

CHRISTIANITY
and the
ENQUIRINGMIND

Essays on the the compatibility of the
Bible and the findings of Science

LOUW ALBERTS

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Scripture taken from the New International Version of the Holy Bible

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DEDICATED TO MY DEDICATED FAMILY

CONTENTS

Foreword

1. Everybody is a Believer
2. Science
3. The Bible
4. Scientists
5. The Origin of the Universe
6. The Birth of the Earth
7. Life on Planet Earth
8. Genesis and the Advent of Man
9. Einstein's Dilemma

Sources for further reading

FOREWORD

In this series of essays a number of topics are dealt with that surface on occasion in lecture rooms, in discussion groups, in and outside the church gathering and often in the home, where

the modern young person can baffle the older parent with questions that are sometimes honest, and at other times mere smoke screens in order to hide a variety of more deep seated problems.

An effort is made throughout to maintain a level of presentation, particularly in the areas of science¹ that will be understood by the intelligent layman, but at the same time provide interesting reading to the scientist and the theologian. There are a large number of books available to the reader who has a science and/or theological background. Such books are normally written from the writer in question's own particular view of life and total reality. This author felt that there is no need for adding yet another book at this level.

There are millions of John Citizens whose lives and thinking are affected every day by the results of science and technology, as well as through the Christian faith. Such impacts obviously vary from person to person. The challenge was to attempt a contribution to their search for answers in a manner that is understandable but, scientifically speaking, also reliable.

The essential aim is to ease the unnecessary tension and polarization that can arise between an honest scientific approach and a Bible based Christian faith. Christians should be enabled to make judgments, in the area of faith and science, that are based on knowledge and insight rather than on ignorance and prejudice. Scientists must learn to accept that the scientific method holds no intrinsic guarantees that it can lead to ultimate truth. Because of his science background, this writer resisted the temptation to state his own personal frame of reference right at the outset. It is left to the reader to discover this along the way.

A list of books mentioned in the various essays, as well as texts for further reading, is presented at the end with a brief factual comment on each. Beyond that, the format of writing avoids substantiating statements with a vast number of text references. Only in those cases where direct reference or quotations are made, acknowledgement is given in the form of footnotes.

A word of sincere thanks is due to Mrs M.A. Engelbrecht for typing the manuscript and to the Council for Geoscience for the provision of office accommodation and library services.

—Louw Alberts—



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ONE

EVERYBODY IS

¹ Unless otherwise stated, the term science will always refer to natural sciences as distinct from the humanities.

A BELIEVER

Now faith is being ... certain of what we do not see. ([Hebrews 11:1](#))

The above title may sound strange to some readers and even annoying to a few. It actually refers to all sane, normal people regardless of their standards of education, religion (or lack thereof), background, age, wealth (or lack thereof), intelligence and walk of life. No one lives without some measure of faith in their personal make-up.

Let us illustrate this statement by considering what is called a world view. The latter term simply means the way one regards the total physical cosmos with its myriads of galaxies, stars, planets and moons. Your world view contains some kind of answer to questions such as: Where did it all come from? Why is it here?

The universe as observed by the eye, telescope and inferences from other physical detection methods, contains some one hundred billion (1 billion equals a 1 000 millions) galaxies, a galaxy being a community of stars. Our sun, a medium sized star, is a member of such a galaxy which is known to most of us as the Milky Way. The latter consists of approximately one hundred billion stars. Our sun holds a family of nine planets, moving in nearly circular orbits around it. Earth, a very exceptional planet from the point of view of being able to support highly developed biological life, is the third planet away from the sun. The presently known universe is approximately ten to twenty billion lightyears in diameter. We use a lightyear as a unit of length. It represents the distance a light beam would travel in vacuum in one year. With a speed of 300 000 kilometres a second this comes to approximately ten million million kilometres.

Let us now consider one of the questions raised earlier: How did this physical universe, including our planet and life on it, come into existence? Three lines of answers are possible.

- It all happened by chance. However small the chance may be is beside the point. An infinite number of universes may have started up spontaneously and amongst them this one occurred and here we are in it. Or alternatively, there is only this one universe and by chance it turns out the way it is, down to the last detail, including men and microbes.
- Let us stick with what we can observe and experience. We cannot and do not know anything beyond that. Therefore there can be no conclusive answer to the question: Where did it all come from?
- It was all purposefully designed by a pre-existent Being whom we call God. Pre-existence simply implies God was already there when it all started up and His origin does not, and need not be part of the answer.

The above three approaches broadly represent atheism, agnosticism and monotheism as embodied in the Christian faith, Judaism and Islam. Clearly there will be shades of differences and variations between the above three approaches. The important point to recognize is that all three views start off with an initial step of sheer belief that cannot be proved or disproved. The starting point of an atheist is no more or less scientific than that of a Christian.

Another way of viewing the situation is to employ the concept of metaphysical theories as for instance used by the famous philosopher, Sir Karl Popper. Metaphysics in this context must be seen as a branch of human enquiry that is not, or cannot be based on empirical or experimental observations. Such theories cannot be proved or disproved by scientific investigation. The alternative views that the universe was created by God, or the universe came into being by chance, would then both fall in the category of metaphysics. This principle would be applicable to all thinking concerned with the beginning of the universe. No one can prove or ultimately disprove, in an exact scientific sense, that our total observable reality is the result of unpurposed chance, and no one can really prove or disprove the existence of God. In every instance it is a matter of belief.

It is interesting to note how science writers of great repute who do not ostensibly acknowledge belief in a personal creator, wittingly or unwittingly reveal a type of religious or faith bias in their thinking. Scientists who do acknowledge faith in a personal God will not be considered at this point. They will be viewed in the next essay.

In the early eighties a group of scientists of the British Museum of Natural History, by way of a public display, advocated a technique for the classification of biological species, called cladism. The details of this particular systematic approach need not concern us at this point. The system, however, does put a question mark on the validity of, or necessity for Darwinism, the latter being, to date, the most widely accepted model by evolutionists in order to explain the origin of species. The then editor of *Nature*¹, a very reputable science journal of long standing, responded in an extended editorial with expressions such as: “The trouble with agnosticism (with respect to Darwinism) is that, however justified logically, it can be carried too far”, and “whatever the philosophical position, there is no way of denying that people’s emotions are engaged by the strengths and weaknesses of theories.”

One cannot help but detect a rather strong measure of religious fervour, in favour of Darwinism, in the foregoing statements. In an earlier editorial of the same journal the attack on cladists came right down to the level of witchhunting. Please note there was no hint of religious bias in the views of the scientists expounding the cladistic approach. It was simply coolheaded science.

Paul Davies, in his book *God and the New Physics*, writes as follows concerning the origin of life: “Even if further work suggests that a natural origin of life would imply a fantastic accident, those who *believe* in an infinite universe, containing an infinity of planets, need have no fear of statistics. In an infinite universe, anything that is possible must happen somewhere by pure chance.” (italics by this author) On comparing this statement with the first verse in the Bible, viz: *In the beginning God created the heavens and the earth*, it is pretty evident that the expressed faith in an entity called chance, is no less a matter of belief than that of a person who assigns the origins to the God that the Bible speaks about.

In the light of the foregoing it is quite fair to reduce the so-called faith vs. science debate to a faith vs. faith debate. The atheist may come up with the argument that as science develops, his leaps of faith are reduced more and more to steps of sheer reason. This argument, however, does not necessarily hold water. As our body of knowledge of the real world grows, the faith leaps of the atheist often have to become bigger. For instance, when Oparin envisaged in 1924 that the first living cell was born spontaneously in a pond of

¹ *Nature*, Volume 290, 12 March 1981

organic soup, it was difficult enough to believe in terms of what was then known about cells. In the light of what science has since uncovered, such as the information embodied in the DNA molecule, the necessary leap of faith becomes impossibly great.

Francis Crick, who received the Nobel prize for his famous work on the genetic code, makes the following dubious claim in a book entitled *Life itself, its origin and nature*, viz. that most modern scientists do not subscribe to any of the doctrines attributed to Moses, Jesus Christ or Muhammad. Crick states further that a scientist has an almost boundless optimism concerning his ability to forge a wholly new set of beliefs, solidly based on both theory and experiment. It is doubtful whether many scientists share Crick's enthusiasm and confidence in the scientific method, but his attitude and approach are certainly based on a pretty dynamic faith in the so-called scientific method. In this connection it is worth noting another remark by the eminent science writer, Paul Davies, in a review of a book written by Polkinghorne. The latter is a well-known British scientist who openly confesses to being a Christian, and in fact became a clergyman in his church. "The belief that there is something behind it all is something that I personally share with, I suspect, a majority of physicists." Paul Davies further expresses a very similar thought in the closing paragraph of his book *The Mind of God*.

Another Nobel prizewinner, Steven Weinberg, concludes at the end of his brilliant book *The First Three Minutes*: "The more the universe seems comprehensible the more it also seems pointless. But if there is no solace in the fruits of our research there is at least some consolation in the research itself. Men and women are not content to comfort themselves with tales of gods and giants, or to confine their thoughts to the daily affairs of life; they also build telescopes and satellites and accelerators, and sit at their desks for endless hours working out the meaning of the data they gather. The effort to understand the universe is one of the very few things that lifts human life a little above the level of force and gives it some of the grace of tragedy." So much for the conclusions of a leading scientist who believes it all just happened by itself.

These examples of the foundations on which scientists base their faith demonstrate the following principle: For an atheist to scoff at a Christian because of a so-called non-intellectual (ie. a believer's) approach to the origin of the cosmos, would reveal nothing but absurd ignorance. The atheist exercises a capacity for credulous acceptance that even exceeds that of many a Christian. No one has the right to regard the other's initial stance of faith as intellectually superior or inferior. We can all afford to be careful in our assessments. Furthermore, the sooner a scientist admits to himself that the initial step of faith in his world view results in a built in subjective bias to the way he sees and practises science, the more hope he has of being reasonably self-critical and in the process reaching out towards objectivity. Philosophers such as Herman Dooyeweerd and Michael Polanyi, have successfully demonstrated that all acquired knowledge has a subjective component in its very character. It goes without saying that in the case of the human sciences such as psychology and sociology this is even far more evident than in the case of the natural sciences. The latter have the advantage of easier experimental control which can help to eliminate errors arising from subjective inputs.

Two concluding remarks. Firstly, if any authority in education decides to completely eliminate the so-called religious approach in the teaching of cosmology and biology, such an authority is, perhaps unwittingly, opting for the atheistic or agnostic approach. After all, education in science is not only concerned with the "how" of natural phenomena but also with

the “where from” and the “where to”. One just cannot avoid the first steps of belief in your view of the world and life. Neutrality here is a myth. To eliminate one view is to support another.

Secondly, the various initial stances of faith illustrated in the foregoing, come about in many ways. In most cases it can be traced back to environment and training. There are, however, millions of cases where conversion has taken place from one stream to another. Once one has accepted the reality that the initial step is an act of faith, the question immediately arises: What next? Turning to our main sources of information that are available, viz. science and the Bible, will lead to answers.

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TWO

SCIENCE

In the English culture, the term science normally refers to the natural sciences such as physics, chemistry, geology, zoology, astronomy, etc. In many European cultures the term science embraces all branches of knowledge. For instance, the German word *wissenschaft* refers to all sciences in general and subdivision occurs by adding a prefix such as *natur* (nature) and *geisten* (of the spirit ie. humanities). In this essay the English custom will be followed and unless specifically stated otherwise, the term science will be used only to imply the natural sciences.

