, creation as continuing to a climax, an eschaton, not simply being. After all for the Christian, God’s activity in creation culminates in the hope of a new creation. We also perhaps need to see natural evil as an expression of the world being what it is. After all the tectonic plates govern the continuing formation of the world as well as they do the eruption of volcanoes or the power of earthquakes. The biological growth processes produce normal development as well as cancer development and the process of natural selection produces the emergence of life capable of aesthetic, moral and religious aspects as well as of nature ‘red in tooth and claw’. God has created a world that is free to be itself, but also one where the ultimate result emerges out of an interplay of chance and necessity. These perspectives provide a wider horizon from which to view creation. We can thus be assured that God is both good and in control, but
our perspective may need to be broadened and our time frame lengthened. Having said all this however it remains difficult to come up with a full and satisfactory rational explanation of the problem of evil. In many respects the ultimate answer to the problem of evil is not philosophical but experiential. In a world in which suffering exists, the clear Christian message is that God shares that pain.

6.7.3 Process theology

Process theology sees the World as part of God and God as process - a limited God, a God who develops along with the universe. Such ideas deny the transcendence of God in bending to a "scientific immanence".

6.8 IMPLICATIONS FOR CHRISTIAN HOPE – ESCHATOLOGY

6.8.1 Scientific speculation — Persistence of a non-personal immortality

Tipler and Freeman Dyson address these aspects, but more from the standpoint of science fiction, than science. It is questionable whether there is an interface here in the science theology debate which can be followed at this point.

6.8.2 Is Christian eschatology limited to part of the universe?

The Biblical eschatology of Christian hope, encapsulated in the doctrine of bodily resurrection and a new heavens and earth raise appreciable questions for the science faith debate and are being explored by Christian scholars such as Robert Russell. It might be questioned whether in such areas we are operating outside of science in a new creation or that Christian eschatology is limited to a part of the universe. No easy answers can be given.

6.9 CREATION AND THE BIBLICAL RECORD

The interpretation of the creation accounts has always been varied and biblical interpretation should not be equated with biblical inspiration. Scientific developments may well be an important tool in such interpretation. It is outside the scope of this chapter to consider this matter in any detail, but just to refer to some basic facts.

6.9.1 Historically —many approaches - not just literal/allegorical

**Platonist approach**

Was typical of many of the Patristics, Augustine, Origen, Basil etc.

**Literal — Aristotelian**

In the 17th century, Ussher's chronology, following on the literalism of the Reformation, gave rise to a dating of creation (4004 BC) that carried its authority into the margins of many Bibles. Geological studies in the 18th century on the age of the earth however dispensed with such a chronology and left literal and semi-literal interpretations of Genesis to the so called Scriptural geologists (see Chapter 1).

**Scriptural geologists**

Three scenarios were put forward to maintain a literal interpretation of Genesis. Not all presupposed a young earth. They all attempted to fit the Bible to science by proposing a series of ages corresponding to days, a gap between Gen 1:1 and 1:2, or the proposition that creation including humanity was formed with the appearance of age (Gosse). All of these interpretations are still presented, but are bound to come into conflict with a God who is neither magician, charlatan nor mechanic, but Creator.
6.9.2 Interpretative principles

Again these can only be referred to in outline. One must recognise that the
Genesis accounts are expressed in the cosmology of the Ancient Near East (ANE).
Such cosmology bears little resemblance to modern science.

Expressed in the literary form of the ANE

The poetic parallelism etc., the “mythic,” saga, story are apparent.

Affected by the context of the ANE creation myths — Enuma Elish legends
etc.

It is important to discern the truths in such accounts. Nearer home, aboriginal
stories e.g. may also be seen to point to Christ and in Christ to see their
fulfillment. Aboriginal people often have no problem with the Genesis story as
they see it as being like their own stories. It would not occur to them that stories
that relate to long periods of time would have to be interpreted literally.

6.9.3 Literary framework

Structure of the seven days — see Thompson (2007).

6.9.4 Literary structure of Gen 1

Introduction 1:1-2, The whole universe

Day I Act 1 Light

Day IV Act 5 Light bearers (1:3-5) (1:14-19)

Day II Act 2 Firmament dividing

Day V Act 6 Birds and sea waters, above and below creatures (1:6-8) (1:20-23)

Day III Act 3 Waters and land

Day VI Act 7 Land animals, separated reptiles (1:9-10) (1:24-25)

Act 4 Vegetation

Act 8 Man (1:11-13) (1:26-31)

Day VII

Conclusion: 2:1-4a God Ceases his creative activity

6.10 CONCLUSIONS

6.10.1 Impact of physics on 21st century cosmology

The impact of 20th century physics on how we think about the world has been of
immense magnitude. We have seen the necessary dismantling of our common
sense ideas of space and time and the impact of non-deterministic quantum
mechanics. The discoveries in atomic, nuclear and particle physics on the one
hand and astronomy and cosmology on the other, have changed forever our view
of the universe. It is an ever expanding and changing entity. Stars continue to be
born and to die. We are able to penetrate even further and further to the outer
limits of our universe and that means probing even further and further back in
time. We should welcome the new knowledge, not uncritically, but with
discernment.
6.10.2 Scientific and theological concepts in consonance
We need to find consonance between what we learn from physics and what we experience as Christians. Put another way, it would be strange indeed if the stories from nature and theology were out of step.

6.10.3 Exegetical principles—genre, culture, context are important
We must discern the substance of the message—not confuse it with the form.

6.10.4 Creation is important for cosmology
It provides a theological and metaphysical basis for the scientific understanding of the universe. A full view of the world is incomplete without this.

6.10.5 Cosmology is important for creation
It gives a new dimension of awe and wonder to the creator, Ps 19:1, "When I see the world the work of thy hands" etc. The experience of understanding a tiny part of our world is as moving as any religious experience in prayer or worship. It is our responsibility to use our intellect to take advantage of all kinds of knowledge and to use them to the glory of God.
6.11 REFERENCES

Gribbin, J, 1987, In Search of the Big Bang, Corgi, UK.
Sherlock, C, Creation, Creationism and Scripture, Interchange 35, p.17-32
Wilkinson D, 1997, God, the Big Bang and Stephen Hawking, Monarch, Tunbridge Wells.
Worthing, MW, 1996, God, Creation and Contemporary Physics, Fortress, Minneapolis.
Chapter 7  EVOLUTION AND CREATION

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7.1 INTRODUCTION

No area of science touches more directly on the theological/biblical concepts of Creation, Humanity and the Fall than that of Evolution and Creation. Problems arise however with interpretations of both the scientific and the biblical data. Many consider that Evolution and Creation are alternatives and therefore that one must make a choice between these two explanations of the natural world. This difficulty has dogged the debate since Darwin presented his explanation of the multiplicity and development of species in the 19thC.— and even before. The issue has therefore become polarised and often the subject of bitter controversy. Huxley in the 19thC. and his modern counterpart Richard Dawkins in the late 20thC. have contributed to this polarisation as have those Christians who espouse a view of creation that envisages God acting in a staccato fashion to create individual species including man by acts of special creation.

A consideration of the history of Darwinism and of its context in 19thC England has indicated the complexity of the debate between evolution and creation. Darwin himself struggled with the issue of natural selection as either a substitute for God or as an explanation of God’s activity. Darwinism was also perceived by his contemporaries as either a basis for atheistic naturalism or as an example of the way God acts in creation. Historical aspects are considered in Chapter 3: Darwin and the Aftermath.

History also served to illustrate the problem of linking a particular interpretation of Scripture, or a particular approach to theology, to an outdated understanding of science. The solution to this dilemma is to understand evolution by natural selection as a proposed mechanism, a means by which God brings about the rich variety of the biological world and to reject as nonscientific any conclusion that evolution is an agent of creation. The latter may be a valid proposition to put but it is a metaphysical proposition not a scientific one and it is best to distinguish such a view with respect to evolution as “evolutionism”. If one clearly recognises this distinction then it will be appreciated that there is no intrinsic conflict between evolution and creation. Evolution needs to be judged on scientific grounds and creation on theological and biblical grounds.

We need to ask three questions therefore.

1. How do we interpret the scientific data?
2. How do we interpret the theological and biblical picture?
3. Are these pictures in conflict or are they to be seen as complementary?

7.2 INTERPRETING THE SCIENTIFIC DATA

7.2.1 Science seeks truth

If we are seeking truth we must examine the scientific data seriously and with integrity. We cannot dismiss it on trivial grounds or on the basis of presuppositions of what theology or the bible are saying.

7.2.2 Scientific truth is derived by scientific method

It must be interpreted on scientific grounds— by the scientific method.

7.2.3 Science as input to interpretation

We must also consider the implications of the scientific data in interpreting or reinterpreting theological and biblical matters.
7.2.4 Science and scientism

On the other hand, we must not allow the scientific conclusions to become philosophical conclusions, or evolution to become evolutionism or naturalism. This is to go beyond the scientific bounds to scientism— Cf. Dawkins.

7.3 INTERPRETING THEOLOGICAL/BIBLICAL DATA

7.3.1 Distinguish scientific and theological questions

In considering the issue of evolution and creation we need to distinguish the scientific from the theological questions. Evolution and creation are not alternatives, but represent respectively a secondary cause or mechanism and a primary cause. The former is outside the bounds of theology. “Biological man” and the “Image of God” are not alternatives, but represent two viewpoints of the same humanity. The former is outside the bounds of theology.

7.3.2 Interpretation is not inspiration

There have been a variety in interpretations, both throughout history and at present, as Christians and others have struggled to understand the text of the creation accounts. Theistic evolution, progressive creationism, special creation or literalism have all been understood by their proponents to best interpret what the text is describing. It is important therefore not to equate a particular interpretation with orthodoxy.

7.3.3 Science as an aid to interpretation

It may be necessary to reconsider a particular interpretation in the light of extra biblical information including emerging scientific data. This is well accepted with regard to language and cultural input and needs to be extended to input from science, if that is relevant.

7.4 EVOLUTION— SCIENTIFIC ASPECTS

7.4.1 Introduction

Issues

There are a number of very evident facts about the biological world that are well explained by evolution, by postulating a progressive transmutation of species from lower animals to higher animals including humans. Evolution therefore has good credentials as a scientific theory. This fact can be appreciated by most of the lay observers.

Variety of Species

There is an enormous variety of biological species, in the contemporary scene some 30 million separate species can be recognised. To this must be added the some 100 times this number which have become extinct over geological time. This is attested to by the fossil record. Thus we have a total number of different species over the history of biology of some 3 billion in all.

Relationship of species

There is a close anatomical, physiological and genetic relationship between species with a commonality in basic structure, in basic functions and in genetic constitution amongst living things. A continuous series can be constructed from the most simple plants and animals to the most complex. Thus there is evidence for a continuum rather than for a series of discrete species. The closer the species
are in the series the closer the similarity in their anatomical structures, their physiological functions and their genetic makeup.

**Origin of Species**

From these facts can be suggested that the origin of different species occurs, not by the individual creation of each of the three billion varieties, but by one species gradually transmuting into another to form a continuous series. **Thus the biological answer to variation and speciation is evolution.** It has become a basic principle of biology—one that unifies the whole of biology and undergirds modern biology.

**Definitions**

**Evolution** is the gradual unfolding of new varieties of life from previous forms over long periods of time. It was suggested as a possibility long before Darwin. The difficulty was that, before Darwin, a satisfactory and experimentally verifiable mechanism could not be agreed. Some mechanisms were suggested but they had little evidence to support them. See below.

**Proposed Mechanism** is by natural selection, acting from generation to generation, so that changes induced by mutation, are selected and passed on selectively from one generation to the next resulting in a change in allele frequency (or the genetic makeup) in successive populations.

**Evolution thus:**

Denies a static unchanging world;

Denies a separate origin for each species; and,

Considers man to be part of the biological world;

**but it does not deny the theological considerations:**

Creation or a Creator;

Man made in the image of God;

the nature and origin of sin.

**7.4.2 History**

**Background**

The development of information from geology and paleontology in the 18thC formed an important background for the emergence of evolution. This information related both to the fossil record and the age of the earth. The identification of fossils as evidence of previous life forms and their ordering in a fossil time sequence suggested some development over time. Initially no absolute time scale was known although geology progressively increased the time frame. Absolute timing of fossil artifacts, however had to await radioactive dating in the 1940’s to provide firm evidence of the enormous time span involved.

With the advance of geology and the abandonment of catastrophism as an explanation of both the geological findings and the fossil record, a further foundation was laid for a consideration of evolution in the late 18th and early 19th centuries. This advance in geology culminated in the development of uniformitarian geology by Lyell in the early 19thC. Darwin had Lyell’s very recently published *Principles of Geology* with him on the Beagle journey. Before the 18thC the age of the earth and the date of creation was established from biblical data notably by the findings of Archbishop Ussher. Thus both the age of the earth and the date of creation was considered to be 4004 BC, and this date appeared (giving it credence) in the margin of many bibles. By the end of the 19th century,
long time frames (although not to the extent now recognised) were universally accepted and creation over a long period was unquestioned.