What is science really all about? What are its essential aims? Why do so many talented people across the world devote their energies to this branch of human knowledge? Why are societies and their governments prepared to spend billions of money units annually in the pursuit of scientific knowledge? The answer, perhaps curiously enough, is to be found outside the realm of science.

In the Bible, particularly in a passage such as the eighth Psalm, it is spelt out that man is to be the employer and guardian of nature and its gifts. If God is responsible for the presence of man on earth it is almost obvious that it is inherent in the very makeup of man to want to understand nature. This understanding is not only for its own sake, but also in order to ultimately control nature's resources. This is the essential driving force behind our scientific enterprise. For instance, nuclear energy could not be employed for better or for worse, before a certain amount of knowledge and understanding of the atom had been gleaned through investigation. The reading of nature leads to the control of nature.

A tribal native of the jungle studying the feeding and drinking habits of antelopes in order to hunt them successfully, is obeying the same general principle as a physicist researching

electrical super conductors in order to make optimum use of our energy resources and electrical circuitry in general. In both cases the gifts of nature are probed in order to capture and utilize, even though the two illustrations occur at vastly different levels of sophistication.

The purists would claim that they are doing research simply for the very sake of the understanding of and insight into the way nature operates. Such scientists could be subjectively completely honest as individuals, but that does not invalidate the overall principle as applicable to the human race. In this process the very research and understanding of creation have become an inherent and beautiful part of human civilization. The mere understanding of the genetic code or the origin of the universe, is culturally as important as the ability to appreciate the paintings of Rembrandt, the plays of Shakespeare or the symphonies of Beethoven. Somehow our educational systems have not inculcated this truth to a sufficient degree in our youth. At the same time, the theologians should have spelt out the message that if man is to be the ruler over nature, this dominion carries with it, the awesome responsibility of caring for nature. The ecology incentive should have been part of the Christian message throughout the centuries. Surely God does not look with favour upon rulers who merely exploit and do not care for his handiwork.

Let us now consider the scientific method which normally runs as follows:

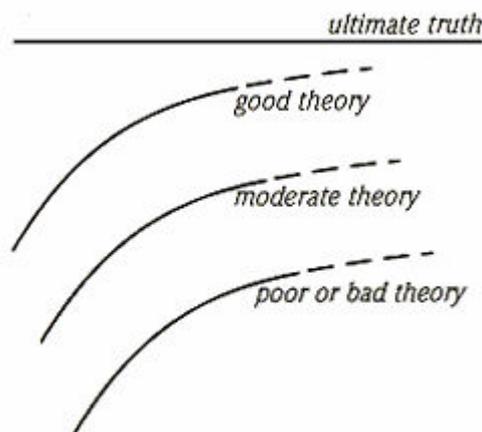
- The collection of data through observation.
- Sorting and systematization of the data.
- Putting up a conceptual model or theory in order to explain the available information.
- Testing the theory by subjecting it to new data or investigating predictions that emanate from it.

The above programme is not to be regarded as a rigid procedure but does provide the philosophical basis for the scientific approach. In order to bring these ideas home to the non science reader let us consider the following illustration.

A scientist picks up a piece of solid matter hitherto unknown to man, for instance a new mineral, and he wants to find out all about it. He could heat it to see what happens, pour various acids on it and observe the reactions and subsequent products of the chemical reactions, perform X-ray measurements on it etc. etc. Having collected his data he would group it in orderly fashion and eventually put up a theory which would ring as follows: This piece of material consists of atoms such as silicon, magnesium, iron, oxygen and others. These atoms are arranged in a certain geometrical pattern, in colonies called crystals, and the latter make up the piece of solid material. This would be the scientist's theory and typical questions could be: Will the model be able to predict the hardness and density of the material, or explain some new additional information that a laboratory assistant has just reported on? Such questions may require that the model be adjusted somewhat in order to accommodate the new information. If it repeatedly fails to do so, scrapping of the model in favour of a new one is called for. This may not be so easy to do and the scientist could go on working with the existing model whilst realizing its limitations. Sometimes a parallel theory would be employed in order to accommodate the remaining data that the first theory could not handle.

An excellent case history illustrating the above situation is to be found in the theories of light. For some two centuries light was regarded as a wave motion and this theory explained most of the available experimental information. Towards the end of the 19th century and in the beginning of the 20th century, new facts emerged which could not be explained by the wave theory and an alternative model came into being, viz. the photon or particle theory of light. More and more experimental results poured in that could only be explained by the new theory. For many decades the two theories lived individually and happily side by side, until the advent of quantum electrodynamics in the second half of the 20th century, explained that the wave and particle theories were but two simplified aspects of a more complex phenomenon.

The scientific method leads one to the inevitable conclusion that while truth or ultimate reality may be the key objective of research, the practical objective is validity. Strictly speaking, the question should not be how true a given theory is, but rather how valid it is in explaining the available data. In general, theories are not true or false but rather range from good to bad or weak. If it appears to be very weak and explains relatively little of the known facts it will eventually be discarded. If it is so successful that it explains all the available data on the phenomenon in question it can be regarded as approaching ultimate reality or truth in an asymptotic way. This is illustrated below.



The status of a science theory

No scientist can claim that a theory has acquired the status of ultimate truth, which would imply that there will never be a new observation that it cannot explain. The degree of validity that a given theory has acquired will in general depend on the complexity of the problem being investigated, and the amount of intelligent scientific research that has been applied to it. For instance, hydrogen is the simplest chemical substance known. According to the classical model, the hydrogen atom has one particle, a proton, in its nucleus and one spinning electron revolving around the nucleus. The behaviour of such an atom is reasonably well understood and most of the observations can be satisfactorily explained. Thus the classical theory is quite good. Please note, not perfect, because modern atomic theory has brought adjustments to the above picture of the hydrogen atom.

In the case of a heavy atom such as uranium, the model can at best be seen as rather approximate because of the complexity arising from the many nuclear particles and electrons involved. Once atoms become grouped into units called molecules, and molecules are

grouped to form tangible matter, the theory becomes much more difficult and our understanding far more limited.

So much for inanimate matter. In the case of biological matter, it must be apparent that when one deals with such a bewildering assembly of millions of atoms constituting the cell of a biological system plus that strange, not understood component called life, that our understanding is still very far from complete. Cells are the basic units constituting a living biological system. Such a system is called a species. Trying to explain how the various biological species arose is far more daunting than the vast majority of humans seem to realize. Moreover, if our research takes us billions of years back in history, with no hope of repeating the “experiments” that took place in nature (as was the easy case of the mineral investigation described earlier) the problem becomes virtually intractable. Glibness of answer in this area of science indicates ignorance of the difficulties involved, or possibly superficial belief that glosses over the myriads of unanswered questions. Categorical belief in a theory of evolution such as ascribed to Darwin, without recognizing the limitations of the model as well as the fundamental difficulties of the associated problems in question, is not true to the spirit of science, but rather verges on quasi-religion. On the other hand, it is completely unreasonable of some Christians who expect scientists to collect information in the biological world, past and present, but not present models attempting to explain their findings. It is in the very nature of the scientific method to do just that, otherwise science is reduced to a mere purposeless compilation of facts. The inference is that theories of evolution and the possible mechanisms involved can be part of a legitimate and honest scientific effort. This issue is so important that it will be dealt with separately in another essay.

THREE

THE BIBLE

The true status of Christianity is determined by the status of a book called the Bible. Its message can be summed up in three words, viz. creation, fall and redemption. This implies that God is responsible for the coming into being of the cosmos and everything it contains. Man, as identified by the term *homo sapiens sapiens*, with his spiritual, intellectual and emotional components, has a unique status on planet earth. This particular species started off with a close personal relationship with God, and this relationship was marred by the advent of sin. Finally God provided redemption and salvation by coming to planet earth in the person of Jesus Christ. This is in essence, what the Bible is all about.

If one considers the history of the Bible itself and its role in the history of mankind, it clearly illustrates why it is still the best seller in the 20th century and will undoubtedly continue to remain that way. This remarkable volume is a collection of 66 books written by some 40 different authors over a period of approximately 1 500 years, spanning several millennia of human history. If one bears in mind that the handwritten copies of individual authors' works were very scarce, that there was little or no liaison between them at the various times of writing, it becomes truly stunning to note the agreement of theme and message. The authors were separated by generations in time, their places of writing in many cases hundreds of kilometres apart, while their backgrounds covered a spectrum ranging from kings through

prophets to fisherman and herdsmen. The writings themselves covered a wide variety of literature types such as history, law, poetry, biography and personal correspondence.

The Bible is unquestionably a unique book. Its reliability, as confirmed by history and archaeology, is dealt with in masterly fashion by Josh McDowell in his well-known book called *Evidence that Demands a Verdict*.

However, over and above the evidence and support provided by branches of knowledge such as history, archaeology and literature that confirm the reliability and power of the Bible, there are two other factors that, in the mind of this writer, one has to consider.

Firstly, there is its impact on human lives. The overwhelming evidence of individuals who have been changed for the better by the Biblical message cannot be ignored. This is not to be confused in any way by the past and present errors and deliberately committed wrongs emanating from organised sections of religion, where institutionalised power became the driving force and took pre-eminence over the original message.

Men and women do not become angels overnight when they embrace the Gospel of Jesus Christ, but the countless numbers of alcoholics who became responsible men, prostitutes who turned into clean living women, collapsing marriages that reverted to ideal home and family strongholds, restless students and academics who found peace and purpose in their lives—the list is endless—cannot be explained other than by acknowledging that the Biblical message is indeed a powerful source for the good of mankind.

Secondly, and more important, is what one could call the God factor. This can be understood in the following way. One does not believe in God because of, or as a result of belief in the Bible, but conversely the Bible can be believed because of belief in God. The Bible does not attempt to prove the existence of God. The reality of the Deity is simply accepted in the very first line, viz. *In the beginning God created ...* Only occasionally is there a somewhat derogatory reference to atheism such as Psalm 14:1 which states: *The fool* [in a spiritual sense] *says in his heart, "There is no God."*

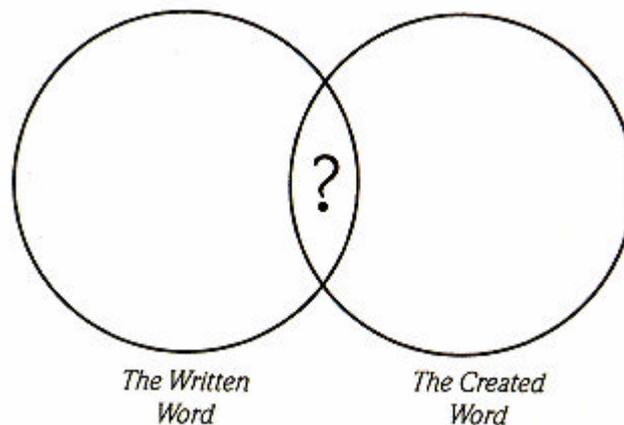
A child raised in a Christian environment does not initially acquire an understanding and belief in the Bible as a revelation from God. The concept of and faith in God is primary and the acceptance of the Bible is secondary. Bible stories are told as coming from God's book. When a missionary moves into a new field he would not start off with his first sermon, whenever and wherever that may take place, by holding up the Bible and claiming that he has come to declare this Book and its contents to the community in question. He would rather point upward and say: "I have come to tell you about God." After faith in a personal Deity is established, then only acceptance of his communications can follow. A very telling example of this approach is provided by the Bible itself. When the apostle Paul faced a very learned and sophisticated audience in Athens, he did not start off by referring to the religious literature available to him via Judaism. He commenced by telling them about the unknown God that they worshipped, but whom they did not know.

As was pointed out in the first essay, all human beings' initial premise in their view of life and the world is an act of faith. In the case where this initial step is a belief in God it then becomes meaningful to ascertain what form of communication He has made available to man. The Bible offers itself, without excuse or defense, as the Word of God. In evaluating this claim all the information gleaned from history, archeology, theology, philosophy, ethics,

literature etc. can be employed to substantiate the contents of what is commonly known as Scripture. Over and above such intellectual exercise, we have to revert to the concept of God. If He is capable of bringing into being the whole of Creation then surely He is also capable of ensuring that a suitable means of communication is made available to man. To illustrate. If the question should cross one's mind: How do we know that the 66 books constituting the Bible constitute the necessary and sufficient communication from God? When the Christian church leaders finally decided, towards the end of the fourth century, what religious writings would constitute the Bible, what guarantee does one have that they could not have made mistakes? Were all the relevant writings available? We know, for instance by inference, that Paul wrote more than two letters to the Corinthians. It appears that David wrote more psalms than those which appear in the Old Testament. The answer to the enigma is simply this. If God was going to leave a suitable means of communication, then He was the final Editor. Surely the Creator of billions of galaxies is capable of engineering the circumstances that led to the Bible as we have it today. Because God is God, the Bible is reliable.

Two questions in the context of this publication have to be briefly dealt with: If science is such a noble enterprise as demonstrated earlier, what should one's attitude be when there appears to be clashes between what the Bible says and what science claims? For instance, the first chapters of Genesis and scientific explanations for the origins of the universe and all it contains, including earth and life on it, if read superficially, just don't seem to agree. Whilst these problems will be dealt with more fully in subsequent essays, the principles involved can be stated here.

Consider two overlapping circles.



The Two Words

The one on the left represents the Bible or, better still, the Written Word and our understanding of it. The circle on the right represents the body of our understanding of the physical universe. Let us call it the Created Word. There is a small overlapping region where both "Words" deal with the same phenomena, such as the origins of things. It is in this area that the questions arise. It is here where the pseudo-problem of the so-called clash between the Bible and science resides. It is interesting to note that a very large part of both Words don't overlap, but somehow people tend to focus on the potential area of conflict. Why is there conflict? If God is the author of both Words they should be in agreement. The answer is almost obvious. We are reading one or both Words incorrectly. Theologians have to admit that our interpretation of what the Scriptures say is forever undergoing changes. Scientists

will also readily agree that we are not necessarily correct the first time we read the Created Word. (In fact if we were, we would soon be out of jobs.) Our understanding is subject to ongoing evolution.

As our reading of the two Words improves we find more and more harmony in the overlapping area. There need be no tension in our minds and hearts if we detect seeming conflict between the findings of science and our reading of the Bible. It is actually reasonable to assume that Christian theology taken from the Bible was the forerunner of the scientific era in Europe. In both the Middle East and the Far East, very fascinating incidental discoveries in both science and mathematics were made millennia ago, but these never gave rise to a scientific establishment.

Surely the concept of a divine rational Creator bringing a cosmos into existence that would operate in terms of definable natural laws, would have been a great stimulus towards the scientific enterprise.

The second question referred to earlier can be worded as follows: If the Bible is God's communication to mankind, how is it possible that there are so many interpretations leading to a divided Christianity, which often exhibits bitter conflict between its various branches. Having minor differences arising from different cultural backgrounds may be acceptable, but surely God did not intend mankind to have such a varied approach to His written Word!

Again in the context of this publication it is necessary to state the following principle: The Bible, God's communication as such, must not be seen as the revelation of God. Christ is the revelation and the Bible is the record describing that revelation. Without Christ the whole Biblical message would become near meaningless and empty. The magnificence of Christ's coming into this world will be seen later when we discuss the origin of the physical universe, space and time.

The conflicts referred to above, according to this writer, stem to a large degree from the fact that regrettably, through the centuries, the emphasis was placed on the record and its interpretation rather than focusing on Christ, the revelation of God.

FOUR

SCIENTISTS

A typical question frequently posed to the author usually runs as follows: "How can it be that you as a trained and practising scientist, profess a personal faith in God?" The implication of such a question is obvious. The public at large is under the impression that scientists make up the bigger fraction of unbelievers in those parts of the globe that have been exposed to Christianity for some time. This is simply not true. Of the many scientists that the author has personally met in many countries, only a small fraction were confessed atheists or agnostics. A bigger fraction are staunch believers although admittedly, there are the large middle block who believe in God in a general sort of way, but are not committed to Him.

Such a situation, however, is applicable to most groupings in society, be they medical doctors, attorneys, carpenters or typists. Scientists are simply human beings who are in need of love, who are subject to uncertainties and frustrations, and often have to seek answers and guidance outside the realm of measurement and reason. Again, like ordinary people, scientists' beliefs are determined more by their home and cultural environments than the knowledge they have acquired in the pursuit of their fields of knowledge. Two personal experiences substantiating this view can be mentioned here. In the sixties I was doing research during a sabbatical spent at a British university. A Bible study group of senior students that met after five in the afternoon and which I joined, revealed that the majority of those involved were either scientists or engineers whilst the minority came from the humanities. In the mid-sixties, attending an international conference on magnetism in Nottingham, I found myself sitting next to an American physicist from the well-known RCA laboratories. During the conversation it turned out that he was a committed believer in Jesus Christ. When I expressed my pleasure and surprise at finding a fellow believer he rejoined: "Do you know Dr G. from Lincoln laboratories?" I did, because the man referred to had just published an excellent book in his own research field. The subsequent remark in our conversation indicated that Dr G. was also a committed believer. I felt rather pleased that within one evening I had identified two Christians in that august gathering of 500 scientists. On passing through the hotel foyer I overheard a small group talking about the religious views of Faraday and Newton. I joined the group and one tall gentleman turned to me and asked: "Why are you interested in this conversation?" I explained my own convictions. The tall gentleman in question turned out to be the director of a well-known industrial research laboratory and he was a deeply committed Christian. I do not know how many more conference goers were like my new discoveries, but it is unlikely that I had come across the only ones in such a short time.

The way the public at large view scientists and their religious beliefs, can probably be assigned to two major factors. Firstly, there are the notable historical incidences of Galileo's confrontation with the church in the 17th century on the relative movements of the sun and the planets, and Darwin's publication of his famous book *The Origin of Species* in 1859. The contents of these debates are so well-known that they will not be described here. Suffice it to say that such cases contributed disproportionately much to the overall picture of the so-called debate between science and religion. Secondly, it so happens that well-known popularisers of science such as Huxley and Carl Sagan, were hardly sympathetic to a Christian view of the world and life.

In order to get a more balanced perspective, a brief resume of some outstanding scientists' views over the past four centuries, right up to the present day, will be presented here. The reader can draw his or her own conclusions from this evidence. The information provided here can be found in the list of texts given at the end.

The earlier great names in science such as Kepler, Galileo, Descartes Boyle (who described his own conversion in vivid terms) Pascal and others, had no problem believing in God. Their views on how He operated in the real world certainly differed and that in turn affected their approach to their investigations. Pascal for instance, is quoted to have said that God's revelation of Himself is "in Jesus Christ without whom no communion with God is possible".

Benjamin Franklin, the greatest name in American politics and science during the 18th century, listed 13 virtues for successful living. The last one reads: Imitate Jesus and Socrates. In the mind of this writer the greatest star in the firmament of science is Isaac Newton. To this day his contributions in mathematics, mechanics, astrophysics and optics form a vital part of

our knowledge in these fields. Not only was he a firm Christian believer but he also spent the latter part of his life studying and writing theology. Undoubtedly his belief in God as the Creator had great influence on his views and work in cosmology.

In Michael Faraday's work we identify major contributions in the fields of electrochemistry, magnetism and electromagnetism. The vast modern electrical industry of the 20th century rests on the principles that he discovered in the 19th century. His eminence took him to the position of President of the Royal Society of Britain. At that time it was certainly the highest scientific honour that a person could achieve in the whole world. This great, yet gracious and humble scientist, belonged to a Christian group called the Sandemanians. They were Bible believers and you could not become a member of the church without confession of sin and personal faith in Christ.

James Clark Maxwell, the star theoretician of the 19th century, whose contributions in kinetic theory and especially in electricity and magnetism are still basic to our thinking in these fields today, was a devout Christian. He is said to have known the 119th Psalm (176 verses) off by heart at the age of 8. He died at the early age of 48. During his last illness he said to a friend: "I have looked into most philosophical systems and I have seen that none will work without God."

Lord Kelvin, who can rightly be called the father of thermodynamics stated: "I have many times in my published writings within the past fifty years expressed myself decidedly, on purely scientific grounds, against atheistic and materialistic doctrines." On one occasion he said: "If you think strongly enough, you will be forced by science to believe in God, which is the foundation of all religions."

One more great name in classical physics is that of Max Planck. As the father of the quantum theory he could be looked upon as the bridge from classical to modern physics. He is recorded to have said: "There can never be any opposition between religion and science, because the one is the complement of the other."¹

There is similarly, a list of great names in the field of medicine who were true believers. For instance Lord Lister, the great surgeon, Sir James Simpson of chloroform fame who was an enthusiastic evangelical, and many others were readily identified with the Christian faith.

What about the twentieth century? Admittedly the proportion of committed believers in science has probably dwindled, but this is simply a reflection of the situation in Western society as a whole. As most scientists come out of the Western world the overall picture once again does not indicate that scientists are any more or less religious than any other section of society.

Two adverts pertinent to the 20th century are worth mentioning here. A well-known figure in British medicine, Rendle Short, records² that round about 1930 a questionnaire was addressed to the Fellows of the Royal Society, one of the most senior scientific bodies in the world. Two hundred, a good number in those days, responded. The replies can be tabled in the following way.

1 Refer to the book by Mott, listed at the end.

2 See list at the end.

Question	Positive response	Negative response	Indefinite
Do you credit the existence of a spiritual domain?	121	13	66
Do you believe in survival after death?	47	41	112
Are recent remarkable developments in scientific thought favourable to religious beliefs?	74	27	99
Does science negate the idea of a personal God as taught by Jesus Christ?	103 (in the sense it does not)	6 (in the sense that it does)	71

In their responses several scientists expressed an opinion which ran something like this: “The fact that I am a professor of chemistry does not enable me to express a more, or less, authoritative opinion on any other subject, religion, politics, and so on, than any non-scientific yet reasonably educated man or woman.”

The second advent worth mentioning is taken from a book (published in 1991) by the Nobel prizewinner in physics, Sir Neville Mott. In this publication entitled *Can Scientists Believe*, a number of scientists wrote essays about their personal views on religion. These views varied from evangelical to liberal theism. Interestingly, this book was reviewed by John Polkinghorne who is an Anglican priest, a former professor of mathematical physics and President of Queens College, Cambridge, UK.

In one of the essays written by John Habgood he mentioned that in the late 1980’s a new body came into being called The Society of Ordained Scientists. This is a group who are actively involved in the Christian message, either as people who have continued as scientists, or who have gone into full-time ministry. At the time of writing there were 55 members.

It would be well beyond the scope of this essay to give an exhaustive treatise on the religious beliefs or lack thereof, of all the great names in science. The purpose was to demonstrate that the tendency of the general public to think that scientific endeavour is incompatible with religious belief, is simply not so. Scientists are just human beings and their response to the Christian message, whether positive or negative, is much the same as that of other humans.