**Pre Darwinian evolution**

As indicated above evolution was not suggested first by Darwin. His grandfather, the notable sceptic, Erasmus Darwin was talking about the possibility of mutability of species in the 18thC. Lamarck, the French biologist had a strong following for his concept of evolution. He suggested that environmentally determined changes were passed on to succeeding generations and thus favourable traits were perpetuated.

**Darwin**

Darwin was a careful observer and accumulated a mass of data in support of his theory of evolution by natural selection. His conclusions were influenced by the controversial views of Malthus and his theory of a struggle for human survival in Britain’s 19thC. growing industrial society, with the pressures of limited resources of food and the problems of famine and disease. Population numbers were kept relatively constant as a result of these pressures. Darwin saw the analogy with nature as a whole and the explanation of his observations of nature.

**Facts and interpretation**

Fecundity, variation, selection and survival were the key elements in Darwin’s proposal. The first two represented observed facts, the last two represented suggested interpretations of the facts to explain the origin of species.

**All species had enormous fecundity.** The potential for population growth was therefore considerable. Thus without natural checks numbers would increase very rapidly. Population numbers however remained relatively constant.

**Therefore** there was a struggle for survival

**All populations showed considerable variation.**

**Therefore** advantageous variations are selected by natural selection sometimes called “survival of the fittest”. Darwin envisaged this process progressing to produce new species by transmutation of species

**Evidence for Darwinism**

Darwin’s genius was his production of overwhelming evidence to support his theory. This came from three main sources.

- Fossil records over a long time span.
- Natural sequence of fossils.
- Development of variation (speciation) in isolated populations. e.g. Galapagos islands.

**Problems**

Natural selection was not without its problems however. These have now been essentially dealt with in the contemporary theory of Neo-Darwinism.

Darwin however had no explanation for the basis of variation. This is now known to be the result of mutation.

Darwin also had no explanation for the fixity of variation in new generations. Again this has been clarified by the Mendelian mechanism of genetic inheritance.

**Objections**

It needs to be said that Darwin recognised the objections to his theory better than most and discussed them fully in the “Origin”. Again most of these have
been dealt with by later observations but they still emerge as potential objections. There are three main groups:-

- The paucity of missing links, the gaps in the fossil record.
- The difficulty presented by complex organs such as the eye or the wing.
- The adequacy of the time span—is it enough?

Regarding gaps in the fossil record, see Conway Morris (2006). Regarding the time needed for evolutionary development, see Neild (2004).

Response

The response to Darwinism was mixed. Gradually however it was accepted by biologists although some remained doubtful until relatively late in the 19th century. See also chapter 2.

The Christian response was varied and still is. Gray, Wright and Warfield were evangelical and supportive. Huxley used it to promote a conflict position and his own agenda for scientific hegemony in 19thC England, where the universities were controlled by the ecclesiastical establishment.

7.4.3 Neo-Darwinism—modern Darwinism

Modern evolutionary theory distils the result of studies in modern genetics, population genetics etc. into the widely accepted theory of Neo-Darwinism. This has been contributed to by the following disciplines

Mendelian genetics

This provided a basis for variation by mutation. It also provided a basis for inheritance of variations by means of undiluted Mendelian characteristics.

Population genetics — Fisher

Provided a basis whereby small differences in population variation have been shown to be able to drive the process of natural selection at a remarkably rapid pace. It resolved the mutation vs. gradualism debate.

Genetic chemistry

Molecular biology techniques revealed the similarity and gradation at the chemical (DNA) level between species. Methods of inheritance by means of DNA etc. are identical from bacteria to humans. DNA sequencing between species reveals species relationships, common ancestors. Thus minor differences in DNA serve as a “molecular clock” to determine the gap between species. Humans and chimps for example have 98% of their DNA in common.

Experimental techniques - demonstration of microevolution

Over quite short time spans it can be demonstrated experimentally that the selection of variants can occur in a variety of populations. Drosophila, black/white moths and Sickle Cell Anemia in humans are examples.

To reiterate, the evidence for modern Darwinism comes from:-

- Fossil sequences
- Population genetics
- Microevolution
- Genetic technology

While there are still debates about the detailed mechanism, the general theory of evolution is considered by the scientific community to be well established.
7.4.4 Human evolution

The evidence for human evolution comes from three sources:-

- Paleo-anthropology—fossil man—molecular biology.
- Genetic data.
- Cultural considerations—tools, art, language.

Fossil evidence, skeletal and cultural

There are three groups of fossils distinguished, representing pre-human, early human and modern human fossils. Many recent discoveries have been made particularly in East Africa.

Prehuman australopithecines—ape men

These appear in South and East Africa around five million years ago. This group is characterised by bipedalism, a small cranial cavity and a protruding jaw similar to apes but with shorter canine teeth. They are not considered a direct ancestor of man, but to come from a common stock.

Early man - homo habilis, homo erectus

These appear in Africa two to three million years ago and spread to Asia (Java man, Peking man) between one million and 500,000 years ago.

This group is characterised by an enlargement of the cranial cavity (2/3 of the size in modern man) and the development of the first “made” tools.

Oldowan tools appear at 2 million years ago, while more advanced Acheulean tools at 1.5 million years ago and fire at 700,000 years ago.

Modern man—homo sapiens

These appear first in Africa at 200,000 years ago and spread to West Asia (100,000), Australia (50,000), Europe (40,000), North America (15,000). They are characterised by a further increase in brain size and the development of sophisticated tools, and of art and religion (30,000). There are many unanswered questions and matters of dispute. The evidence however suggests an origin of modern man in Africa and a spread to other areas, descendants of early man (H. erectus) having become extinct. This is the so called Noah’s Ark theory or the “African Eve” theory. This is supported by the genetic evidence.

Genetic data

This information is particularly important and can be considered under three headings.

Comparison of DNA with related species

Relationships and the closeness of this relationship can be deduced by such studies.

Backward projection from variants in populations from different areas

Mitochondrial DNA data suggest a common all female line ancestry to modern humans in Africa some 150,000 years ago. This is the “African Eve” or “Mitochondrial Eve” theory\(^1\).

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\(^1\) See ‘The Daughters of Eve’ and ‘The Curse of Adam’ by Prof Brian Sykes, Oxford University. The first relates to mitochondrial DNA passed from mother to daughter; the latter to the Y chromosome passed from father to son. These are markers for tracing back the origin of most European women to seven ‘mothers’.
Examinations of population variants today

Sickle Cell Anemia, which is caused by a difference of one amino acid in the β-haemoglobin chain, can be shown to be selected positively in malarial areas where this variant presents survival value but deselected in other areas where sickling is a disadvantage.

Cultural data

Cultural anthropology reveals characteristics such as language, religion, conceptual thinking in early human communities at 30,000 years.

One might well ask, what does it mean to be human?

7.4.5 Dating the past

Many of these studies depend on the ability to date the past by a variety of techniques. Pre 20th century dating was imprecise, but it needs to be said that these techniques are now reliable and can be confirmed by a number of overlapping methods.

Mid 20th century—radioactive dating procedures

Uranium-lead dating

U238, U235 decay to lead isotopes Useful for long periods to 4.5 billion years

Potassium 42 —argon dating

Useful for shorter periods Determines time from lava cooling

Radio carbon dating

Useful for periods 50,000 years or less.

Thermoluminescence

Periods to 100,000 years, similar to Radio Carbon dating.

7.4.6 Problems for evolution

These may be considered under two headings.

Scientific

Evolution is well established and the major issues are well recognised and taken into account by the scientific community. They are still essentially as recognised by Darwin but better addressed.

Gaps—missing links

There is still the unevenness of the fossil record— the presence of gaps and the absence of large numbers of intermediate forms. However there is a continual and progressive filling in of the fossil record as time proceeds. There is also reason to consider that rapid progress through intermediate forms would occur before the emergence of a relatively large successful population, so that fewer intermediate forms might be expected. Gould suggests a further process to account for speciation, called punctuated equilibria.

Complex organs such as the eye.

Small and intermediate changes are themselves adaptive and selective. There is not the need to envisage a full organ as being necessary for selection to be generative of changes. (See Dawkins, Out of Eden 1995, and Neild, 2004).
Time available is not sufficient
The monkey random typist argument. However there is not a completely random process, but rather directed selection, progressively moving towards the goal, (see Dawkins, The Blind Watchmaker, 1986).

Dating problems
These can be corrected and checked against alternative methods. The use of more than one method is normal practice in any event.

Pseudo-scientific
Scientific objections are often raised without understanding the scientific method or the way the scientific community operates. These follow a particular pattern suggesting that:

- evolution is only a “theory”, or,
- evolution is non-falsifiable, or that
- some of the data does not fit or is disputed.

Some of these objections consist of the resurrection of old objections or those fully considered or discredited, or of scientific concepts that are bizarre or inadequately substantiated science. These include disputes about dating, or of fossil explanations by catastrophism.

Many of these objections verge on the fraudulent, failing to take into account the whole picture or, at the very least, show a failure to understand the way in which science works.

7.5 Evolution — Theological Aspects

7.5.1 Theological issues

Introductory considerations
Two questions might be posed.

1. Does evolution exclude creation by God?
2. Is evolution incompatible with a belief in God as Creator?

Two reasons are given in support of answering yes to these questions.

Evolution is seen as presenting an alternative explanation to creation by God.

Therefore it is concluded that evolution and creation are alternatives incompatible with each other and one or other must consequentially be rejected. The secular humanist would accept that they are incompatible and accept evolution as the chosen alternative. The “creation scientist” would agree that they are incompatible but consider that evolution is unacceptable.

Natural selection contradicts the nature of God through “predation and pain”

In a sense this is a much bigger issue— the understanding of why the world is the way it is.

However, let us examine the issue further and look for some definitions. What is creation? What is evolution?
7.5.2 Creation

There are three aspects which must be included in any understanding of the biblical doctrine of creation. They relate to the nature of the Creator, of the creation of humanity and of the nature of humanity as “fallen”.

**Creator**

Asserts that all things, including time, owe their existence to God. The universe exists by the will of God. God’s creative activity is continual and so includes not only beginnings but also his continued providence and sustenance.

However, any theological consideration of creation does not address certain aspects of origins. It does not indicate how God created.

- Does not imply instantaneous creation.
- Does not preclude a scientific explanation.
- Does not deny freedom and the potentiality for evil in creation. “Best of all possible worlds”.
- Does not indicate creation in time but of time.

**Humanity**

The essential picture is of humanity made in the image of God and capable of relationship with God. However, while it affirms that humanity is more than just another animal it does not deny that man is part of the animal world—biological man. Nor does it imply instantaneous creation of man. It does however raise some issues about the relationship of emergent properties in “biological man” in relation to “theological man”.

**The Fall**

Man is by nature sinful and in need of redemption.

However, it does raise some issues about the relationship of the origin, nature and transmission of a sinful nature in relation to the emergent “biological man”.

7.5.3 Evolution by natural selection

This term must be restricted to the scientific explanation for the origin and nature of species including man. It includes the process (evolution) and the mechanism (natural selection). Evolution is not a force, but a mechanism, a description, to explain the “way things are”, in biology.

Therefore, its truth or otherwise is determined by scientific investigation on the basis of the evidence, i.e. by “good science”. It does not exclude God as a primary cause and does not disprove God as the creator. As a scientific mechanism it does however (as does any scientific theory) potentially explain the way God acts in nature.

It therefore presents a “scientific challenge”.

The alternatives are therefore not

Evolution or creation, but rather

Evolution or some other plausible scientific explanation determined by the scientific method.

**No other plausible scientific explanation so adequately explains the data.**
7.5.4 Evolutionism

Evolutionism equates evolution with a force, an agent of creation—naturalism and blind chance are considered as agents of creation rather than God. It excludes God, by definition from the equation. Evolutionism does provide an alternative to God as creator. However it is a metaphysical concept, not a scientific one.

Evolutionism is thus an extension from evolution, but has no legitimate scientific basis. It does not logically follow from an acceptance of evolution as a scientific explanation, but goes beyond the domain of science.

It is espoused as a philosophy by scientific rationalists and **rightly opposed by Christian believers**.

7.5.5 Creationism

Derived from a literal interpretation of the creation accounts in Genesis (young earth, flood geology interpretation). However it must be considered a belief system rather than science. Rather it is "folk science", seeking to support a particular scriptural interpretation. Creation in creationism is equated with “instantaneous creation” in six literal days. Because it excludes all other interpretations of origins it becomes incompatible with “evolution”. The issue therefore is that of hermeneutics—of biblical interpretation.

**How do we then interpret the Genesis creation accounts?**

7.6 BIBLICAL INTERPRETATION ISSUES

7.6.1 General principles

In coming to biblical passages dealing with origins there are some important guidelines which are consistent with a high view of biblical authority and inspiration.

**Take Scriptural authority seriously.**

As inspired by God, the revelation of God, but not forgetting that it is expressed through human vehicles.