FIVE

THE ORIGIN OF THE UNIVERSE

From the very beginning of modern man’s history, cosmology played a very important role in the various cultures. What are the stars really like? When, where and how did they

originate? Today the various conclusions are mostly regarded as mere myth, but they nevertheless do indicate how important it was to the societies concerned. To illustrate: “The Mesopotamians described the earth as a floating vessel on the waters of the deep. Above it stood a solid dome covered with the waters above, which occasionally seeped through rain. The sun, moon and stars whirled around on the inner surface of the dome. These heavenly lights were thought to be eternal deities, creators of the material elements of the universe—water, earth, sky (that is the dome), and possibly fire.” (Taken from *The Fingerprint of God* by Hugh Ross. See literature list.)

With the advent of the first telescope, built by Galileo, and the theoretical models developed by Copernicus and Kepler, our concepts of the universe have developed spectacularly over the last three centuries and today we have a vast amount of experimental data at our disposal, together with a rather satisfactory theory as to how it all could have happened. Certainly as in the days of old, the modern picture plays a very significant role in 20th century man’s views on the world and life.

From a scientific point of view the fundamental questions are: Was the universe always there or did it have a date of birth? If it did have a beginning in time (as measured by man) how was it born and what is its history? How is it constituted? Is it infinite or limited in extent?

With the rapid advancement of sophisticated equipment and facilities in general, most of the information available to us was gleaned from observations made in the twentieth century. This knowledge will be briefly reviewed and the best picture that has emerged giving answers to the questions above, will be described. Technical detail will not be dealt with in a discussion at this level. It can readily be found in the literature list.

In the main there are two approaches. The view was held by many scientists, especially in the second quarter of this century, that the universe has always been there ie. it is infinitely old, infinite in extent and will go on for ever. If matter disappears into energy through nuclear processes in stars, new matter comes into being because, every now and again, a particle such as a proton or neutron (protons and neutrons are particles or building blocks constituting the nuclei of atoms) is born spontaneously out of nothing. The net result is a universe in a state of equilibrium which is the same in character everywhere. This approach was attractive to people with an atheistic or agnostic world view simply because a universe that started up anew would be too close to the Biblical picture. Over and above the fact that material particles cannot just be born out of nothing, the main objections against the “steady state” model arose from radio as well as optical astronomical observations. The stream of evidence against this picture really started off with the work of Sir Martin Ryle at Cambridge University. His radio astronomical data indicated unequivocally that the universe was not uniform. Moreover, the steady state model would tell us that galaxies are continually dying and new ones coming into being.

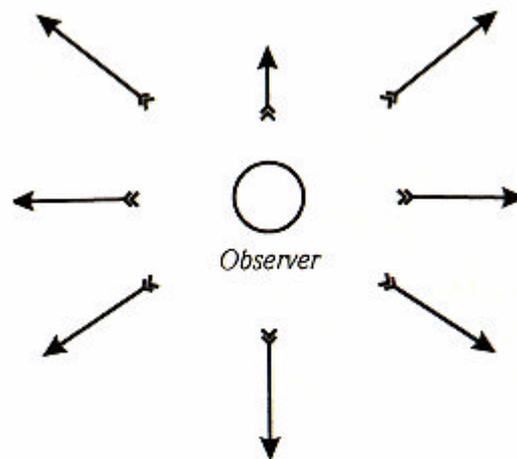
Observations on galaxies have once again established that the existing picture fits in with the idea that the universe had a definite beginning in time as depicted by the so-called big bang model. This approach will now be dealt with at some length.

In the 1920’s a soviet scientist, Friedman, deduced from Einstein’s general theory of relativity that the universe must have had a beginning in time. It was a courageous view because the great Einstein himself at first opposed Friedman’s conclusions, but eventually

conceded their validity. These ideas were also an anathema to the political philosophers in Russia in the first half of this century.

Concurrent with Friedman's work, astronomers measuring the distance of stars from the earth and measuring their speed of movement, found that the galaxies are moving away from us and the further they are away the faster their departure speeds. The information was put together in a famous publication by Edwin Hubble in 1929.¹ As the reader may know, the importance of Hubble's work is reflected in the fact that the telescope now floating in space around the earth was named after him. The distances and speeds of such far away objects are determined by techniques based on concepts such as parallax, luminosity and wavelength shifts in the red end of the optical spectrum. Details of the techniques can be found in standard texts and will not be dealt with here.

The situation can be pictured as follows:



The expanding universe

The length of the arrows indicates the speed with which the galaxy is receding. The further away, the faster they appear to be moving.

The concept of an expanding universe became embedded in the literature and the minds of scientists. It is necessary to mention here that one must not conclude from the picture above that we as observers on earth are in the centre of things. Wherever these observations are made in the universe, the picture will always be the same. This is because our apparatus is making measurements of a three-dimensional expansion in a four-dimensional universe. Because this is difficult for the mind to conceive, one can think of it in the following more simplified way.

Imagine a spherical balloon being blown up. Very tiny insects are evenly distributed over the surface. As the balloon gets bigger, every insect will see its neighbours moving away from it. The nearby neighbours will be moving more slowly than the ones further away. In fact, the speed of recession will be exactly proportional to the distance away from any insect doing the observation. The insects are living on the surface of the balloon which is a two-dimensional

¹ Edwin Hubble. *Proceedings of the National Academy of Sciences*. Volume 15, 1929, pp.168–173.

The order of events can be summed up as follows:

Energy → material particles → stars and galaxies → planets, including earth life

As our knowledge of fundamental particle physics increases, the details of what took place especially during the first second will change, but the broad picture will remain the same. This picture arises from observations of the expanding universe, knowledge of the nuclei of atoms and fundamental particle physics, gleaned from experiments conducted in huge particle accelerators in various parts of the world. It is also backed up by the vast wealth of a knowledge of physics accumulated over centuries. The question does, however, arise as to whether there is further direct observational evidence that the big bang model is a good one. The answer to this is a resounding “yes”.

From the original theory it was expected that there would be a weak leftover energy background, or afterglow if you wish, filling the universe. This prediction was brilliantly confirmed in 1965. Penzias and Wilson measured the presence of this background energy and the result was very close to the predicted value. One outstanding problem remained. Why was the universe not just a uniform ball of energy and material particles? Why did it have a structure in the form of stars, galaxies and clusters of galaxies? The original measurements of the background energy appeared to be uniform and the puzzle remained unsolved until 1992. Observations, together with brilliant experimental and calculation procedures from the *COBE* (Cosmic Background Explorer) satellite established that the background radiation was indeed not uniform but cloudy, ie. it had slight variations in density. These results were confirmed by balloon borne experiments. The final conclusion is that the universe, right from birth, contained the initial structure that finally led to what we observe today. Further observations by the Hubble telescope, travelling in space around the earth, have added more and more confirmatory evidence that the model is as correct as man can hope to establish.

A few further, fascinating comments are necessary.

Let us name the initial blob of energy the cosmic nucleus, and let us assume at this stage that somehow it just got there. If we do have this starting point, how could the rest of the expansion leading to a universe as we know it, take place? The requirements are actually so astounding that it takes us well beyond the capacity of our imaginations. If, right at the start, the universe expanded too slowly, the material particles and ultimate matter that formed would, under mutual gravitational attraction, collapse into a very dense blob, in fact it would end up as a premature crunch. On the other hand, if it expanded too rapidly there would not be an opportunity for galaxies and ultimately, planets to form. The necessary balance between too slow and too fast is so acute that it cannot differ by more than 1 part in 10^{55} (which is 1 with 55 noughts following on). Just to get an idea what this means, consider the whole earth as being made up of average sized sand grains. There would be 10^{31} such grains. Now place 10^{24} (a trillion trillion) earths, all made up of sand grains on a huge scale and balance it exactly. Remove one sand grain from one of the earths and you have the deviation necessary that could disrupt the big bang's correct procedure.

Just to stretch the reader's imagination a little further. The well-known astrophysicist Roger Penrose, computed the odds that the present universe came into being, rather than a black hole cosmos, to be 1 against $10^{(10)^{30}}$ (1 with 10^{30} noughts after it).

There are, in nature, a number of physical constants designated by letters that are common to all scientists world wide. Here are a few:

- e: the basic unit of electric charge associated with an electron. Electrons are the particles moving around the positive nuclei of atoms.
- m: the mass of the electron.
- c: velocity of light in vacuum.
- h: Planck's constant, a very important constant associated with energy.
- G: the gravitational constant associated with the force of attraction between material bodies.

If such constants did not have the precise values that they do possess and did not stand in relation to one another (in size), in the way they do, then the programme that ultimately led to life on planet earth, indicated in the sketch, could not have taken place.

There are a number of very important forces in nature whose expressions are associated with the constants mentioned. The following four are especially important for our topic discussion. They are: electromagnetic forces, gravitational forces and the so-called weak and strong nuclear forces. In understanding the role they play, the reader is reminded that atoms consist of an electrically positive inner nucleus which is built up of two kinds of particles i.e. protons which are electrically positive, and neutrons which are electrically neutral. The hydrogen nucleus consists of only one proton. The helium nucleus consists of 2 protons plus 2 neutrons and so on. The nucleus is surrounded by electrically negative electrons which are held in position by virtue of their orbital motions, in much the same way as the planets move around the sun. In the normal atom there are as many electrons as protons present, and because their electrical charges are equal and opposite, the atom as a whole is electrically neutral.

There are a number of books with excellent discussions, for instance *God and the New Physics* or *Accidental Universe* by Paul Davies, explaining in detail how necessary the precise value of the various forces are in order to provide a universe that will ultimately support biological life as we know it. To illustrate. If the strong nuclear force holding protons and neutrons together were just slightly stronger than what it actually is, protons and neutrons would have such an affinity for one another that they would clump together to form only heavy elements, and there would be no light elements such as hydrogen left. The latter is absolutely essential to support life. On the other hand, if the strong nuclear force were slightly weaker, then there would only be hydrogen in the universe and that would not do either.

If the gravitational force was too strong, stars would burn out too quickly and their behaviour become too erratic. For instance, our sun has just the right rate of burning and is very steady in the emission of heat and light, which is of course vitally necessary for sustaining life on earth. Moreover, the balance of gravitational and electromagnetic forces is crucial in determining the character and life of stars. Again the electromagnetic forces play the most important role in the formation of molecules (where atoms come together in groups that have particular chemical properties) and of course, if we don't have the right molecules, biological systems such as plants, animals and people could not come into existence.

The reader can sense that there is a vast network of factors necessary to provide the correct materials and energy resources in order for a planet, with all the necessary resources such as earth, to come into existence. Every point in this network is determined by the values of the basic forces. Disturb one force even slightly in strength and the network becomes so distorted that the well-known astrophysicist, Hoyle, who in his earlier writings certainly made no room for a Deity, did concede that “a super intellect has monkeyed with physics, as well as with chemistry and biology”. In his later writings he gave more realistic credence to the super intellect.

At this stage of our discussion it is necessary to be reminded that the information that we gather on planet earth indicates an expanding universe. One must bear in mind that this information, carried by the light that enters our telescopes, left its point of origin a long time ago, in fact billions of years in the case of the outer edges of our known universe. What happened after the departure of such light signals we don't know as yet. Is the universe still expanding and will it continue to do so for ever, or will the expansion come to a halt and will gravity then start pulling everything inwards so that we end up again at a point? Such an event is referred to as the big crunch as opposed to the big bang. After the big crunch we can have a big bang again and so the cycle repeats itself. Such a situation is described as an oscillating universe and in that case we, right now, happen to be observing the expansion phase of a particular cycle. The answer to the situation depends on the total amount of matter in the universe. If there is enough of it, gravity will eventually take over and the big crunch can set in. If there is not enough matter, ie. below what is called the critical mass, the expansion will just go on. The two situations are respectively described as a closed and an open universe. At this stage the research results concerning the mass of the universe indicate a value below the critical mass.