**Consider genre.**

Is it literary or literal, narrative or poetic, historical or allegorical?

All of these genres are present in the biblical record and a literal interpretation is not necessarily the appropriate one, particularly if there are conflicts with truth from other sources such as science.

**Consider the context, world view of the hearers.**

What was the scientific world view in the ANE in the first and second millenium BC? Cosmology was understood in terms of a three-decker universe, with no concept of modern cosmology.

The important question is what did the text convey to the hearers?

**Consider the purpose of Scripture.**

The primary purpose of Scripture is as a guide to faith and conduct, not of science.

Problems have arisen from such a misconception. Many have espoused a **biblicist interpretation**, where the Bible determines science, while others have espoused a **concordist interpretation**, where science determines the biblical interpretation. Neither is an adequate approach to Scripture.
History is illustrative of these issues and also reminds us that there have been many interpretations of Genesis both throughout history as at present.

**Use extra-biblical evidence to clarify interpretation.**

It is important to consider seriously the implications of contemporary science. Scientific truth and biblical truth will not be in conflict. This approach has good historical precedent.

### 7.6.2 Gen 1:1– 2:4a: Creation by the word of God

Several questions need addressing.

**Literal or literary?**

Numbers, structure, repetition, sequence suggest a literary interpretation rather than a literal one.

- **ANE background: the ANE world view**
  - *Enuma elish* and other creation myths suggest a presentation of Gen. 1 as a hymn of praise extolling the nature of Israel’s God, emphasizing a monotheistic understanding.

- **Interpretation**
  - The basic facts emerge from the text of God as creator—separate, independent. There is a polemic against polytheism, monism, dualism.
  - Creation is separate, dependent and good.
  - Humanity is special, made in the image of God, having dominion over creation and in relationship to God.
  - The sabbath is special conveying a new relationship.
  - It is a polemic against contemporary ANE world views.
  - Concerned with who God is and who we are, not the how of creation.

### Gen 2–3: Adam and the fall

The interpretation of this narrative is a major issue for the evolution/creation debate, but it is not often faced up to. We might well ask how do we interpret it?

- **Literary or literal?**
  - Structure is important—Gen 2, Gen 3, Eden and the fall—narrative.

- **History or myth, saga**
  - Myth and its meaning.
  - Perspective and message.
  - Should we interact with the scientific (anthropological) data?

- **Who was Adam? (See Alexander, 2008.)**
  - Was Adam a historic person or a generic term?
  - Was the creation of the *Imagio Dei* gradual or instantaneous?
  - Was the “Fall” gradual or instantaneous?
  - These are important questions for discussion.
7.7 REFERENCES

Alexander, D, 2008, Creation or evolution: Do we have to choose? Monarch, Oxford and Grand Rapids.

Berry, RJ, 1988, God and evolution, Hodder and Stoughton, London.

Blocher, H, 1984, In the beginning, IVP, Leicester.


Finlay, G, 2004, God’s books: Genetics and Genesis, Telos Books, Auckland, NZ.


Lucas, E 2001, Can we believe Genesis today? The Bible and the questions of science, IVP, Leicester.

Neil, D, 2004, God created the heavens and the earth, Telos Books, Auckland, NZ.


Poole, M, Wenham, GJ, Creation or evolution - a false antithesis, Latimer House, Oxford.


Chapter 8  THE NATURE OF HUMANITY

Allan J Day
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8.1 INTERFACING BIOLOGY AND THEOLOGY

There are two interfaces between science and human personhood, ethical and theological.

The rapid progress in reproductive technologies and of genetic knowledge has emphasised the profound ethical implications that arise directly from the technological power of modern biology. It is now more important than ever to be considered human, a person. There are increasing threats to survival. These ethical aspects will be considered later (chapter 10).

There is however another interface, a science/theology interface—that of using biological knowledge to interpret the nature, meaning and value of “human life”. This has been emphasised by three recent developments in biological science.

Firstly, with the Human Genome Program (HGP) we have the capacity, not only to identify genetic disease and potentially to use both somatic and germ cell line therapy, but also to identify completely the human genetic constitution. Never before has humanity been potentially laid so bare.

Secondly, with the appearance (in February 1997) of “Dolly” and of somatic cell nuclear transfer we have the clear possibility of human cloning—of Xeroxing persons.

Thirdly, the investigation of brain function has revealed a tightening of the mind/brain link—the mind (soul) being integrally bound to the body (brain), rather than having any independent existence.

Science, theology and ethics are thus inextricably bound up in the consideration of the nature of persons. There are also implications and the threat of possible conflict between developing biological science and some aspects of Christian belief.

In a response to these scientific issues, many religious authorities as well as politicians are unconsciously joining the scientific reductionists in bowing to a genetic determinism with regard to the nature of persons. In the opinion of many religious authorities human cloning would be “a clear violation of the uniqueness of human life”. Even Bill Clinton at a press conference at the Oval office in March 1997 indicated that cloning was more than mere science it was “a matter of morality and spirituality as well...”. He described those who might want to replicate themselves as “trying to play God”. Cloning is seen therefore as a religious issue.

What it means to be a person needs to be examined however a little more critically.

- What does it mean to be human and when do we become human?
- Are these defined biologically, psychologically or spiritually?
- How do these perspectives intersect or do they conflict?

8.2 WHAT CONSTITUTES A PERSON—WHAT CRITERIA DO WE USE?

There is little argument that humans should be treated differently to animals. The fact of human rights etc. is universally agreed. There is also general agreement that a moratorium should be declared on human cloning, to allow some of the issues to be evaluated.

But the basis for personhood is not at all clear. What constitutes a person?

In trying to address these questions we need to consider a number of inputs from various areas, genetic, biological, behavioural and theological, in order to get adequate answers.
There are a variety of anthropologies, derived from different standpoints. None of these are complete in themselves, but form part of a complete picture of what it means to be human.

### 8.2.1 Genetic anthropology

This is, biologically at least, the most fundamental level. Genetic technology has now made it possible to determine, who we are in terms of our genes. These are not magical life entities, but basic chemical (DNA) compounds. Genetic anthropology thus focuses on our fundamental chemical basis.

**The genetic code**

Watson and Crick in 1953 reported the chemical structure of DNA. Two strands of DNA were linked by four bases (Adenine, Guanine, Cytosine and Thymine). These were linked in such a way that Adenine/Thymine and Cytosine/Guanine were always bonded together so that the two strands are complementary. The four bases strung along a single strand could be arranged in a variety of sequences of three, which coded for protein synthesis, each set of three representing a code for an amino acid to be linked in a particular sequence to form a protein.

There was thus a simple genetic code, capable of an almost infinite variety of sequences—an alphabet of four letters (bases) forming simple three letter ‘words’ strung together in longer or shorter ‘sentences’ that made up a gene, coding for protein synthesis. Life had been demythologised, reduced to chemistry.

Thus all biological species from the most simple organisms through to and including humans have a common genetic basis, differing only in detail. There are differences in degree only from humanity to primates; 98% of the DNA is common. All living things have a common history in evolution. This commonality is emphasized by the Human Genome Program which potentially lays bare our complete human genetic constitution.

**Human Genome Program**

Costing $3 billion and based at NIH in Washington, but with contributions from many countries, it aimed to determine the complete human genetic constitution by 2005. There are 23 pairs of human chromosomes, 1.5 million “potential” genes, but about 20,000 actual genes. These have been sequenced and localised and their function determined. The project ran ahead of schedule with a draft sequence announced in 2000. The complete sequence was published in 2003. The program raises important questions about who we are as persons. We have been potentially laid bare.

**Is this a basis for the consideration of human worth?**

We cannot deny that our genetic uniqueness depends on only a 2% difference in DNA from higher primates. But we must resist the temptation to reductionism—to reduce our personhood to a purely genetic frame, expressed simply in a rearrangement of the order of bases in our genes. Genetics provides only a partial anthropology; however it is anthropology viewed from the genetic window. There are other windows.

### 8.2.2 Neurophysiological anthropology

**Humanity characterised by self consciousness—mind**

There is an emerging new reality in humanity—not possessed by lower animals. This is the property of self consciousness, the mind. This reality however is expressed through the body (brain) and cannot be considered as a separate “substance” from the body. It can be the subject of investigation and observation and is now seen to be integrally related to the brain, not separate from it.
Recent developments have seen a closing of the mind/brain link

This is indicated by a number of facts.

*Physical aspects of mind can be investigated.*

The mind is clearly expressed through the brain and does not exist apart from it. This is illustrated by many observations of increasing sophistication.

Broca 150 years ago described areas of the brain associated with speech problems, the ability to understand or communicate.

Phineas Gage, whose dramatic injury to his frontal lobes resulted in definitive personality change.

Psychotropic drugs have an effect on personality as does schizophrenia. These can both be linked to physical or chemical brain changes.

Differing levels of various transmitters (changes in the chemistry of the brain) are associated with mood disorders.

Neurophysiological changes accompany the perception of faces etc. in experimental animals and can be tied in with cognitive activities in humans. Even spiritual and creative artistic experience can be related to changes in the temporal lobe such as temporal lobe epilepsy.

*Mind thus cannot exist independently of the physical substrate of brain*.¹

Mind is not however just an epiphenomenon (a symptom) of the brain. It does have a separate reality. Mind (soul) is expressed through the brain but is not identical to it.

*There is no basis for a separate existence (substance) of the "soul"*

This is not to say that the concept of 'soul' as the "I", the person, is not helpful, but simply to say that neuroscience gives no basis for Cartesian Dualism—'the ghost in the machine', the separation of matter and soul (mind) as two entities. Although this would be the contention of most neuroscientists there are a few that still espouse a dualist (body/mind) view. Foremost among these has been the Nobel Laureate, Jack Eccles.

Jettisoning dualism and considering that the mind is expressed by the brain is not to endorse monism, the contention that the mind is reduced to the brain.

### 8.2.3 Physical anthropology

This approach emphasises humanity as a product of human evolution having a unity with lower animals but evolving both in a genetic sense and in a cultural sense. These aspects may be expressed under the following headings:

*Human evolution*

One race, but one with biological life—Australopithecus, Homo erectus, Homo Sapiens being a series. Evolution however includes not just physical characteristics, but also religious capacity, language capability and also the generation of self-consciousness and freewill. The major physical aspect of human evolution is the increased size of the cerebral cortex, but this has implications for the non physical (mind/soul) characteristics which are revealed by cultural anthropology.

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¹ Should one say, rather, that mind cannot function independently of a physical substrate?
Genetic and cultural evolution—Ayala

Both the capacity for language and the capacity for freewill (rather than determinism) may be the result of both genetic and cultural evolution. The evolution of the physical faculties for speech may be accompanied by the development of specific language skills determined by cultural factors. That is, the capacity for speech is genetic but the capacity to speak, for example, Japanese, is cultural.

Implications

These conclusions, or this picture of humanity, may be threatening for some Christians. However it needs to be emphasised that physical anthropology does not give a complete picture of humanity any more than does genetics or neuroscience. Anthropology does not say that humanity is not created by God, but rather that an explanation of origins, including higher (unique) aspects of humanity can be explained by natural mechanisms and have a continuity with lower animals.

8.2.4 There are other biological pictures

Physiological, psychological, social etc. These are all different biological pictures. They give different and complementary views of humanity. None give a complete view, they complement each other. All are needed to provide a complete view. In many ways as we move in any consideration of humanity from the most basic (genetic) picture to those with complex systems (social and religious) we see new and emergent properties appearing that cannot be described or reduced to the level of physics and chemistry or to physiological systems or to brain responses.

8.3 SOME RESPONSES TO BIOLOGICAL ANTHROPOLOGY

The fundamental question is, do these pictures exclude a theological anthropology or are there serious conflicts with such a picture?

It is an important issue since a theological anthropology, informed by Scripture, forms a basis for our concept of human worth and dictates our ethical restraints with regard to the manipulation of humanity.

Consider three possible responses which have been adopted.

8.3.1 To reinforce reductionism: proponents

This may be expressed in the context of various biological approaches. Let us consider the contentions of three reductionists, one from evolutionary biology, one from social biology and the third from genetics and neuroscience. All are vocal exponents and all seek to reduce humanity to its basic component parts

Dawkins: DNA — the "River out of Eden"

Considers humanity as essentially a DNA survival machine. DNA is the river that flows out of Eden. We are nothing more than "selfish genes". Aesthetic, moral and spiritual properties are reduced to these. `

EO Wilson: Genetic determinism — behaviourism

Considers all human behaviour to be determined by the chemical (genetic) message of the DNA within cells.

Crick – "The Astonishing Hypothesis"

Relates to mind and DNA. Crick’s astonishing hypothesis is "That you, your joys and sorrows, your memories and your ambitions, your sense of personal identity and freewill are in fact no more than the behaviour of a vast assembly of nerve cells and their associated molecules". Susan
Greenfield in her recent TV series promotes this view. Spiritual and intellectual properties arise in the brain. There is no place left for the mind or spirit. All are reduced to the physical brain.

**Critique of reductionism**

It can be experimentally asserted however that we are shaped by both nature and nurture, by genetics and environment. We are not described even biologically by chemistry (even DNA chemistry) alone. There is an emerging complexity at each level of biology. The description at each level is complementary. The whole picture being more than the sum of the parts. The physiological description cannot be reduced to a physico-chemical, or a behaviorist view to a genetic one. There are many levels of organisation. There are many different scientific viewpoints from which we can observe and define humanity, literature and theology also.

**Emergent realities: levels of organization**

This can be illustrated by the following diagram adapted from Peacocke (1993). See also Murphy and Ellis (1996).

- **LEVEL 1 – PHYSICAL**: physics, chemistry, biochemistry, linked via DNA and molecular biology with
- **LEVEL 2 – BIOLOGICAL**: cytology, cell biology, physiology, ecology, linked via cognitive sciences (neuro biology) and sociobiology (behaviour genetics) with
- **LEVEL 3 – BEHAVIOURAL**: consciousness, cognition, reasoning, social psychology, linked via philosophy and theology to
- **LEVEL 4 – HUMAN CULTURE**: religion, linguistics, arts, worship, morality.

Each level is expressed through the mechanisms of the lower levels but is not reduced to them. Each level represents a new reality more than just the sum of the individual constituents.

**8.3.2 Retain outmoded theological models**

A second response is to retain outmoded theological models. The second response to the developing biological picture of humanity is to adopt a siege mentality, to cling to outmoded models that are based not on truth but on presuppositions, rather than to reexamine these models.

**Conception, genetics and the soul**

Many Christians consider immortality to be intrinsic, an expression of the presence of a spiritual substance infused at conception—a soul. It needs to be asked whether this is consistent with biblical theology or just an overhang from Platonist metaphysics. It certainly presents a conflict with the modern scientific understanding of mind.

**Body, mind and spirit – dualism or tripartite humanity**

Humanity as body and mind or as body, mind and spirit, give a fragmented view of humanity which cannot be sustained by either biology or biblical theology. This does not mean we must espouse reductionism, but we do need to revise our presuppositions. We need to review and not therefore reject theological (biblical) anthropology.

**8.3.3 To revise presuppositions about humanity**

We need to learn from history. Galileo forced a re-examination of concepts of a central earth as Darwin did of a static creation. There is a need to relook at
biblical revelation with respect to humanity and to determine what is the theological picture of humanity; to reject a dualist understanding, but to consider the reductionist implications of a purely monist model.

8.4 BIBLICAL ANTHROPOLOGY

8.4.1 Perspectives

Scripture views humanity from a different perspective than does biology. It is concerned with purpose, not description or mechanism. Further, Scripture complements but does not conflict with biological pictures of humanity. It provides both a context and a limitation to biological technology. Humanity is both the subject and the object involved with technology. What protection do we merit? What right have we to play God?

Essentials

Several key elements can be highlighted. Humanity is created by God, is part of the created universe, but is not God. Humanity is one with nature and animals. There is a continuum in the Genesis 1 & 2 record. Humanity is however made in the “image of God”. Therefore it has a special place in creation. “Imago Dei” is used sparingly in Scripture. It does not imply creation in God’s “physical image”, but there are several aspects that are involved. These include self consciousness i.e. mind, freewill, self determination, moral responsibility, character. Two aspects in particular however are paramount.

Relationship, Gen. 1:26–28 and Gen. 2, 3.

There is a three level relationship. Humanity is created in relationship with humanity, (male/female), with the rest of creation, and with God.

Representative “tselem” —image in the market place

To look after and care for the whole of creation. In Judeo Christian theology, humanity has been elevated not to a centre stage role to dominate nature as frequently caricatured, but as a steward to look after the interests and to care for the whole of creation. “Playing God” or “interfering with nature” are emotive terms often used in the genetic debate, but need to be seen in the context of this stewardship role. Scientists have a theological mandate to act (but not a mandate to pursue an agenda that is contrary to principles of justice and respect for humanity as the object of their technology) as part of a theology of stewardship.

8.4.2 Nature of humanity

What does scripture say about it? What about the soul? See Brown et al. (1998); see also Crick “The Astonishing Hypothesis”.

Gen 2:7 “God breathed... became a living being”

Humanity is of the earth—at one with nature. “Earth to earth” is emphasised in the funeral service. Humanity is given life by God: “nephesh” means life (not soul), cf. Gen 1:21. Life, emotions and heart, are all involved and are frequent translations of “nephesh”. The picture is of a unity, given life by God, one person made in the image of God. The Hebrew view of man was a very unitary one, dependent for life and immortality on God. We are embodied “souls”, not dual entities. “Soulness” represents the person, the “me”, the essential nature of humanity, but is not separate or distinct from it.

New Testament

Greek culture was Platonist giving rise to a dualist or triist model of humanity. Humanity was envisaged as having both a spiritual and a somatic component. The spiritual component was eternal and survived, while the somatic was
downplayed and evil. NT scriptural terms are derived from Greek culture, but the NT concept of humanity does not differ from the Hebrew unitary view of humanity. Body (soma), soul (psuche), spirit (pneuma) represent three aspects, three views, of the one person. They can be considered as different aspects of one person not as different parts or substances. Christian immortality and hope does not reside in an immortal soul but in the resurrection (1 Cor. 15; creeds) of the whole person.

Bube (1995) sets it out well. Humanity is viewed from three perspectives.

<table>
<thead>
<tr>
<th>TERMS/MANIFESTATIONS</th>
<th>FIELDS</th>
<th>CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BODY (soma)</td>
<td>Chemistry</td>
<td>DNA</td>
</tr>
<tr>
<td></td>
<td>Biology</td>
<td>Genes</td>
</tr>
<tr>
<td>SOUL (psuche)</td>
<td>Psychology</td>
<td>Self Consciousness</td>
</tr>
<tr>
<td></td>
<td>Sociology</td>
<td>Emotions, Mind</td>
</tr>
<tr>
<td>SPIRIT (pneuma)</td>
<td>Theology</td>
<td>Spiritual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relates to God</td>
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</tbody>
</table>

Together we get a picture of humanity. Thus biblical views are not contrary to biological views.

There may however be a need to reassess the presuppositions held by some Christians and also by non-Christians about Christian views of humanity.

### 8.5 SOME REASONABLE CONCLUSIONS

Biology and theology give different, but not contradictory, views of humanity. They are not in conflict although certain presuppositions may be. They represent complementary views.

A biblical understanding of humanity confers a mandate on humanity to manipulate nature. Such a mandate is not intrinsic, it is related to humanity’s place in creation. The theological picture of humanity also sets limits for this manipulation, again related to the place and potential of humans made in the image of God.

Theological anthropology is informed by the scientific understanding of humanity as exposed by biological study. It is not however replaced by the biological view of humanity. Rightly understood a biblical anthropology has much therefore to contribute to a full picture of who we are as persons and is discarded at our peril as we move into the new territory of molecular genetics with its increasingly powerful technology.
8.6 REFERENCES


Brown, WS, Murphy, N, Maloney, HN, 1998, Whatever happened to the soul, Fortress, Minneapolis.


Jeeves, MA, 1994, Mind fields, Apollos, Leicester.


Murphy, N, Ellis, GFR, 1996, On the moral nature of the universe: Theology, cosmology and ethics, Fortress Press, Minneapolis.


Chapter 9  GENETICS, REPRODUCTIVE TECHNOLOGY AND ETHICS

Allan J Day
Chapter 9 - GENETICS, REPRODUCTIVE TECHNOLOGY AND ETHICS

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9.1 INTRODUCTION - GENETICS, ETHICS AND THEOLOGY

The genetic revolution has important ethical and theological implications. This has been highlighted by a number of key developments in genetic knowledge and technology over the last 20-30 years.

These include **firstly** the introduction of genetic engineering by recombinant DNA technology in 1973. Initially this was followed by a voluntary moratorium for 2–3 years to enable some of the implications of this powerful technique to be explored.

**Secondly** the commencement of the Human Genome Project in 1990 with a planned completion date in 2005 (actually achieved in 2003). This program has created a number of ethical dilemmas — some relating to the use of this information for insurance and other similar purposes and some related to the use of the technology for gene therapy etc. and the possible danger for germ line changes.

A third development is the cloning, by adult nuclear transfer, achieved for sheep in 1997. Dolly has become perhaps the most famous sheep in history. Human cloning from adult human cells is now technically feasible, particularly bearing in mind the enormous experience gained from in vitro fertilization technology over the last 20 years. At present however human cloning is under either voluntary or legal ban in western countries, but pressures for its use are mounting. There is also pressure from both religious and political sources to prevent its use. Bruce (Church of Scotland Ethics Committee) indicates it is a “clear violation of the uniqueness of human life”, while Bill Clinton indicates that “those who wish to replicate themselves are trying to play God” Before considering the basic ethical approach to this area, it is necessary to consider the current scientific and technological background to the genetic revolution. To consider what is known and what is possible. The field is rapidly developing.

9.2 SOME INFORMATION FROM BIOLOGY

9.2.1 Reproductive physiology

**Conception and implantation**

Conception occurs from the biological standpoint with the fusion of the gametes or sex cells from the genetic parents. This results in the formation of a zygote from the combination of the nuclear material of the ovum and the sperm. Genetic fusion thus results in unique genetic material; i.e. a new biological individual results to give a one cell zygote. The zygote then progressively divides to become a multicelled organism—a blastocyst. One cell becomes 32, then 64 cells prior to implantation. These changes occur as the fertilized ovum makes its way through the Fallopian tubes to the uterus. Implantation in the wall of the uterus takes place at the blastocyst stage at 10–14 days from fusion. There is some confusion about the definition of “conception”. Biologically this is understood to take place at fusion. However the term is often used clinically to represent the time of implantation at 10–14 days from initial fertilization.

**Preimplantation embryo**

Several characteristics of the preimplantation embryo are relevant to any consideration of its status as a “person”. The preimplantation embryo is pluripotential—twinning is possible and occurs in a proportion of cases with the division of the original zygote into two to produce genetically identical or monozygotic twins. In addition particular cells from the zygote are not committed to develop into foetal cells at this stage. They may develop into either placental or embryonic cells. Moreover the removal of some of the blastocyst cells does not prevent full foetal development. A further consideration is that in abnormal circumstances a hydatidiform mole (a sort of cancer of the fertilized ovum) may develop. This abnormality contains genetically unique human genetic material,
but can hardly be considered on this criterion to be a “person”. The preimplantation stage is also characterized by considerable wastage. Some 60–70% of fertilized ova fail to become implanted or to develop further and they are lost without any symptoms.

**Embryonic growth and development**

The term embryo is best reserved for the products of conception from implantation to the 8th week. There is both rapid growth and differentiation. The embryo attains a length of 2 cm, and a weight of 2 gm at 8 weeks. All main systems are developed and the external bodily form established by this time.

**Foetal period—8th week to term**

This period is considered to be the foetal period. There is rapid growth, but no major differentiation. Movements can be detected ultrasonically at 7–8 weeks, and clinically at 17–20 weeks. Viability is often the product of better neonatal technology. At present a premature foetus may survive from around 20 weeks or about 400 gm in weight.

**Central nervous system**

Neural tube development commences at three weeks with a definite polarisation of ends appearing. At this stage we can identify one end as the head. Cortical differentiation is, however, progressive from 7–8 weeks, with gradual development of cortical areas associated with consciousness etc., although the details of such development are still unclear.

### 9.2.2 Reproductive technology

**Artificial conception—IVF**

The first infant conceived by in vitro technology was born in 1979 in Cambridge (Edwards 1979). This is now a commonly used approach to infertility right around the world with Melbourne playing a very significant role. Human IVF makes possible the use of gametes from a variety of male and female sources and also of surrogacy. Its use of genetic material from other than couples in a stable relationship is however discouraged in many centres. In this case the biological and social parents are identical. The possibility of donated gametes and of donated wombs raises no technical problems, but certainly some ethical ones. In vitro fertilization also raises problems related to embryo wastage, since often large numbers are produced and not used. These may be stored for subsequent use or be candidates for embryo experimentation. Again the question is asked. Are embryos persons? This issue will be discussed below.

**Pregnancy and prenatal diagnosis**

Amniocentesis is a technique in which foetal cells are removed for genetic or other appropriate examination. It is an invasive technique, which has some risk. It cannot be performed until relatively late in pregnancy (18 weeks) so that the question of subsequent action is difficult. It may form the basis of a recommendation for an abortion under some circumstances where genetic abnormalities are detected. However such abortions are more hazardous. Chorionic Villi Sampling can obtain similar genetic information but can be done much earlier (12 weeks). It has become a fairly routine procedure in pre-natal care, but its role needs to be considered in relation to the potential use of the material. Genetic diagnosis of both genetic constitution, or abnormality, or, of course, of the sex of the foetus, is possible by present technology. However at present little can be done with this information apart from it forming a basis for abortion.
Abortion—surgical and chemical (RU486)

Most abortions occur spontaneously and represent normal attrition or the removal of genetically defective embryos. Most occur before implantation. Spontaneous abortion needs to be distinguished from induced abortion, in which active surgical or chemical intervention is involved. The surgical methods are now supplemented by the use of chemical agents such as RU486 which is a progesterone antagonist and prevents the continuation of implantation. The indications given for abortion may be medical—to protect the physical health of the mother. Abortion is however frequently performed for social reasons. With the advance of genetic technology and of the prenatal diagnosis of genetic abnormality, the latter is becoming an increasingly important indication. An extension of this indication is the use of prenatal diagnosis and abortion to tailor infant requirements to order. To select boys or girls or any other genetic feature for that matter. Thus we achieve the undesirable end of the commodification or the “production of children”.