From a philosophical and religious point of view the above situation is important. An oscillating universe could be regarded as having been there forever, and therefore it had no beginning. Suffice it to say that the speculations on such a situation are severely criticised by many a leading scientist and, in any case, if the universe eventually does indicate oscillation, it is certain from thermodynamical reasoning that it could not go on doing so forever. Note that the laws of thermodynamics are regarded as the best established laws in science. In fact, it would not go back to more than roughly 12 oscillations. In other words, the universe would still have a definite beginning.

Finally, we have to consider the beginning itself. Where did the original somewhat mysterious blob of energy come from? We called it the cosmic nucleus, mysterious in the sense that it has virtually zero dimensions, but infinite content. There are essentially two approaches. Firstly, it was put there by the Creator. The fact that He is Almighty God makes it perfectly possible for Him to do so. It is meaningless to ask, if space and time came with the big bang, where was God before the great event took place? There is no need whatever for the God of the Bible to be confined to space and time. HE simply IS and it is perfectly reasonable to expect Him to be outside his own Creation. The second approach is to attempt to explain the coming into existence of the cosmic nucleus in terms of the laws of physics. The famous Stephen Hawking of Cambridge University, is associated particularly with this approach. He applied quantum mechanical theory, which has been very successful in explaining phenomena on atomic and sub-atomic scale, to the problem of the beginning. From this approach emerged the concept of the possibility of an infinite number of universes, and we happen to be inside the right one for life to exist as we know it. This idea could of course, never be proved. One has to *believe* or reject it. It has to be pointed out that there is no scientific evidence that

theory which is applicable to atoms and particles constituting atoms can be applied to the very birth of the universe. Jumping from one end of the scale to the very other end is indeed a great leap of faith. The answer to the problem will have to remain in the realm of scientific speculation. Laboratory research with the giant accelerators available to physics, has led to experimental results that can take us, with fair confidence, to what happened after the first few seconds. To explore the physics that will take scientists right up to a tiny fraction of a second after the being started, will require equipment so huge that pooling of all the world's resources could not nearly afford it.

However, let us suppose for a moment that we could establish the origin of the cosmic nucleus in terms of the laws of physics. One is then immediately confronted with the challenging question: Where did the laws come from?

A brief look at some of the laws will guide our reasoning. The law of gravity tells us that material bodies attract one another. A stone falls "downwards" to the surface of the earth because the stone and the earth attract one another. We only observe the movement of the stone because, the earth being so big by comparison, only moves a near infinitesimal amount towards the stone. As the moon orbits around the earth it is held in position by the force of gravity. If this force had to disappear suddenly the moon would fly off into space. With the aid of this law a great many natural phenomena can be explained. There has never been a case where the law does not apply. The popular myth that space travellers have eliminated the law of gravity is just a myth. The myth persists because it leads to a well paying UFO industry.

A similar law accounts for the way electric charges act on one another. In the area of energy we have the laws of thermodynamics which govern the nature and behaviour of energy in its various forms. Are these laws autonomous? Do they exist independently of the physical universe, or are they the by-products of the universe? Or, are they simply the products of man's reasoning in describing the universe?

It must be clear to us that the laws cannot be both the cause of the universe coming into being, and at the same time, the result of the universe being what it is.

If, and this would be a sheer leap of faith, the laws are there, independent of the existence of the universe, then their origin can only be ascribed to God the Creator.

Whichever way we reason, we cannot escape the revelation penned down in the first verse of the Bible. *In the beginning* [of time] *God created the heavens and the earth* [space and material objects]. The words in brackets are added simply to indicate that our present day understanding of the cosmos fits in well with the first verse in the Bible.

SIX

THE BIRTH OF THE EARTH

One of the most important photographs produced this century was one taken from a space satellite. It depicted the earth as a beautiful sphere, bluish-green in colour with white clouds swirling all over it. Nothing like it was ever seen or detected before or since. Whereas all the other planets photographed thus far, show up as totally unfit for biological life there is this grand exception, our planet. It also brought home to us the fact that we live on an isolated spaceship with no supplies coming in from the outside. Mankind is totally dependent for its physical survival, now and in the future, on planet earth and its resources. It places a tremendous responsibility on the shoulders of each generation.

With a fair degree of understanding as to how the universe as a whole came into existence, it becomes very meaningful to consider the advent of a solar system surrounding a star such as our sun. Our family of planets (nine in all) plus smaller bodies like moons and meteorites, revolve around the sun in near circles. All lie roughly in the same plane, rotating about their own axes. This is a rather unusual configuration in space. Several basic questions present themselves.

- Did the sun and planets originate in the same process or separately? If the former proves to be the case then one might expect many stars with families of planets surrounding them. In the latter case, planet formation and subsequent capture in the gravitational field of the sun could be quite a rare event. Then there would also not be so many planets in the universe.
- As we know from scientific measurements that the earth, for instance, came into existence some ten billion years after the big bang event and the associated birth of stars, we may conclude that planets are made up of stuff that came from stars. Was this feed material in the form of gases or solid material particles or both?

It is an interesting exercise to study the various models of planetary formation that were proposed over the last century, but for the purpose of this essay we will briefly describe the most recent and acceptable views.

The term supernova refers to the magnificent phenomenon of an exploding star. A huge star having reached a certain age, undergoes a process wherein the inner core contracts to form a super heavy neutron star called a pulsar, and the outer periphery explodes, spewing huge amounts of debris in the form of clouds of gas and dust particles. The explosion is accompanied by a blaze of brilliant light which can easily be observed on earth. Such eruptions occur about three times per galaxy per century.

The important conclusion is the following: A planet such as earth contains heavy elements such as metals ranging from iron to uranium, whereas the original material in the universe out of which the stars were formed, was essentially hydrogen and helium. Where did the heavy elements come from? The answer lies in the supernova phenomenon. Stars that are big enough and old enough can, because of the intense gravitational compression taking place within them, undergo nuclear processes that give rise to the heavier elements. When the explosion occurs, the atomic seeds for putting together a planet such as earth have already been born inside the massive star and are consequently, together with lighter elements, blown out into space, then serving as building material for the planets. The great question arises: How did the building material come together to form planets moving in a given way around a suitable star?

Consider a huge cloud of dust particles and gas originating from a supernova explosion. The cloud as a whole rotates and gradually flattens into a disc called a pre-planetary disc. On further contraction the outer edges move faster and swirls or eddies develop in the cloud. Eventually the cloud breaks up into smaller clouds, all still rotating within themselves, and revolving round the centre of the original cloud. The central portion which contained most of the original cloud, collapsed by gravitational force into what is now the sun. Originally it was cold, but as it became more and more compressed, nuclear reactions started up within it, heat was generated and eventually light emitted. The other minor clouds condensed and became the seeds for the planets. These seeds grew as they collected more and more dust particles to eventually become our planetary system with its attendant moons, comets etc.

There are many unanswered questions arising from this “best model thus far”. For instance:

- How does one explain the earth’s metallic core?
- Why does the sun in the centre and the large planets at the outer edge, consist mainly of light gases while the group of smaller ones, ie. Mercury, Mars, Venus and Earth contain the heavy elements? Normally one would expect the original cloud of gas and dust rotating about its centre to have a distribution of material ranging from light in the middle to heavy at the outer edges.
- The collection or accretion of dust particles by initially smaller bodies in order to grow to planet sizes, does not account for possible vaporization on impact.
- Venus, Uranus and Pluto rotate in a direction opposite to that of the rest of the planets. Picture an observer looking from outer space onto our solar system. Looking from “above” he will see the sun and planets rotating in an anticlockwise direction, with the exception of Venus, Uranus, and Pluto. Similarly, all the planets will be revolving around the sun in an anticlockwise direction. So will all the satellites or moons around the planets, but again there are a few exceptions. A very general term, such as localised turbulence, is often employed to explain away the above questions. But, let’s face it, there is still no really satisfactory understanding of the origin of the solar system. It is quite conceivable that an already existent star entered and captured the parent cloud in its gravitational field. Whatever detailed model ultimately prevails, it is very evident that one has here an amazing interplay of gravitational and rotational forces.

Name	Sun	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
Radius of the body (in earth radii)	109	.38	.95	1	.53	11	9	3.7	3.6	.9
Distance to the sun (in earth distances)		.38	.72	1	1.52	5.2	9.54	19.2	30.1	39.5
Length of day (in earth days)		58.8	224	1	1.03	.41	.43	.45	.65	6.4
Length of year (in earth years)		.24	.61	1	1.88	11.86	29.45	84	164.8	248.3

1 earth radius = 6378 km.

1 earth distance from the sun = 150 mill. km.

Our solar system

However, let us accept the broad outlines of the gas dust cloud model as being correct. It is fascinatingly remarkable that out of a featureless swirling cloud of material, an orderly set of bodies such as our solar system emerged, but more so, that considering its origins and the complicated pattern of mutual gravitational forces, it has not only settled down into such a beautifully simple system, but has also remained so very stable over a period of some five billion years. This stability is demonstrated, for instance, in the strange conduct of the planet Saturn's complex ring system. Pictures of these rings indicate that they appear as solid circles surrounding the planet. Actually they are composed of myriads of small orbiting particles. Close-up photography has revealed an incredibly complex system of a vast multitude of rings, with spokes and other irregularities. According to our present understanding of mechanics they should have collapsed long ago instead of persisting for billions of years, without let-up, in their present format. To quote Paul Davies¹: "It is impossible to ponder the existence of these rings without words such as 'regulation' and 'control' coming to mind."

Naturally we are most interested in our home, planet earth. In order to appreciate what is involved, it is interesting to approach it in the following way. Let the reader assume he is a designer who wishes to establish biological life as we know it. By using the term "biological life as we know it" one implies that our designer will operate in his planning and reasoning within the framework of natural science. We will see to what inevitable conclusions this will take us. It would be well beyond the scope of this essay to consider all the factors involved, but for the sake of demonstration, a few of the essential ones will be looked into.

- If the designer ultimately wants biological specimens such as plants and animals, a decision has to be made as to what kind of atoms will be employed and how they will be fixed to one another. After considering the various forms of interatomic forces as they occur in various substances such as metals and salts he/she will find that the only choice is the so-called covalent bond as displayed in carbon chemistry. So the decision will be that the element carbon is essential for the chemistry of living things.²
- Considering the minor, but nevertheless vital role that heavier elements will also play, the decision will be that the heavenly body serving as a home for the biological specimens must provide carbon and a number of other required elements. This in turn, will demand a selection of a parent dust/gas cloud coming from a suitable supernova explosion. The latter will require a universe, developed precisely according to a large number of very finely tuned parameters, a universe of a certain age and a certain minimum size. Of the billion galaxies in the universe a small fraction will be suitable to house the birthplace of the planet in question. Hence a suitable spiral galaxy such as the Milky Way, must be available and the place of settlement within the galaxy must be right.
- In the design of a suitable planet it would be wise to have a fair number of planets formed simultaneously. For instance, if there is only one to start with, it is very likely to have an elliptical orbit around its star. This would result in too high and low temperature extremes as it comes closer and then recedes from the star. Having a number of planets would lead to their

1 Paul Davies in *The Cosmic Blueprint*. See list at the end.

2 All alternatives are well discussed in a book by R.E.D. Clark. See list at the end.

mutual gravitational interactions, causing their orbits to ultimately settle in circles. This would result in a steady exposure to the radiation emanating from the sun. If there are to be a number of planets it would also be very clever to have large ones, like Jupiter and Saturn towards the outside, in order to shield the life supporting planet from dangerous comet bombardment.