9.2.3 Genetic engineering, gene therapy

There have been a number of key developments in this area over the last half century.

Watson and Crick—1953

The genetic code and its characteristics are considered briefly in Chapter 8. The role of DNA and the four bases, Adenine, Guanine, Cytosine and Thymine in forming a genetic code was not fully understood until 1966 even though Watson and Crick had determined the chemical structure of DNA in 1953. Adenine/Thymine and Cytosine/Guanine bonding ensures complementary pairing of the two strands of DNA. The three-base coding for individual amino acid addition in protein synthesis provides the basis for the chemical nature of genes as the carrier of genetic characteristics.

Nobel Laureates 1963–1973

The period between 1963 and 1973 was particularly productive in elucidating the mechanisms of DNA and RNA function. Transfer RNA provides a means whereby the nuclear message is transmitted to the cytoplasm of the cell. The genetic characteristics carried in the nucleus DNA are thus translated into somatic cell activities. The mechanism for gene synthesis has also been elucidated.

Recombinant DNA molecular biology—1973

In 1973, as indicated above, techniques were developed for synthesizing and cloning DNA. This raised tremendous possibilities not only for general biological applications but also for human applications. Human proteins such as insulin or human growth hormone could be synthesized by non human means. There was also however the possibility of human gene therapy <has something dropped out of this sentence?>somatic and germ cell.

Human Genome Program—A biological “moon shot”—1990–2005

This program is the biggest biological program ever attempted. Three billion dollars based at NIH is committed to determining the total human genetic constitution. It has been compared to a “biological moon shot”. It will be possible to identify all the genes that make up the human genome and the aberrant genes that replace these in genetic abnormalities. There are 23 pairs of chromosomes, 1.5 million “potential” genes, but only 20,000–30,000 actual genes. These will be sequenced and localized and their function determined. The program raises many ethical questions.
**Human gene therapy**

**Somatic 1990**

The synthesis by cloning techniques of human genes which can be used to replace deficient genetic functions in individuals so affected is now feasible. Adenosine Deaminase deficiency has been treated by such somatic gene therapy. It involves the introduction of modified white blood cells and retroviruses into the bone marrow of patients with defective genes. In this way the defective enzyme is produced.

**Germ cell**

This procedure is currently forbidden because of the potential dangers involved with changing the genetic constitution of the individual. This is an irreversible process involving as it does the substitution of synthetic genes for natural genes in the germ cells which of course then replicate in subsequent generations.

**Cloning adult nuclear material—Dolly**

As indicated above the technology for human cloning is now available and conjures up all sorts of pictures of rows of little Hitlers etc. being produced in laboratories. It certainly has its ethical counterparts that warn about proceeding without due caution, but we need to be guided by proper ethical principles not by emotion.

**Stem cell cloning**

Similar procedures may be used to prepare cloned embryos, which can be used to produce stem cells—so called therapeutic cloning. These can then be used as a source of transplant material.

The wealth of human and animal techniques available make genetic engineering a powerful tool in the manipulation of biological nature. It also forces us to consider the nature of being human and the implications of humanity for any biological manipulation.

**9.3 SOME ETHICAL NORMS**

**9.3.1 General approach to ethics**

**Problem of rules/principles**

Ethics and morality need to be distinguished. Morality is essentially a set of rules, whereas ethics provides a framework for making moral decisions. It is thinking about moral behaviour—moral philosophy. In many areas and in particular in the emerging bioethics scene there are no set nor clear-cut rules. We need to define the principles that should determine our actions. These may often conflict with each other. It is not appropriate for this to be an emotive response, but rather one that is based on rational considerations.

**Basis for behaviour**

Classically the basis for behaviour may be defined by two types of criteria:

- **Principles—deontological ethics**
  
  Such principles may be derived from natural law, or from biblical/theological principles or by society norms. However we are reminded that we live in a pluralist society.

- **Consequences—teleological ethics**
This is utilitarianism, the criterion being the production of the best result for all (see Singer, Wells). There are limitations to both systems, but a critique is beyond the present scope.

**Morality and legality need to be distinguished.**

Moral issues are concerned with what is "right". Legal issues are concerned with the protection of society or its weaker members. For example, embryo rights may have both moral and legal aspects.

**We operate in a fallen world—outside Eden.**

Therefore we are frequently faced with the issues of the lesser of two evils, of reconciling conflicting principles. Thus it is possible to conceive of a situation where the "moral course" may involve actions that are "sinful" taken in isolation.

**Pluralism, Christian morality**

Again "what is acceptable" may not be "what is good". The ethical view is not necessarily the accepted practice. It is important however to respect autonomy of decision, e.g. regarding abortion, homosexuality.

### 9.3.2 Ethical principles in the biotechnology debate

There are three basic areas for consideration in the bioethics debate.

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<thead>
<tr>
<th>Technology</th>
<th>Dominion</th>
<th>Stewardship</th>
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<tr>
<td>Medical treatment, including genetic manipulation, is part of the Genesis 1 stewardship mandate. We are not playing God, but exercising the mandate given to humanity by God. The question remains however, how far can we go? Our stewardship is exercised in an atmosphere of responsibility to God and his creation. It is subject to limits. Questions of cost arise and of relative cost, where (ethical) choices must be made. A single IVF treatment may be costly. Compare this to a third world immunization program! Care must also be exercised in the invasion of the technocratic approach into a relational field such as procreation. There are no trite answers to these sorts of issues, but they must be considered in supporting any responsible action.</td>
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**Biblical understanding of family, marriage**

Genesis 2 sets forth as a basic creation ordinance the institution of marriage and of procreation as being conducted within a monogamous, exclusive, heterosexual and mutually supportive relationship. Procreation is not just a biological function associated with genetic sex, but with the development of children in a family relationship. Sexuality is thus not just biological, but involves mutual support—community.

**Nature of humanity—human worth**

Humanity is created in the "image of God". Therefore human dignity does not depend on any intrinsic value, but is determined by the possibility of relationship to God. It is not determined by the value of an individual to society for example. Human life is subject to the sovereignty of God and is not to be taken lightly either in self murder or murder.

Exodus 20, "Thou shalt not kill", is not just a negative proscription, but involves the positive, preservation of life in all circumstances. However it will be noted that Exodus 20 is qualified. It is a general principle, but there are exceptions in the Hebraic law. The emphasis is on the preservation of life: both positive—"do not kill", and negative—to promote a climate to support life. Therefore it is concerned also with the protection of infants from environmental assaults in pregnancy, with famine in Ethiopia, with the prevention of road accidents and with the provision of

*Author: Allan J Day*
cheaper HIV AIDS therapy to pregnant third world victims etc., because human life is valuable to God.

9.3.3 Questions

- What about the foetus?
- What about the embryo?
- Are embryos persons? Do they have equal value?

Abortion, IVF, embryo experimentation, stem cell cloning issues are determined by these questions.

9.4 THE EMBRYO—IS IT A PERSON?

Several possibilities present themselves. Firstly let us consider the proposition that the embryo is a person. Can this position be sustained as some maintain and if so what are the consequences?

9.4.1 The embryo is a person.

The first argument is based on biology. The embryo is a unique genetic individual.

**Biological basis—genetic uniqueness.**

It cannot be denied that at conception we have the beginning of a new, unique individual. It is a strong argument for the value of embryo “personhood”. There is a continuum from this point, both as a member of the species and as a “human person”.

**However, we must ask whether humanness is comprised of "genetic uniqueness".**

Being human is not just biological or genetic. This position asserts that humanity is fully described by their genes. This is a reductionist view and is discussed in relationship to the nature of humanity in Chapter 8. We must reject that proposal. In any case **Genetic uniqueness may not determine humanness.**

As indicated above “hydatidiform mole” chimera are abnormal, but have unique human genetic material. They do not develop into a person nor would any consider they have any claim to personhood. Again as indicated above the early embryo is pluripotential. Twinning, therefore will produce two or more individual persons, but with identical genes. The genetic material is thus not unique, but is held in common with the identical twin. The early embryo develops partly into placental and partly into foetal tissue. Thus any part has the potential for either. Embryo wastage is extensive. We do not claim that the destiny of wasted embryos is the same as for persons. An embryo therefore needs **nurture, environment, social surroundings to become a person, not just genetic identity.**

**Moral or social basis—O’Donovan**

O’Donovan considers that the status of the embryo is not defined by the biological alone, but defined by our personal engagement, commitment as a society. We have a stance of moral commitment: the embryo is to be treated as a person. Care and attention are associated with the response to the embryo.

Thus all embryos are to be treated as persons, although they are not actual persons; i.e. they are considered in relationship with society (and with God).

**Philosophical basis - Iglesias**

Emphasizes that there must be a distinction between the potential to **become** a person, and the potential of a person. That is, ontologically the embryo is a
person and becomes what it is. “What makes us persons is the kind of beings we are” not the manifestations or attributes which may come later.

To consider the embryo is a person has certain implications.

**Implications**

The embryo would have full human rights, and be treated as of equal value to an adult.

This consideration is relevant to abortion—no distinction can be made between mother and foetus. It is relevant to the disposal of surplus embryos, and of experimentation in IVF and in stem cell cloning.

What are these human rights re experimentation? They are defined by the 1964 World Med. Assoc. guidelines and the 1975 Declaration of Helsinki. There are three aspects emphasized.

- The importance of the research must be proportionate to the risk.
- Consideration of the individual must prevail over the interests of science or society; i.e. life and health of the patient/subject is paramount.
- Informed consent is required, and, if not possible, a procedure is only considered if no harm is done to the patient/subject and the procedure is for therapeutic purposes.

Cf. embryo research—death of the embryo i.e. issues of damage/consent.

These considerations do not hold if the embryo is not a person.

Does one therefore equate all embryos as persons?

This leads us to the second possibility.

**9.4.2 The embryo becomes a person at some definitive point.**

But when? There is a biological continuum, so no clear cut biological point can be attested. There are, however, a number of points that have been suggested. They include:

- Implantation: 10–14 days
- Neural development
- Early late, 3 weeks after birth or post birth.
- Quickening
- Ultrasonic 7 weeks, clinical 17–20 weeks
- Viability
- 20 weeks, but reducing
- Birth—continuing care is necessary
- After birth, cf. Singer
- Foetus is thus of no value
- Prochoice prevails therefore with abortion

**McKay position**

*Attempts to cope with the wastage issue*

Therefore we have M and X embryos, those that survive and those that are wasted.
Bases personhood on cortical neural development
That is, a decisive moment of maturation of the CNS before which the “I” does not exist—there is nobody there—not a cognitive, relational agent. This proposes development of personhood at some point.

M embryos can look back to the hand of God in their development.
X never reach development, therefore have no history.
There is no basis in Scripture or science to consider every embryo is a person with a moral claim on us.

Implications of a step wise personhood
The pre-person embryo must be considered as a non person, with no rights. Therefore it has no more value than a piece of “tissue”, such as a removed appendix. It has the potential to become a person but is not a person. Therefore it can not be treated as a person.

9.4.3 Embryo is a potential person—relative value
See G Jones (1987) p. 152:

“A human foetus is a potential person in contradistinction to an actual person (a normal adult human) or a being with a capacity for personhood (a temporarily unconscious person) or a possible person (a human sperm or ovum) or a future person (a person in a future generation).”

Thus it has value at all stages, but the value of the embryo is less than that of the six months foetus. For example, the potential person will become a person with suitable nurture and therefore deserves to be treated with respect. In this view a high premium is set on embryonic life at all stages but the value is less for an embryo than a foetus etc. Protection is never absolute.

9.5 SOME SPECIFIC ISSUES
Finally let us consider some particular issues in this area.

9.5.1 Pre implantation screening
Cystic Fibrosis, Tay Sachs and Huntingdon’s Chorea are all serious genetic abnormalities that can be detected by pre natal genetic screening. Should we destroy affected embryos? Is the embryo a person?

9.5.2 In Vitro Fertilization
Are we playing God? The issues become more complex ethically as we move from the simple situation of ova and sperm coming from the social parents to the issue of donation of either ova or sperm or both. In this case the genetic and social parents are not the same. A further move is to the usage of a donated uterus (Surrogacy). With the production of excess fertilized embryos the thorny issue of embryo experimentation also arises.