- In all the above reasoning our designer will have to make sure that the star around which the chosen planet will orbit must be of exactly the right kind. Not just any star will suffice. It must be of a given mass. A star more massive than the sun, for instance, would burn too rapidly and the heat and light coming from it will vary too much in intensity. If the star is too small, the life supporting planet may have to be too close to it in order to receive sufficient radiation. Coming too close will result in gravitational interactions that will slow down the rotation of the planet about its own axis. The days and nights would become inordinately long as happened with Mercury and Mars. The extremes of boiling hot long days and subzero long nights would not be amenable to biological life.

However, even the best of near “steady state” stars are not steady enough. For example, the sun’s radiation has increased by some third of its value since life started up on earth. “Fortunately” this was compensated for by a concomitant change in the contents of the earth’s atmosphere, brought about by the right species of life on it.

- Let us now take a brief look at what our designer has to bear in mind when it comes to the chosen planet itself. Remember we had to settle for biological life based on carbon chemistry. This requires that carbon must be freely available over the surface of the planet. Clearly the best way would be to have carbon in the atmosphere in the form of a gas and for obvious reasons one would settle for carbondioxide, non-toxic, slightly soluble in water, but not too soluble. Together with the requirements of oxygen, mixed with a somewhat inert gas such as nitrogen and water vapour, the chosen planet must be of just the right mass in order to have a gravitational field that will hold the prescribed atmosphere. Bodies such as the moon and Mars hold no atmosphere because they are too small to hold it down. Against that, Jupiter is so massive that it holds light gases such as hydrogen and methane and they are not amenable to biological life at all.

As already pointed out, the speed of rotation around its own axis must lend itself to days and nights of the right length in order to minimise temperature differences. A further great advantage would be to have a massive temperature stabiliser. Of all the substances in nature, water is the best candidate for holding a lot of heat per unit mass. Hence, water oceans on the planet would be a great positive factor. It would be just as well if the water had the peculiar property, different to other liquids, of being heaviest just before freezing. Ice would thus form from the top down, enabling the specimens living in the water to comfortably survive under the ice caps when freezing does set in. Tilting the planet in such a way that the axis of rotation is at a small angle to the plane of revolution around the sun, would result in seasons and thus a much larger surface area on the planet would be good for a wider variety of species. A solution of non-poisonous salts in the oceans would support the formation of clouds; the latter providing moisture over the land surface, as well as shielding the planet to a degree from the sun’s radiation, thus providing further levelling off of the temperature. Setting up the chemistry of the oceans in such a way that poisonous salts are not present is a formidable task, but with very astute chemical engineering it can be done.

Providing the planet with a relatively large satellite such as the moon, will guarantee that there is a lot of vitally necessary movement of the coastal waters in order to cleanse and replenish the necessary nutrients for life in the sea.

In conclusion. One could go on for a long time, listing many more characteristics pertaining to a life supporting planet. These factors are well discussed in literature, and books by writers such as R.E.D. Clark and Hugh Ross provide ample information. The latter author has calculated that the statistical chances of finding even one more planet such as the earth in all of the known universe is ommissibly small. Man's home is a very unique place.

The unavoidable question that arises is the following: If one cannot escape the reality of design and a designer whom we call God, then why did He go to such an immeasurably great deal of trouble to put together such a vast universe in order to provide one tiny sphere, called earth, on which man can live? Surely there must be other worlds with life on them? Is it not supremely arrogant to assume we are the only intelligent biological species in existence? What about all the stories of spaceships and aliens landing on planet earth? This author has a decided view on this. These stories are just stories that sell well, be it in book or film format. If there are such intelligent beings "out there" who are technologically way ahead of us, why don't they make contact with our scientific and technological institutions? Surely the great research laboratories of the world would be the obvious landing places. Why do the supposed spaceships always land in strange places and why have they never communicated with scientists or engineers of repute? Surely they will have picked up the myriads of electromagnetic waves emanating from our radio and T.V. masts and our space probes. Why no intelligent rational response to all the signals that have left planet earth? We need spend no further time on this topic.

To return to the challenging question. Why did the Deity put up such a vast system as the cosmos if the foreseeable culmination is a home for plants, animals and especially mankind? The Bible has the answer. Men and women are made in the image of God with the capacity to reason, choose, enjoy intellectual activity and especially to love. If we are made in His image, then going to all the trouble to provide such a remarkable place to live, becomes very reasonable. Regrettably, the relationship between God and mankind was seriously upset, resulting in all that went wrong on planet earth. But that is another topic.

SEVEN

LIFE ON PLANET EARTH

If the origin of the physical universe and a planet such as earth seems amazing, then biological life itself and its manifestations in ever so many forms, ranging from tiny bacteria to plants and animals and finally mankind, is even more phenomenal. It is fair to say that never in the history of scientific endeavour has there been as much controversy and debate, ranging from mild differences to vituperative slander, as in the case of the explanations of the origin of life and its various forms. To this very day the literate world is divided into many camps on this issue. Needless to say, people often argue and debate without clearly defining their terms, and in the process more confusion than clarity is generated. We will concentrate on clearly describing the concepts we are dealing with in this essay.

The first question one has to face is the advent of biological life itself. The term life is so difficult to define that most writers tend to avoid it. Credit must be given to Paul Davies for making a serious attempt in his book *The Cosmic Blueprint*. We give the following general definition: Life is the property of a system that is exceedingly complex, even in its very simplest forms; the complexity being ordered and harmonised, unique in every individual as well as in grouping, with an inherent functional purpose of its own, always derived from a living predecessor and has the property of reproduction.

At one stage of history there was hope that the transition from living to non-living matter would be a continuous one, but the advent of modern molecular biology has firmly established that the gap between life and non-life is unimaginably enormous. Accepting the fact that an ingeniously designed planet is available to serve as a home for plants and animals, science faces the inevitable challenge to try and understand how life started. Bypassing all the myths and wild speculations that come up in history, one can seriously consider the first attempt by the Russian scientist, Oparin, in 1924.

The picture is well-known today. An organic rich pool of water on planet earth containing all the necessary prebiotic (ie. before the advent of biological life) components such as carbon, nitrogen, hydrogen etc. was subjected to lightning and ultraviolet rays. The impact of lightning discharges and ultraviolet radiation from the sun caused atoms to form groups known as amino acids. They had to be of the right atomic constitution with the atoms arranged in the correct spatial orientation. These groups came together to form the first protein molecules that in turn collected to form the first living cell. Thus life started off on planet earth. All this had to happen in a chemical reducing atmosphere because in an oxidising atmosphere such as we have on planet earth today, the envisaged process could not take place. Of course, if there was no free oxygen in the atmosphere, there could not have been any ozone and that in turn would mean that the ultraviolet dosage from the sun would be so lethal that the first living cell just would not have survived. We are all aware these days how important the ozone in our atmosphere is for our survival.

This picture requires a great deal of faith in the concept which we can call an unpurposed accident. Some seventy years ago, relatively little was known of the biological building brick called a cell. One might think of a hundred huge airplanes packed with bricks, cement, sand and water, flying high and opening their latches to let all the materials come tumbling down. What are the chances that the cement, sand and water will mix in the right proportions during downward transit, then settle between bricks which fall one on top of the other, to eventually produce a neat house with the right rooms to fulfil all the functions a home requires. This is the kind of illustration one could use when the "life by accident" picture was first proposed. Today the situation is staggering. The amazing development of biochemistry of the last half century, revealed the true complexities of the cell and its covering membrane, the nearly immeasurable amount of information encoded in the DNA molecules in the cell, the necessary presence of thousands of complex molecules called enzymes and co-enzymes, and so one can go on and on. The very simplest of bacterial cells is more complex than any factory or plant ever constructed on earth.

The above illustration of the airplanes has to be extended. One has to consider millions of airplanes, all loaded with various building materials, flying hundreds of kilometres above the earth's surface. What are the chances that, on opening their latches simultaneously, the materials will mix and fall into place to end up in the shape of New York City. Several writers have put numbers to the mathematical chances of the first living cell coming together

spontaneously. These numbers vary according to the cell model chosen, but they all have one common characteristic, namely that the chances are so small that one has to accept that the phenomenon of life is a planned miracle. One of the better known numbers is that calculated by the well-known, in fact famous physicists, Hoyle and Wickramasingh. They came up with 1 in $10^{40\,000}$ which means one in 1 with 40 000 zeros after it. It is well nigh impossible to imagine what this implies. If the whole known universe was made up of tightly packed sand grains, all the grains would only number a small fraction of the above figure. Even if one chose to believe that life started off spontaneously somewhere in the universe and came by accident onto planet earth, it is evident that the whole known universe is too small to have housed the possibility of such a fantastic accident.

The objections to this type of calculation run as follows: It is not necessary to accept that the first living cell came together from its constituent atoms in one brief event. Simpler configurations of atoms and molecules could have formed over millions of years in many water habitats. The evolutionary principle of natural selection would determine that more and more complex groups survived, to ultimately move into the final living phase. This highly speculative argument can be ignored for the following reasons: Firstly, the application of the conjectured principle of natural selection to inert, dead material, which has never even been directly proved for live material, is hardly scientific. It is a matter of belief. Secondly, the associated functions that ultimately have to end up in the living cell, just cannot develop gradually. The minimum information content in the DNA code necessary for reproduction cannot slowly grow from zero to the necessary required level. It has to be there from the beginning. Finally, the original assumption that the atmosphere initially contained no free oxygen has not been established by any scientific investigations. Moreover, if the rich organic soup ponds were present at the beginning, some of this material should be present in ancient sedimentary rocks. None has been found.

To summarize. The palaeontological records reveal that life on earth in its simplest forms, started off some 3 500 million years ago. With all the modern skills and equipment available to the scientific community one would have expected that artificial conditions, over the past half century, could have been set up that would be vastly more amenable to the production of life than what fortuitous circumstances in nature could ever provide. In spite of the vast research programmes geared to such efforts, the results thus far, have shown no promise whatsoever. As biochemical information accumulates, the conclusion becomes stronger that the advent of life on earth must be a divine miracle.

The next question we have to consider is how the various life forms came into existence over the past 3 500 million years.

The fossil record tells us the following: Life in its very simplest forms existed almost from the very beginning of the earth's history. Single cell bacteria have been shown to exist from approximately 3 500 million years ago. Climatic conditions were such that only the simpler forms of life could persist for nearly 3 000 million years. Then more advanced forms began to appear. An abundance of fossils of larger species have shown up from about 600 million years back and continue to do so up to present times. The peak in animal size is the well-known dinosaur period when these huge specimens flourished some 100 to 200 million years ago. The reader can recap the overall picture from the Cosmic Timetable given in Essay 5.

One can regard the fossil record as consisting of successive bands with life forms of ever increasing complexity. It is fair from a scientific point of view to describe this whole scenario

with the term evolution, ie. ranging from the simple to the complex over a vast stretch of time. It is, however, very important to recognize that there is not a gradual transition in life form from one band to the other. Within bands there are small variations termed micro-evolution, but after long periods of near static invariance, called stasis, in any band, a new band appears quite suddenly without intermediaries. In the language of physics it can be described as quantum jumps from one group to another. The term used in biology is saltation or macro mutation. One can hardly avoid remembering the Bible verses in Genesis 1:21-25 where one reads that God created each according to its kind. However, we will return later to this point of view.