The following issues also raise significant questions:
- Genetic screening and abortion
- Gene therapy—somatic, germ line
- Cloning—reproductive and therapeutic references
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Chapter 10  THE EARTH AND ITS ENVIRONMENT

Ross H Macmillan
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10.1 INTRODUCTION

There can be little doubt that there is in the community at least the perception of a crisis in the environment. A range of views are expressed. Some argue that there is no crisis or, at least, that it is limited or manageable. Many would see it merely as a crisis in science or technology. Others emphasise the religious and theological background. Some would offer a primitive spiritualistic, pre-scientific solution. Many Christians seek an understanding based on both biblical and scientific principles. Some of the above views are, of course, not mutually exclusive.

Humans have always altered the environment, but for most of history the effects have been small in scale, diffuse in location and limited in time. Until the 16th/17th C., the greatest effects resulted from agriculture as it developed from merely hunting/gathering to a multi-cultural and later to a mono-cultural industry. The elements of a crisis, such as the pollution of the air and waterways, which first appeared at a few locations in Europe during the Industrial Revolution, still appear in developing countries where industrialisation is taking place.

What then is the nature of the perceived environmental crisis?

To see it as purely a crisis in 'science and technology' is to fail to see the big picture. Moltmann (1985), while acknowledging the pervasive roles of these, calls it a 'crisis of domination based on the striving of human beings for power ...' and a crisis of the 'whole life system of the modern industrial world'. This suggests that any study must be set in a wider religious and social context. It is highly significant that modern science, and particularly technology, developed in Europe in the context of a set of underlying Christian values (Hooykaas 1972). It is not surprising therefore that in a course on 'Science and Faith' we should look back and seek to identify the respective roles of science and theology in these developments. We begin (following Russell, 1994) by consideration of alternative world views and changes in attitudes that humans have adopted in relation to the earth, before considering some modern manifestations of the crisis and the theological attitudes towards it.

10.2 WORLD VIEWS IN RELATION TO CREATION

Pre -scientific

The 'pre-scientific' understanding of the world was partly phenomenological (what you see is what is true), partly mythical (a story with 'fantastic' elements to explain the otherwise inexplicable) and partly spiritualistic (of a world ruled by spirits). The ancient Near East and Australian aboriginal creation myths are typical of such pre-scientific views.

Scientific

The modern 'scientific' world view which initially at least was materialistic, reductionistic and rationalistic had its origins in the Enlightenment and Puritanism in the 16th and 17th C. It was based on success in understanding, predicting and controlling the world. Key ideas were of reproducibility, predictability, verification, proof, falsifiability and laws that provided a universal explanation. The scientific approach treats the world, at least partly, as a 'mechanism' even when biology is being considered (Russell, 1994).

Post-modern

The post-modern understanding of science frequently involves a disdain for rationalism and conventional science because of the (perceived) destruction of the earth in the name of science and technology. Creation and nature are seen rather as organismic, mystical and spiritualistic (Russell, 1994).
Theological

While there may be truth in some of the above, Christian theology looks outside pre-scientific mythology, scientific rationalism and post-modernism for an appropriate understanding of humans in relation to creation. It claims a revelatory basis that involves a 'creator'; the appropriate relationship of humans to the earth is summed up in the word 'stewardship'.

Again some aspects of these may not be mutually exclusive.

10.3 Historical Review of the Human Understanding of the Earth

10.3.1 The Earth in Space

Russell (1994) explains three changes in the human understanding of the earth, viz, its nature, position and status.

Nature — from isolation to integration

Early ideas from ancient Babylonian and Greek myths were of a flat earth, floating on water under an over-arching heaven. However a spherical earth was recognised from the 6th BC as floating in space (Job 26:7). Greek cosmolologists (e.g. Aristotle 384–322 BC) integrated creation into a geocentric system but made a distinction between heaven with circular motion but no change and ether as the only element, and the earth with rectilinear downwards motion, four elements (earth, air, fire and water) in which all was subject to change.

These Aristotelian ideas resisted theological criticism until Copernicus in the 16thC. Changes in the heavens (due to the appearance of super-nova and comets etc.) and on earth (as illustrated by Newton's and chemical laws) suggested that one view of science applied to both earth and heaven; this led in turn to a (romantic) view of the unity of all creation. Scientific advances brought about the integration of the whole universe as the subject of the one set of laws. *If the earth is "special" in any sense, then we cannot know this from science* (Russell, 1994).

Position — from fixity to mobility

The ancient idea that the earth was the centre of the universe had a phenomenological basis. Copernicus transformed this understanding of a fixed earth with heavenly bodies rotating about it to a rotating earth hurtling through space around the sun which itself is hurtling through space. This led to a changed view based on new observations of heavenly bodies—planets, super-novae and comets—and the discrediting of old geographic ideas about earth, continents etc.

Augustine (354–430) explained that Scripture accommodated itself to common human understanding and language. Hence there was no necessary connection between 'position' and 'value'; removal of the human home from the centre of the universe did not mean that it was diminished in status.

This change in the understanding of the earth from being the centre of the universe to being a speck of cosmic dust whirling in the immensity of space involved a vast transformation of the then current world view. *What had altered little was the understanding ... of human and other values that owed nothing to science but much to theology* (Russell, 1994).

Status—from organism to mechanism

Ancient Near East mythical philosophy saw the heavens as part of God and the earth as divine and organismic, giving birth to everything, including all life. This 'deification' of the earth gave rise to animistic religion. It was generally rejected by the early Church fathers as not in accord with the Old Testament where the
worship of 'the queen of heaven' or of local gods was condemned. God alone must be worshipped; '... the earth is my footstool ...' (Isaiah 66:1).

It was also superseded in the West due to the development of reformation theology and the rise of modern science. Yet the idea of the earth and creation as organismic has never been entirely eradicated; the notions of 'mother earth' and 'mother nature' live on in figures of speech, vague notions, superstitions and in 'folk theology'.

CONCLUSION — a mechanistic world view

The above changes and the rise of experimental science in the 16th and 17thC transformed the world view, including nature, from organism to mechanism. The connection between this and the Judaeo-Christian tradition has been discussed elsewhere (Hooykaas 1972). This concept of 'mechanism' as in a clock (logical, determinate, predictable and repeatable) was seen as an expression of the 'laws of nature' which represented the will and providence of God acting in the universe.

This rise of modern science involved the development of concepts based on biblical theology: the removal of myth from nature, recognition of the 'laws of nature', the adoption of the experimental method, doing science for its own sake for the glory of God and controlling/developing the earth for human betterment. The promotion of these scientific concepts arose within various Puritan (Boyle), Calvinistic (Beeckman) and Catholic (Descartes) traditions. However some, who were major contributors to the mechanistic view (Newton), could never quite bring themselves to believe in pure 'mechanism' at the immediate level.

By the mid 19thC the organismic view was superseded and the mechanistic view was nearly universal. However the latter was both an ally and an enemy of biblical theology. It involved: design which demanded a designer and a mechanical view which became the base for apologetics; a materialistic, reductionist view suggesting that the earth was nothing more than materials, atoms etc; self sufficient deism in which the creator had left the clock after creating/winding it up and a deterministic view in which creation was incapable of accommodating either human free-will or divine providence and a mechanical earth that was seen as expendable/susceptible to abuse.

In biblical terms the mechanical world-view has much to commend it. It includes the idea of design and a designer, an element of determinism and repeatability, the base for the scientific enterprise and technological exploitation but also the ever present danger of damage or misuse. It excludes the organismic view and the pre-scientific myths.

10.3.2 The earth in time.

Again, following Russell (1994), we can consider an historic sequence with a commentary on each from a theological point of view.

A static earth

The pre-scientific view was of a largely static or at least cyclical universe, not only in nature but in human history. There is an element of truth in this at least in the short term scale of human life and experience (Ecclesiastes 1:4-7). But for many, the Bible demanded a linear view of history moving, under God, toward a certain destiny.

An earth in decay

An alternative view is of an earth as the scene of change and subject to corruption and decay (Psalm 102:25–26) compared to the 'unchanging' heavens. This was tied to an apocalyptic understanding of the end of history with the
coming of a new millennium (after Augustine's seven Christian ages). One view (Luther (1483–1564)) was that:

'The whole world degenerates and grows worse each day . . . the last day is already breaking ... the world will perish shortly' (cited in Russell, 1994).

Others, for example, Burnet (1635–1715), Donne (1573–1631), Wesley (1703–1791), etc., saw the mountains, the irregular features and the roughness of the surface of the physical world, as evidence of decay (especially since the flood) because they were not made like that. Hence they were evidence of God's judgment on the earth (Job 14:18).

**An earth in equilibrium**

The rise of natural theology led to a new understanding of earth, not just as in decay but as evidence of the goodness and benevolence of God. Thus the understanding was of the mountains as providing shelter from the cold winds and their denudation as evidence not only for the decay of the earth but as a natural process providing soil for the fertile flood plains. So the earth as a whole was seen as in a geological cycle, with parts subject to decay while others were subject to growth and rebuilding. The conclusion was that the earth was neither static, nor in decay, but with a long, open ended history.

**An earth of great antiquity**

There has been a 'young earth' history from earliest times, popularised by Ussher (1581–1656). This involved an active and frequent intervention by God for example, in the flood. By mid 19thC most geologists accepted an active earth and uniformitarianism (constant natural processes) where the time since creation did not limit the period over which the present formation of the earth could have taken place. Many scientists who were Christians distanced themselves from 'young earth' ideas as a result of unsuccessful attempts to produce a detailed correlation between science and Scripture.

Contrast this with the major attack against the old-earth theory that came, not from theological conservatives, but from science itself through Lord Kelvin (1824-1907) and others. This was based on the age of the earth calculated on the basis of the heat loss from it and from the sun (without including the then unknown nuclear processes). All of Kelvin's calculations gave answers that were far too small, although much longer than those for a young earth. However they brought with them the possibility of change in the time scale available for changes in other areas such as biology. He and others helped to establish a science that was not inimical to theistic theology; its study was, as he said, 'the noblest privilege which (the Creator) has granted to our intellectual state' (cited in Russell, 1994).

### 10.4 MODERN EXPLANATIONS OF THE EARTH AND ITS ENVIRONMENT

#### 10.4.1 The White thesis

The ignorant or arrogant despoliation of the earth has arisen, it is said (White 1967) by science and technology, which has developed the capacity, and the Christian religion, which gave the mandate (Genesis 1:28) for human mastery over nature and its subjection to suit human desires. However we need to differentiate between what the verse, taken in isolation might be seen to justify, and the general tenor of Scripture. There have been, no doubt, many misunderstandings in the former but there is little biblical evidence, rightly understood and taken as a whole, that would justify a 'dominion' attitude to nature. Christian writers, while acknowledging the superior place of humans in relation to the rest of creation, are also careful to emphasise human responsibility for stewardship under God. As Calvin (1509-64) said: 'Let everyone regard
himself as the steward of God in all things which he possesses' (cited in Russell, 1994).

Genesis 1 places man as the peak of creation and as steward under God, an idea which is reinforced in other places, e.g. in Genesis 9 and Psalm 8. While humans are created in the image of God, their role is to rule in God's place which includes ideas of care, use and enjoyment.

There is evidence from pre-Christian times and non-Christian areas (e.g. Buddhist) that the idea of human dominion did not arise from Christian understandings alone. Consider Bernal (1967) writing about Marxism: 'It will no longer be a question of adapting man to the world but the world to man' (cited in Russell, 1994). McPherson (undated) offers an alternative focus for White's invective.

'I think that White aimed at the wrong target. A sturdy belief in unlimited progress has characterised Western thought for centuries. This notion of progress is not distinctively Christian by any means and it is this belief that should have been White's target... The remedy ... is to sever science and technology from their progressivist theology of history in which they had found their home'.

The White thesis will not do.

10.4.2 Post-modern theses

There are alternative, post-modern, post-Christian understandings of these ideas. Post-modernism arose out of a rejection of the ideas of rationality and the development of a more intuitive way of thinking. Its understanding of the created order arises out of its religious roots.

Monism

Monism stresses the unity, interconnectedness and equivalence of all things. In theological terms it erases the God-creation distinction. As applied to the earth it would promote the conservation and preservation of eco-systems on the basis that all things have equal status and the denial of human rights compared to other life forms.

Pantheism

In pantheism all, including creation, is God. In ecological terms it implies that plants, animals and places have spirits which are all part of the 'nature spirit'. Seeing the earth as sacred may lead to opposition to its development for human use since humans have no special rights. White (1967) asserts that by destroying pagan animism, Christianity has made it possible to exploit nature in a mood of indifference to natural objects.

These post-modern understandings have spawned a wave of beliefs under the title 'new age movement'. Many of these echo what Christians have been saying about Western culture but they subordinate rationality to intuition and mystical ways of knowing. This in turn leads to a 're-deification' of nature, a return to pre-scientific notions of an organismic earth, a rejection of modern science and a fuzzy eco-spirituality (Lucas, 1996).