It is clear, and very reasonable, to expect that scientists in viewing all the changes that took place over time in the biological world, together with all the characteristics possessed by the various species as observed today, would want to put up theories to explain all the observations. This is part of the very essence of the scientific enterprise. It must be emphasized that collection of data, without presentation of models or theories to explain the observations, is not science.

Let us consider the most prominent theories. First are the views of Lamarck. He proposed that an individual could inherit characteristics acquired by his forerunners. Successive generations would pick up the continuing changes and eventually a new species would emerge. To illustrate: an animal with say the shape of a horse finds itself in an environment where tall trees necessitate the stretching of its neck in order to reach the leaves. With successive generations, the neck grew longer and eventually the present day giraffe emerged. This would imply that there was some feedback into the genetic code of the animal that could then be passed on to the next generation. Today we know that molecular biology forbids such a process and thus Lamarck's model is discarded in modern biology.

The next theory which has dominated the scene over the past 130 years is that of Darwin. The essence of his thinking was that purely accidental variations can take place in the hereditary mechanism of an individual, such a change being called a mutation, which leads to an offspring different from the parent. If the environment is more favourable to the newcomer it will survive and the remainder will eventually die out; if not, the newcomer will of course die. Hence, many many variations brought about by blind chance will eventually lead to the arrival of a new species. From this scenario the concept of survival of the fittest emerged.

Darwin's theory undoubtedly gripped the imagination of the scientific world and it has been pursued with vigour and much enthusiasm ever since. There are two essential reasons. As a theory it could, in principle, explain the many observations encountered in the biological world. The other reason is of a philosophical nature. If all innovations in the biosphere are purely the result of chance, absolutely free but blind, then no external driving force or influence is necessary. One can comfortably dispense with belief in a personal Creator. The Darwinian model when extended to all of life, ranging from inert matter to man, must be seen as a philosophical or faith system, a life and world view, operational on planet earth and even in the rest of the universe (as one enthusiast claimed). In this format one is not considering evolution as defined previously, but a concept called evolutionism. Regrettably, most people equate these two terms and in questioning or criticising the term evolution, they are really thinking of evolutionism.

Darwin's theory has been severely criticised on scientific and philosophical grounds over the past few decades. Some of the main counter arguments run as follows:

- It is not a scientific theory, but rather a metaphysical one because it does not lend itself to falsification or disproof. This criticism emanates from the views of probably the greatest living philosopher at the time of writing, Sir Karl Popper. This displaces the theory from the realm of science to that of belief. Moreover, the concept of survival of the fittest asks the question: What is the definition of the fittest? The answer has to be: The fittest are those that survive. This circular argument is called a tautology and hardly warrants a place in a scientific theory.
- The theory postulates gradual transition from one group to another. The fossil record in no way supports gradualism. This is one of the severest shortcomings in the Darwin model.
- Mutations are generally negative, which simply means that when the genetic code does change because of some accident of chemical or physical origin, the result is a weaker offspring, not a stronger one.
- Mathematicians, physicists and engineers are amongst the severest critics of the Darwin model, simply because this category of scientists like to put numbers to a theory, and their general view is that the mathematical chances of the necessary mutations taking place are so small that planet earth is far too young to provide the necessary timespan for development from molecules to men.
- The unravelling of the structure and function of the cell, including the genetic code, gives no indication of a gradual ascent from the simpler species towards the complex. The DNA molecule in the cell contains an unimaginably vast store of information. Information content cannot just increase fortuitously, no more than new books can appear in a library without any cause or explanation.
- Traditional biological classification (phyla, classes etc.) fits in with the Darwin model. A modern new system of classification called cladism has been developed in recent years. Cladograms deal with relationships amongst living and fossil species, but make no room for any common ancestors. The logic of this new approach cannot be faulted, but it is alien to the Darwin model.
- The Darwin model, and in fact every other evolutionary model, cannot explain the so-called big bang in biology, that occurred some 600 million years ago. As mentioned earlier, for nearly 3 000 million years earth was inhabited by simple creatures such as algae, bacteria and plankton. Then suddenly in a short space of time, some 10 million years, there came into being a vast array of more complex multicellular creatures. This burst of creativity is still something of a mystery from a scientific point of view.
- There is no successful laboratory demonstration that establishes the Darwin model. Such a situation is foreign to the scientific approach.

Finally, the most recent model to explain the origin of species, developed by Gould and Eldridge, must be briefly considered. It is called punctuated equilibrium. These scientists recognized the reality of stasis exhibited in the fossil record. Species simply remain constant for long periods of time and then suddenly a new species, complete in its own right, appears on the scene. They argued that any small change taking place in an individual within a given population would be absorbed by the remainder of the population. Somewhere on the periphery of the group a major genetic quantum jump would take place. The new species

would multiply without having to compete with the original group and finally make its appearance as an established entity. The logic of this model is attractive, but in no way can modern molecular biology tolerate the required quantum jumps and there is no palaeontological evidence to substantiate the model. However, it is a useful and plausible theory to explain what has been termed micro-evolution. Small changes, from a mouse to a rat or vice versa, from a white to a brown seagull etc. can be understood in terms of this model. It cannot justify macro-evolution, such as the jump from a reptile to a bird.

In spite of the preceding comments on the limitations of the various models, the reader must be reminded once again that scientific research must lead to theories that will attempt to explain the observations. This writer has no objection to theories attempting to explain the changes that have taken place over aeons of time. It is, however, of dire importance that the weaknesses and shortcomings of theories and models be recognized and admitted. There is no justification, in the search for truth, in ignoring the limitations and turning the theory into a system of belief. Recognizing the advance towards higher life forms over the ages and accepting that there is very reasonable evidence that micro-evolution within groups has taken place, but also recognizing that there is a Creator that stepped in from time to time to cause major changes, would be an honest approach in terms of what we know and understand in the present day. This would not be contrary to the available scientific evidence or to the Bible.

A few remaining issues need to be dealt with.

Parents, scholars and students who believe in the Bible are often seriously disturbed by teachers and textbooks that sometimes, unintentionally propound Darwinism with so much conviction that it becomes evolutionism in the philosophical sense. The approach is often quite dogmatic. The question immediately arises: What should the young person's reaction be? He or she wants to understand and appreciate the findings of science, doesn't want to offend the teacher in question and certainly has to pass examinations and tests. A fair approach would be to argue that scientific theories are useful in explaining at least some of the observations, but must be valued for the degree in which they succeed. Moreover, the questions associated with the origin of biological life and species are so complex and difficult from a scientific standpoint, that one must neither expect nor assume that ultimate truth has even nearly been arrived at. After all, physics and chemistry experiments on inert matter can be repeated over and over again in a laboratory, but the happenings on planet earth over three and a half billion years don't lend themselves to repetition and confirmatory tests. As explained before, that is why Karl Popper says that evolutionary theories are essentially metaphysical. It is also wise to recognize that those who accept the Bible as the means of communication from God to mankind, must realize that we have not necessarily come to come to full and final understanding of its message. There is still a lot to be learnt.

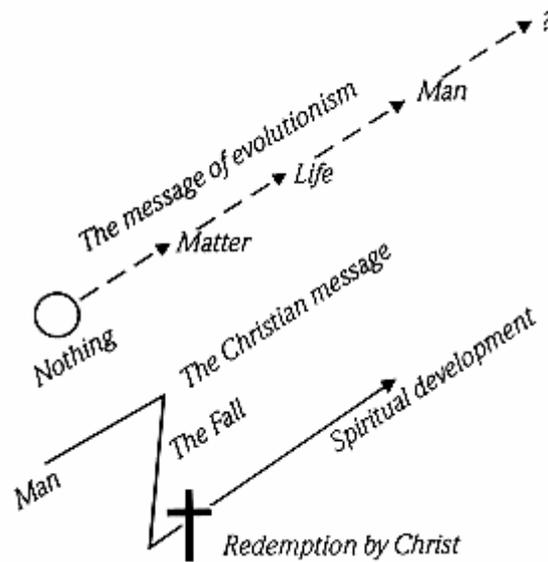
Finally, the most important point of conflict between Christianity and evolutionism as described above must be clearly and emphatically stated. The main issue is not, idiomatically speaking, concerned with Adam and the ape. Speaking from the Biblical point of view there has been far too much concentration on exactly how mankind came on the scene and in the process, the essential difference between the Christian message and evolutionism has been bypassed.

According to evolutionism man is the end product of a continuous line of development starting with inert matter. Some might even postulate that you may start with nothing, then

proceed to matter and so on. Every point on the curve is the fortuitous result of the previous point, with no directive influence from outside.

According to Christianity, man's origin was planned by God the Creator. The Bible teaches that he was created in the image of God which simply means that man had the ability to choose, reason, love, enjoy truth and beauty and so forth. He lived in communion with God, but the relationship was upset because of the willing co-operation of man with the forces of evil¹. Man is thus a fallen creature in the spiritual sense and cannot start the spiritual ascent, other than through the cross of Christ.

To sum up. The problem with evolutionism is that it has no room for a redeemer and that is why Christianity cannot ever come to terms with it.



*Presentation of the main difference between evolutionism as a world view and Christianity.
(As pointed out in the text, the term evolution must not be confused with evolutionism.)*

EIGHT

GENESIS AND THE ADVENT OF MAN

The first chapter of the Bible is truly majestic in style and presentation. It conveys a vital message to mankind.

¹ The problem of evil will be discussed in the final essay

The interpretation and reading of Genesis 1 in the Christian world varies from literal acceptance of every statement to a view that it must be read as mythology, certainly with a divine message. No attempt will be made here to delve into the various presentations of God as creator throughout the Old Testament, or the various creation stories that were told in the ancient world, and whether or not they had any influence on the first chapters of Genesis. The reason for accepting that the whole Bible is God's communication to man has been dealt with in the third essay, and in considering Genesis 1 we will proceed on this basis.

Recognizing that the words were penned down a long time ago by a scribe who had to work in terms of his language and idiom, one faces the daunting question: What is God's intended message for us in those introductory chapters? How must they be read and interpreted?

In this essay the three most important approaches will be discussed.

Firstly, the literal reading. God created, in six consecutive days, the whole cosmos. Furthermore, assuming that the names, births and ages of people mentioned represent the sum total of human history up till the birth of Christ, the date of Creation is taken back to six thousand years ago. It is interesting to note that this approach was not very prevalent in the early church, but really took off after John Lightfoot, Rector of Cambridge University in the mid 17th century and a contemporary, James Ussher, Anglican archbishop of Ireland, published their calculations on the Creation date.

To this very day, there are very many Christians around the world who hold this view. It finds a great deal of support from the Creationist Movement which started in the early sixties in the United States. The essential thrust of this movement is simply this: God's Word must be read and accepted as given to us. Taking other sources of information into consideration when we read and interpret the Bible, can lead to error and undermining of faith. Publications and statements from the various fields of learning, including the natural sciences, that support the literal approach are acceptable. Otherwise, they are to be discarded.

It must be accepted that the Christians who actively follow and participate in this line of thinking are generally committed evangelicals whose sincerity cannot be doubted. They vehemently oppose the philosophy of evolutionism and feel that accepting the age of the earth to be six thousand years, will completely exclude all theories of evolution, since the latter requires vast periods of time. In other words, an old earth as opposed to a young earth can lead to accepting one or other evolution model.