10.4.3 The Gaia hypothesis

A particular form of the post-modern understanding was given expression by Lovelock (1987) in the hypothesis of the earth as a living system entitled 'Gaia' (Greek goddess, mother earth). The name brings with it, from ancient Near East myths, ideas of the earth as one of the 'gods' and as an organismic symbol of fertility. While it may be best described as a conceptual model (Russell 1994), Gaia began as a scientific hypothesis that the earth was a unified but unconscious and purely mechanistic, self-regulating system.
The various responses to Gaia have been partly due to the various ways in which the term has been understood. There is general agreement with the idea of the earth as a self-regulating system (based on negative feedback) that is able actively to regulate some aspects of the biosphere, atmosphere, oceans and soil so as to maintain conditions comfortable for life. Whether—as the Gaia hypothesis supposes—the earth is 'alive' depends on what is meant by 'alive'.

While the idea of the earth as 'mother earth' is seen as a reversion to myth, Gaia allowed a religious interpretation which, it could be claimed, was validated by 'science'. However the scientific aspect of Gaia has not been adopted by the New Age movement possibly because of its distaste for science.

10.5 TYPICAL ENVIRONMENTAL PROBLEMS

We consider briefly three areas that may be taken as representative of the problems mentioned above, viz., population, food supply and climate change.

10.5.1 Population

Most would agree that, in any discussion of science-faith issues in relation to the earth and the environment, population is a crucial factor. Beginning with Malthus (1766–1834) many in modern times have warned about the limit that the earth's resources would place on population growth; others have even predicted what that maximum number would be. World population increased only slowly over the previous centuries but is now over six billion and increasing at an annual rate of 1.4%.

The rate of population growth has increased in recent centuries largely due to the reduction in death rate, due in turn to improved sanitation, nutrition and disease control. There has not been a commensurate decrease in the birth rate which only occurs when there is an improvement in the socio-economic status of the population. While this rate of increase has existed before, two additional facts are significant. Firstly this increase is based on a very high existing population and represents a much larger numerical increase than has previously occurred. Secondly some areas are increasing at a much higher rate which is likely to cause severe local problems before community developments cause a decrease in the birth rate and eventually a maximum in the population.

It is logical that greater populations will increase the demand for resources and services. If these are seen as limiting, then the easiest approach to reducing demand is to reduce population growth rate by limiting birth rate although there is no agreement as to how far and how fast this should proceed. From a practical viewpoint, in areas where life expectancy is short, large families are seen as resource for the production of food and an 'insurance policy' against want in old age. It is only when living conditions represented by health and nutrition are improved that security in old age can be assured; the birth rate then falls and population tends to a maximum.

Religious beliefs often promote large families, where a large family is seen as a blessing from God. Limiting birth rate by artificial means including contraception and abortion is therefore seen as contrary to the will of God and has been proscribed in Roman Catholic teaching. This has led to population growth rates in the Latin American countries of some 3%. In other areas family planning and limitation sometimes based on socio-economic pressures have significantly reduced birth rates and projected populations.

10.5.2 Food demand and supply

As a fundamental human need, food, which is the subject of both biblical and scientific concern, is an appropriate subject for consideration in a course on 'Science and Faith'.
Food demand

Food demand is significantly related to population and hence the current, large and rapidly growing population mentioned above causes a commensurate increase in demand for food. At the family level the desire to keep ahead of the personal and community demand for food (by increasing workers) is one of the reasons that family size increases, a process which eventually compounds the problem.

Any increase in socio-economic status of people also brings with it a corresponding demand for improved quality, variety and availability of food and especially increased animal and vegetable protein at the expense of carbohydrate rich foods. There is also demand for increased food security to eliminate the danger of famine resulting from natural or human causes.

Food supply

Food supply is also related to population and the energy resources that power the food production system. This is especially true in developing areas where human energy is often the limiting factor in food production, e.g., by limiting the area or the number of crops that can be grown per year.

Food supply, however, is also related to the increase in production that is achieved, not only by increased energy inputs in the form of fertilizer and mechanisation etc., but through scientific development and optimization such as plant breeding, pest and disease control and better farm management. There have been enormous increases in food production in recent years and an associated decrease in famine in some countries.

Meeting the need

While on the global scale food supply has generally increased to meet demand, the most significant problem arises when other inputs are limiting, especially at a local level. These include land, water, rainfall, pest and disease control and plant nutrition. The shortage of these as a result of natural calamities (floods, droughts, plagues, earthquakes) and human induced factors such as war, soil degradation and salinity are likely to be critical. Many advances in agriculture for the supply of food have brought with them increases in production but also associated problems.

Pressures on agriculture to produce more or better foods often involve (for example): land clearing and the danger of soil erosion, excessive cultivation leading to soil depletion and erosion, intensification of cropping as mono-cultures which are susceptible to pests and diseases, irrigation which brings the possibility of water logging and salinity, modern crop varieties with the potential for increased production under optimum conditions but also decreased production under non-optimum conditions. In the light of these developments, many farmers (both subsistence and commercial) opt for traditional technologies under a general, if perhaps unconscious but understandable policy of risk avoidance.

New scientific developments in genetic manipulation in plant and animal breeding give promise of increased production through pest and disease resistance, increased growth rates, etc. However these developments often extend the science to unknown and what are seen to be unpredictable areas. Many, in fear of ecological problems, reject or warn against inadequately researched moves into this technology.

The trade in agricultural products is of course one means of satisfying national or local demand. However this can be used to distort the demand and supply of basic food products; e.g., where land is used for the production of export crops (such as to grow animal protein for the rich) in the place of staples (often carbohydrates) for local consumption. On a global scale then the food problem is
not considered to be one of demand and supply but of distribution which in turn is a problem of resource allocation both within and between countries. (See Section 10.7 below).

10.5.3 Climate change

Scientific research shows that there have always been significant changes in the earth's climate. Much of the historical evidence available represents significant natural variation over the long periods of time (millennia). It is only in recent decades that observations have been adequate to measure the trends in climate over shorter periods (decades). These show that the world is in one of its warmest periods in recent climatic history.

The atmosphere contains about 0.03% carbon dioxide and this, together with water vapour, maintains the temperature of the earth at about 15°C due to the so called 'greenhouse' effect. This occurs because the atmosphere is naturally transparent to visible radiation from the sun but is more opaque to the energy that is re-radiated in the infrared range due to the presence of the carbon dioxide and water vapour.

Any increase in carbon dioxide and water vapour, for example as a result of burning fossil fuels, increases this effect and can be expected to increase the temperature of the earth. Whether and how much this will occur is not yet clear but is the subject of much dispute and research (Houghton, 1991). The climate then, which is the long term result of the weather pattern experienced by the earth, is the result of an exceedingly complex set of interacting natural and human factors.

Natural factors

The natural factors include the seasonal and other long term changes in land, vegetation, cloud cover, moisture content, oceans, ice and snow cover as well as the effect of volcanoes, fires etc. At a more fundamental level, the parameters based on these factors combine in a series of positive and negative feedback loops. Such systems frequently become unstable and thereby generate extremes of behaviour. It may be that we are presently in one of these extreme phases.

Human factors

The human factors are likely to have a more long term but perhaps no less significant influence on climate. These result from changes in land use as a result of agriculture, forestry, urbanisation and in the discharge into the atmosphere of pollutants including gases and particulates from burning of fossil fuels and other uses of chemicals. The significant question that arises is, to what extent the current changes in climate that are presently being measured have been caused by human actions or are the result of some significant but as yet unidentified natural changes in the environment?

The influence of climate change (however caused) on local weather is not clear but is likely to be highly variable. Some areas may get hotter/cooler or wetter/dryer or there may be more frequent or greater extremes, e.g. floods and droughts. The rise in sea level is more certain but no less alarming especially for those living particularly on the coastal fringes of the Pacific Islands and the flood plains as in Bangladesh.

One mitigating fact is that changes in climate are likely to be slow in taking effect giving the communities time to prepare appropriate 'defences'. Assuming that the burning of fossil fuels is the primary cause, these problems are clearly global in origin. The responsibility for them is therefore likely to be proportional to the respective contributions to the increase in greenhouse gases from the various countries.
10.6 MODERN UNDERSTANDING OF THE ENVIRONMENTAL CRISIS

In relation to these difficulties, various responses may be identified. For the purposes of discussion we can identify the range by its extremes, viz. 'utilitarian' and 'conservationist'.

10.6.1 Utilitarian

The utilitarian approach takes the big picture, the long term assessment and usually works with large scale averages which blur many serious local and short term problems. It assumes a generally optimistic attitude to technological development and to the solution of any problems that arise. Even where the Christian position is not explicit, the biblical command is adopted (Morgan 1992). 'Be fruitful and multiply and replenish the earth and subdue it.' (Genesis 1:28)

Further, historical experience is extrapolated to allow unrestricted population growth (Beisner 1990).

'... if historical trends continue there is no rational basis for believing that population will ever outgrow its ability to provide for itself using the resources it develops ... on the contrary, what we learn from history is that over the long haul and on the average per-capita health, economic well-being and psychological well-being tend to improve faster than population grows... From a Christian perspective of faith in a God of providence, however, we can be confident that human population will never present an insuperable problem.'

In terms of resources creation is seen as large—for many resources, large beyond our knowing.

'Globally there is not the slightest prospect of us running out of any natural resource that we need in the foreseeable future given a modicum of care and common sense.' (Hore-Lacy 1996)

'Resources of all sorts will be less scarce in the future than they are today'. (Beisner 1990)

Further, as Hore-Lacy (1990) claims,

'... human ingenuity quite literally creates resources ...'

Society achieves this: by substitution of existing resource with new, perhaps sustainable resources (fossil fuel by solar energy); by transformation (of matter into energy in nuclear processes, of previously unusable/uneconomic minerals to economic/useable ones, wood waste to paper, etc.); and by reuse/recycling of old products into new (waste water to irrigation water, waste paper into cardboard).

Hence Beisner (1990), writing regarding oil, argues that we will probably never run out because when the resource dwindles sufficiently, its price will rise enough that people will conserve more and substitute other energy sources. Christians who see resources as a God given gift rightly conclude that as such they are meant to be used, where use would include preserve/enjoy; it is in this way that the intent of the giver is honoured (Hore-Lacy 1990).

For the utilitarians and even for Western civilization Morgan (1992) highlights the significance of the utilitarian approach by contrasting it with the environmental movement.

'Environmentalism is now the main threat to Western capitalism and as a consequence to Western civilization ... in its pure form it is as radical and uncompromising an attack on the entire structure of Western society as can be imagined.'
10.6.2 Conservation

Here one focus is put on the finiteness of earth's resources and capacities and on the limit that these will impose, sooner or later, on consumption and pollution. Others in the conservation movement focus on aspects of the environment such as the preservation of what is often called wilderness—natural habitats such as old growth forests, native grasslands, wetlands, rivers etc., in the name of maintaining ecological diversity and other natural resources. Still others emphasise the significance of pollution due to the discharge of wastes into the atmosphere, waterways and the oceans. Various bases are used for a conservation approach. Whether 'God/god' is seen as being involved will usually depend on what beliefs or world view the observer brings to the experience. In one 'secular' approach an appeal is often made to the aesthetic value of natural areas and to feelings of a quasi-religious nature. It is on the basis of this subjective experience that the demand is made to stop further growth and development.

'The sooner an ethic based on respect for the natural world can be adopted, the better. Whether such a philosophy is included as part of a religious dogma is seen as immaterial.' (Ehrlich, et al 1977)

An alternative more pantheistic approach identifies God with the world. According, for example, to McFague (1981), the world is the incarnation of God's very being and presence ... to destroy part of the world is actually to destroy part of the body of God. Expressed in human terms Berry (1987) is blunt.

'We are the generation when the day of reckoning has come. In this disintegrating phase of our industrial society we see ourselves not as the splendour of creation but ... the most pernicious mode of earthly being. We are the termination, not the fulfillment of the earth process ... we are the affliction of the world, its demonic presence ... the violation of its most sacred aspects.' (cited in Collins, 1999)

Without necessarily agreeing with it, Newman (undated) expresses the conservationist point of view at a more practical if extreme level:

'... all industry is seen as exploitative, dangerous and polluting ... all in the name of progress but in fact just adding more affluence to those who already have enough'.

The importance of conservation is expressed by Berry (1987) who writes,

'Ecology can rightly be considered the supreme subversive science ... these ecological movements are threatening all those cultural commitments that have brought about the present devastation of the earth. This rising conflict is beginning to dominate every aspect of the human process'.

10.6.3 A compromise position?

The brief comparison above of the (albeit perhaps) extreme views suggests that the utilitarian and the conservation approaches are in serious disagreement even about the facts, let alone any solutions. One implies that there is no problem, at least that cannot be fixed; the other that a major crisis is looming and urgent action is necessary. Of course no utilitarian would advocate the unbridled use of the earth’s resources nor would any conservationist advocate their total conservation. Many would agree with Hore-Lacy (1990) that;

'We need to tease out the utilitarian aspect of stewardship without violating the preservation/respect aspect'.

These ideologically opposed groups appear to express an ambit claim on the truth; no doubt both are partly true. However the two such polarised positions do
not provide a useful basis for a compromise especially if they just snipe at each other across the utilitarian/conservationist divide. Is there a position that takes cognisance of both the economic and the ecological necessities? Many for whom both of the above positions have some appeal suggest that there is. The idea that best embodies this compromise, 'sustainable development', is considered later.

The earth's resources may be represented in terms of the quantities of materials, the number of sites for inspiration, or capacity of the earth to absorb pollutants. How would a limit on these resources manifest itself? Given the large variation in the area distribution and consumption of resources and also in population it would be surprising if there was a short run 'crisis' on a world scale. One would expect a series of local crises, perhaps of increasing severity and frequency related not only to demand but supply, particularly if affected by local war, famine etc.

There would be a slow decline in the standard of living for an increasing number of people punctuated by conflicts over any resources that were limiting. Are we already experiencing such conditions? It is implied in the utilitarian point of view that the earth's resources can legitimately be consumed by those who have them and or know how to utilize them, especially if they are used for an accumulation of community wealth. (J Ralph cited in Hore-Lacy 1990)

But is there a limit to the amount of the earth's total resources that one community can use to satisfy its demand, even if used for the accumulation of wealth for that community? And, we might ask, for which 'community' can they be used—local, state, national, first world, technically developed, white, Western, powerful?

The question therefore resolves itself into one of inter-national or inter-community resource allocation, a subject that receives little attention except perhaps in the context of aid. Before seeking an answer to this dilemma it is useful to consider how resources are currently being allocated.

10.7 RESOURCE ALLOCATION

10.7.1 Human demand

We can, again following Russell (1994), identify the following drivers for the ways in which the earth's resources are allocated and/or misallocated.

Human need

In accord with need, humans have sought to take what is useful from the earth's resources and exploit it for personal and general use. The benefits of such exploitation need no further emphasis. However nothing that is done is without its side effects; every resource is to a greater or lesser degree used up or degraded. A significant amount of damage to the environment arises from this legitimate human activity. For much of history this was of a minor nature, was diffuse and had little long term effect.

Human ignorance

While all such human activity affects the earth, there has usually been the failure (initially at least) of knowledge or will to mitigate the side effects of those activities. Hence while enjoying the benefits of development that society has 'demanded', we have caused damage. This is illustrated by the fact that 'the art' (= the practice, the works) precedes 'the science' (= the understanding, the optimisation) and does not, and perhaps cannot, foresee the problems that will arise. Clearly much new science/technology is introduced without an adequate understanding of its benefits and problems. In other ways the community is 'forced' to exploit processes with an intensity that is damaging; for example, excessive soil cultivation in order to meet the urgent need for food.
Perhaps the adoption of a technology depends on the likely cost and or magnitude of the dis-benefit to the user and to society generally. It is clear that the earth is self cleaning for some, even many pollutants and at some levels of these. However some would say that for certain modern chemicals with a long life (e.g. uranium) and some modern techniques with potentially far reaching and unforeseeable consequences (e.g. genetic manipulation), we need to learn from our past mistakes and move more slowly in the future. It is, of course, not helpful or logical for society to blame 'science' for the dis-benefits while itself enjoying the benefits. Failure in the past is not with science per se, but with its human exploiters among whom the scientists may have had a significant role.

**Human greed**

The application of much science in technological development and the consumption of the earth’s resources has been driven (in part at least) by human greed. This can be illustrated from our own experience at a human or corporate level. The destruction of habitat, the taking of productive land, the substitution of staple for export crops, the over exploitation of resources, etc., all illustrate the point. In some countries exploitation for personal/local/tribal use is fostered by local connivance, authoritarian regimes and personal corruption; its benefits are often not shared in a way that could be considered satisfactory from a community point of view.

**Human aggression**

Again the local despoliation of the earth by conventional war needs no emphasis. Nor does the unimaginable damage of nuclear conflict and the possible nuclear winter over the whole earth.

**Human arrogance**

Many aspects of the exploitation of science and technology can only be described as arrogant. These arise from a rejection by humans of their role and responsibility for the earth and the community. This is perhaps best illustrated by the exploitation of people in working environments or in the promotion of products that are known to be harmful to health. The early refusal of car manufacturers to acknowledge the benefits of improved crash-worthiness in cars or of cigarette manufacturers to acknowledge the dangers of smoking (even when privately admitting it) are examples of such arrogance and its twin brother greed.

### 10.7.2 Our common good

All humans enjoy the results of the exploitation of the earth’s resources. However the above review suggests that resources for consumption are at times and in some places often badly allocated without any long term community benefit. The benefits of resource allocation are frequently privatised and the real costs and dis-benefits of use are born by the community. Further, the discussion of the use of the earth’s resources on the basis of world averages is not helpful and only serves to hide the large disparities between the first and the third worlds. For many in our community this mis-allocation is unacceptable; they seek a compromise to the above two positions and an alternative to what is seen as, if not an unsustainable then an unethical global condition. This will involve not a cessation of development but a reallocation of the earth's resources and a more targeted effort to improve the living conditions of the poor.

The conclusion of the above is that the immediate technical crisis is not one of lack of resources per se nor of immediate collapse of the earth's ecological or economic systems. Rather it is one of resource allocation on an inter-national as well as an inter-community, inter-sector, inter-gender etc. scale. For the Christian, the earth’s resources are a gift and the resource allocation question raises the further question: to whom is the gift given? For whom is it intended?
The undifferentiated statement of 'giftedness' and the command to 'fill the earth and subdue it' are not of themselves a useful basis for addressing the disparities mentioned above. Thus the ethical problem remains and will be considered later.

Can we begin to solve the problem of resource allocation; if so, how? The idea that best embodies this compromise is 'sustainable development' an idea of course that no one would seriously oppose.

**10.8 SUSTAINABLE DEVELOPMENT**

**10.8.1 Technical sustainability**

The idea of sustainable development involves consideration of both economic and ecological necessities. These are often seen as in opposition but those who adopt less strident positions find that compromises are possible and that, for example, sustainable resource management has a positive side particularly when the real costs of a project are born by the project and are not transferred to the community. The Bruntland Commission (Anon. 1987) which reported on the environment and development sounded a realistic and hopeful note:

'This Commission believes that people can build a future that is more prosperous, more just and more secure. Our report ... is not a prediction of ever increasing environmental decay, poverty and hardship in an ever more polluted world among ever decreasing resources. We see instead the possibility for new economic growth, one that must be based on policies that sustain and expand the environmental resource base. And we believe such growth to be absolutely essential to relieve the poverty that is deepening in much of the developing world'.

Various approaches may be suggested for promoting sustainable development.

**International proposals**

The Bruntland report suggests three major principles. The world must move towards sustainable yields from forests, from the soil and from the ocean. The world should grow economically so that the poverty in the third world can be overcome as this is the main reason why the rain forests are being cleared, soils are overgrazed and fisheries depleted and why populations continue to grow. The world must develop industries that use energy, water and materials more efficiently and have the highest environmental standards. Clearly if these principles were applied we would begin to solve what all recognise as a serious social and economic problem.

More specifically, treaties relating to the Law of the Sea, the International Treaty on the Movement of Toxic Wastes and the Montreal Protocol on Ozone Depletion have been adopted and show that multi-national agreements can in principle promote sustainable development. Other conferences on, for example green-house gas emissions, have not reached equitable agreement probably because the participants wish to avoid commitments which they perceive will be detrimental to their long term economic position. Governments are the key element at this level but, since ultimately individuals determine governments, then power rests with them. The question arises, is the community willing to pay the costs of implementing treaties and conservation measures that move in the direction of sustainable development? The community is likely to be equivocal over these matters.

**Community work**

For many in local communities the way forward is to think globally but to act locally. Most communities can point to local industrial developments that are sensitive to the environment. If we accept the smelting of aluminium using fossil fuel as an energy source, then the Alcoa smelter at Portland Victoria ('The
Smelter in the Park’) is an example of such a development. In terms of restoring and protecting the environment, Landcare is an excellent example of a community based rural movement that will provide, perhaps in the medium to long term, a win-win, outcome for both the environment and the economic welfare of the whole community. Again governments and many commercial companies can and do promote this type of development through the provision of 'seed' money and matching grants.

**Personal roles**

The benefits of a personal commitment to and action promoting sustainable development are many. While the sum of the total savings from action at the 'margins' of one's consumption might initially be small compared to the total costs, such actions provide a psychological commitment to conservation in principle that may lead on to more significant changes. It also provides signals to others in the community and in Government that the community is willing to bear the extra costs and is perhaps willing to move on to a greater commitment to sustainable development.

'Hope recognises the reality of our environmental problems and then takes small steps towards solutions. It is not wishful thinking nor is it a desperate leap into the future; it is a quite clear vision that we move towards in small meaningful steps, generally with a group of others.' (Newman, undated)

### 10.8.2 The ethical imperative

It has been argued above: that there is a crisis—but not necessarily of resource depletion nor ecological or economic collapse; that it is a problem of global, national and local mis-allocation of resources; that sustainable development at all levels represents a technical, human solution (however poorly defined); that such development will involve both economic and ecological compromises.

If we accept these conclusions, we are left with the problem of finding an ethical imperative to drive the process. But we will not find such an imperative for sustainable development and for the associated national/personal lifestyle compromises within the socio-economic-technical field. They only answer the question of 'how?'

The problem for humans in this, as well as in all other fields, is not one of knowledge but of will (Romans 7:19). We seek an answer to the question 'why?'. For the Christian, the authority of Scripture in relation to stewardship will (ought to) provide the necessary imperative. Others who would not necessarily accept its theological basis, nevertheless argue and work toward a similar end. Having made that claim, we need to recognise the problem of how to interpret these ideas about stewardship and apply them to a modern, scientific, industrial society.

### 10.9 A THEOLOGY OF STEWARDSHIP

Any theology of stewardship concerns the relationships between God, humans and the earth. Within the Bible, the teaching regarding stewardship comes mainly from three areas: the creation stories, the history of the primitive, pre-scientific, agricultural community of Israel and the teaching in the New Testament.

#### 10.9.1 Creation stories

In the creation stories where the idea of stewardship is implicit, we see that God is the creator and sustainer and therefore owner. Creation is good, purposeful, dependable (Sherlock, 1984). Humans are part of creation (Genesis 1:26, 2:7)) but are given a special role which we might describe as stewardship This is to be
seen: in humans having a role as rulers—having 'dominion' over the created order (Genesis 1: 26–30); in the productive aspects of creation—'a garden to till and to keep ...' (Genesis 2:15); in enjoying the fruits of the creation (Genesis 1:29; 2:16); in bringing some 'scientific' order to the creation by naming the animals (Genesis 2:19–20) but with some limit on what was not allowed (Genesis 2:17).

10.9.2 Israel's history

The ideas of stewardship are further drawn out in the history of Israel in their land and by implication in its resources and production. For Israel, the land is God's (as land owner) but is given to them as to 'strangers and sojourners' i.e. to the landless living within the owner's household (Wright 1997). For Israel it was to be used and enjoyed to the extent of their satisfaction (Deuteronomy 8:7-10) although it also brought with it temptation to forget God as both the owner and giver (Deuteronomy 8:11-12, Brueggemann 1977). Their continued occupation was contingent on their fulfilling the owner's commands and retaining his confidence (Wright 1997). In particular Israel was also warned against using the land in ways inconsistent with God's will, for example, by exploiting a brother Israelite or the stranger within their gates (Leviticus 25:35–38). Much of the Old Testament is the story of their failure to live in this way.

10.9.3 New Testament teaching

The New Testament teaching on stewardship is quite general and is expressed in many different ways. It is frequently expressed in terms of the Christian's ruling over the world in the name of Christ in a similar way to that of ruling over and managing a household (Douglas et. al. 1962). Generally the ideas of stewardship are expressed in terms of love. For example Jesus uses parables as in the Good Samaritan (Luke 10:29–37) and the rich man and Lazarus (Luke 16:19–31) as well as other direct teaching to illustrate and to command the sharing of our goods with our neighbours in need. Paul in collecting aid for the poor in Jerusalem (Romans 15:25), and John in 1 John 3:17, are but two further illustrations of the example and teaching of the New Testament writers that is consistent with the ideas of stewardship.

The question remains how this biblical idea of stewardship might be expressed in our modern, technological, industrial and pre-industrial societies.

10.9.4 Conclusion

The ideas of stewardship are fundamental to the biblical story. The ideas are both explicit and implicit, they are presented with both subtlety and authority and speak to Christian and non Christian alike. They are not negotiable for the Christian as a response both to creation and redemption; they are the epitome of good works and Christian love.

But to know the truth is not enough. The world is often a place where humans fail to live up to what they know. They take authority over creation, where the creature is worshipped and served rather than the creator (Romans 1:25) and where there is a serious mismatch between actual and intended purpose. So the whole earth is tainted by sin and groans in anticipation of its re-birth (Romans 8:22). It is, as Moltmann (1985) writes "the enslaved creation that hopes for liberty".
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REFERENCES