There are several serious criticisms against the above approach to Genesis 1.

- One does not need a young earth in order to discard the philosophy of evolutionism as discussed in the previous essay. Science in its own right, can deal with the merits, or lack thereof, of the various evolution models even if the earth is 4 1/2 billion years old.
- Most cosmologists and biologists are not wilfully mean, anti-Christian people. They are simply scientists trying to find answers to questions that one faces as you probe nature. Disdain towards their efforts can only estrange them from the Christian message and that in turn, can and does lead to ridicule of Christianity. After all, the church in past centuries did hold the view derived from simplistic reading of the Bible, that the earth was in the centre of the solar system. Prior to that, the earth was even considered to be flat.

- The problems associated with a six day creation viewpoint are not recognized, ignored or covered up with some strange explanations. For instance: Where did the creation take place? After all, when it is day in South Africa it is night in Australia. Did the creation progress from continent to continent as the earth rotated about its axis?

Where did light and darkness come from on the first three days if the sun only came into existence on the fourth day?

Why did God not go on creating overnight? Surely He does not require light to act.

Why did God establish a vocabulary from the very first day onwards?

Why did God rest on the seventh day? It would be vast impertinence to suggest that He became tired.

Why do the accounts in Genesis 1 and 2, of the order in which the creation acts took place, differ so significantly?

It must be noted that nowhere does the text state explicitly that a certain entity was created on a given day. For instance, it does not state: On the third day God created grass, plants, trees etc., but rather, the passage reads: “ ... *Let there be ...* ” ... *God saw that it was good. And there was evening, and there was morning—the third day.*

Finally. Did God create the whole universe, including planet earth in six days, some six thousand years ago, and build into it an appearance of age, that would make it look billions of years old? Why would He do that? Surely not to fool scientists because that would not be in keeping with the character of the God of the Bible.

Let us now turn to the second approach in the interpretation of Genesis 1.

Simply stated, it runs as follows: The six “days” of creation described in Genesis 1 can be read as six eras of time, each of which can be billions or millions of years long. This approach is probably held by the majority of Christian leaders in the world today. It is dealt with in excellent manner by Hugh Ross¹. The arguments in favour of this view depend very strongly on the translation of the word *yowm* in the original Hebrew text. This term can also legitimately be translated as a day or an epoch or age. Moreover, the words for morning and evening can be read as the onset and closing off of such an epoch. Further support is given by the fact that the Bible clearly indicates that God is not limited to an experience of time, as is the case for humans. Verses stating that a thousand years are like a day and a day like a thousand years for the Lord (Ps. 90), substantiate this understanding of God’s approach to time. Rest on the seventh day can be read as an introduction to an era of rest in a spiritual sense, that has not ended as yet, because there is no evening attached to it.

Questions such as the presence of light during the first three epochs with the sun coming into being in the fourth epoch, are answered by regarding the earth as being enveloped by a translucent atmosphere, such as clouds, which allowed light to come through while the sun and moon remained invisible. The atmosphere became transparent during the fourth era with the concomitant appearance of the heavenly bodies.

¹ A list of Hugh Ross’s publications are given at the end.

Finally, the order of events as viewed from this interpretation of the first seven days, fits in satisfactorily with the findings of science on the origins of the universe and the solar system. The marked difference in the order of the creation events in Genesis 1 and 2 is ascribed to the view that in the first chapter, the physical creation of the universe is described, whereas in the second chapter a spiritual view, with man's position in the cosmos, is presented.

Of the two views presented above, the second one is certainly the more valid and satisfactory. It can be reasonably well accommodated in terms of scriptural interpretation and the findings of modern science. The words "reasonably well" are deliberately chosen because this writer does not feel too comfortable with what might be called a rather complicated explanation of a beautiful, yet simple passage. One cannot avoid the conviction that the author of Genesis 1 had ordinary normal days in mind when he penned down the momentous revelations contained in the chapter. This leads us to the third interpretation of Genesis 1.

The first chapter in the Bible is not a record of history but a revelation of the majestic creative activity of Almighty God. This view was expressed in the early 1950's in the presence of this writer by the Dutch philosopher, Herman Dooyeweerd. The arguments in its favour had already been written by P.J. Wiseman in the mid forties.

The reader must be warned that this approach is presented with a considerable measure of enthusiasm because the writer finds it the most satisfying of all studies relating to Genesis 1. However, it is readily conceded that it is one of several possible interpretations.

The challenge is to reconcile the valid findings of science that, as previously described, the universe and planet earth came into being over billions of years, with Genesis 1 which speaks of seven days.

The concept of creation in six days is taken from passages such as those in Exodus 20 where we read that in six days the Lord made heaven and earth. The Hebrew text omits the word "in" and literally it reads: For six days the Lord made heaven and earth.

The Hebrew word for "made" is *asah*. It implies action and the root meaning is "to do". It occurs about 2 500 times in the Old Testament and is translated in context by words such as show, offer, prepare, keep, deal, commit, work etc. It would be perfectly legitimate to translate the above text as follows: In six days God showed or revealed heaven and earth.

Picture the scene. The beautiful earth with trees, flowers, animals, birds, etc. is already there. The Lord calls the author of Genesis—let us assume it was Moses—and reveals to him on six consecutive days how He brought the whole of Creation into being. All the problems previously referred to, fall away. There was no overnight activity because the scribe had to sleep. Vocabulary was built up from the first day in order to make the record meaningful. The order of revelation does not have to follow the order of the actual creation. This means one does not have to stretch the exegesis as to why day and night were discussed before the sun. Of course the sun had to be there from the onset, but it does not have to be referred to at the beginning². The reader has to be reminded that a revelation is akin to describing a picture. One does not do it by starting on the left hand side and working your way across, centimetre

2 Possibly this was done on purpose because the sun being worshipped by so many ancient peoples had to be relegated to a lower level in the account.

by centimetre, to the right hand side. By way of illustration, it would rather be done as follows:

There is a house surrounded by grass and trees. To the left of the house is a pond with ducks on it. The house has a red roof and white walls, etc. What do we notice? An obvious feature such as the house is mentioned first, then several other features are considered and after a while, more information on the first mentioned feature is presented. The order of significance is dominant.

There is now no need to try and square the Genesis chapter with the findings of science, because the revelation is not meant to give a chronological scientific account of creation. It is intended to reveal that God is responsible for it all and that He was satisfied with the results. It is left to science—the reading of the created word, remember—to find out how God did it over the aeons.

The problem around the seventh day now falls into place. God did not rest because He was tired. He ceased the revelation exercise after six days and a break was taken for the author's sake. Jesus himself stated that man was not made for the sabbath, but rather that the sabbath was instituted for man's sake.

Again, the difference in sequence of events in Genesis 1 and 2 can now be viewed in perspective. The first account is a revelation of God's involvement in the physical creation. The second account deals with man's involvement in creation. There is no reason why the two accounts should be compared or required to correspond.

Lastly, we want to face the question: Who was Adam? How was modern man, homo sapiens sapiens, introduced on planet earth?

Anthropology is a scientific discipline which, inter alia, concerns itself with tracing the origin of man. The vast amount of literature concerned with the description of the fossil remnants of the ancient human-like apes and ape-like humans, will not be dealt with here. Names such as Australopithecus (which has nothing to do with Australia by the way), Homo habilis, Homo erectus, Neanderthal, Cro-Magnon, Homo sapiens and Homo sapiens sapiens will be familiar to some readers. The associated fossil remains go back approximately 4 million years. The collective name used for the ancient specimens is hominids. Several main principles emerge from these studies. Most of the various groupings that dispersed over planet earth have died out. It is enthusiastically assumed by many researchers that the grouping that resided in Africa, eventually gave rise to modern man. One has to face the reality that at this point in time we do not have a long continuous chain of evidence with the odd missing link, but rather chains of missing links with the odd element of evidence available. There is no direct evidence relating modern man to any of the hominid predecessors, but in all fairness to anthropologists it is reasonable, from a purely scientific point of view, to want to do so. It is also worth mentioning that brain size, as deduced from the fossil evidence, remained small and constant over millions of years and only in relatively recent times, say about a quarter million years back, did brain size begin to develop towards that of modern man.

The Christian who believes in the Bible, now faces a choice. God made Adam out of the dust of the earth according to the Scriptures. How he was formed out of the dust, the Bible does not tell us. It is reasonable to believe that God started off with a brand new species, not derived from any previous one. This would be a divine miracle. Alternatively, one might

believe that God took one of the primitive creatures and “breathed” into him a spirit of God-consciousness. In other words, in the latter case God took the body that had developed over many years and performed the miracle of turning him into a being that bore the image of God with the associated spiritual, intellectual and emotional capacities. Please note that the word *believe* is used in both cases. No one can claim to know by any other means than belief. Both avenues depicted above imply unequivocally, a miraculous act of Almighty God.

How do we accommodate Biblical statements such as ... *sin entered the world through one man ...* (Rom. 5:12)? Was Adam the one and only human being by whose actions mankind’s relationship with God was broken, or was he the first person to have a covenantal relationship with God, representing the human race, and whose actions subsequently led to catastrophe? Again in terms of our present understanding, either of these approaches would be reasonable.

There is another challenging verse. “*From one man he made every nation of men ...*” (Acts 17:26). Does this not state that the whole human race has one single human father? Logic tells us that originally there had to be one parent. It is inconceivable that two or more totally independent individuals could each give rise to offspring that turn out to be the same biological species. Very recent publications³ have cast some interesting light on this issue. A study of the Y-chromosomes of 38 males around the world indicated one common male parent, mathematically estimated, to go back 270 000 years but with a lower possible limit of 27 000 years. Clearly this rather stunning result will receive a great deal of attention in the foreseeable future. At this stage it must be regarded as a preliminary conclusion. It does, however, support the Biblical statement referred to above.

One can, with conviction, retain confidence in the Scriptures. A human being is the outcome of a divine plan.

NINE

EINSTEIN’S DILEMMA

Albert Einstein, whose name commands tremendous respect amongst scientists and laymen alike, believed in God the Creator. The beauty of order and planning in all of nature enthralled the great thinker. Einstein’s quest was to know “how God created this world”. He was convinced that God was not “malicious but subtle”. This last remark indicated that it required resourceful thinking and research to find out how it all happened. However, the god that Einstein believed in was not the Deity described in the Bible. His god was a scientific amoral hypothesis, not a personal God interested in, or involved in planet earth and its inhabitants. Somehow a “superior reasoning power” had to be associated with the whole cosmos. He was baffled by the paradox of God’s omniscience and omnipotence and man’s ability to make choices. The dilemma was expressed as follows¹:

3 Svante Paabo. *Science*, Volume 268, 26 May, 1995, p.1141. Dorit et al. *Science*, Volume 268, 26 May 1995, p.1183.

1 Taken from *The Creator and the Cosmos* by Hugh Ross

If this being is omnipotent, then every occurrence, including every human action, every human thought, and every human feeling and aspiration is also his work; how is it possible to think of holding men responsible for their deeds and thoughts before such an almighty Being? In giving out punishment and rewards He would, to a certain extent, be passing judgment on Himself. How can this be combined with the goodness and righteousness ascribed to Him?

Einstein was simply giving expression to the age old question of reconciling God's sovereignty and man's responsibility. Instead of seeking an answer or being provided with one by the religious leaders of his day, he opted for an escape route wherein God became impersonal and thus the question need not be faced. He is not somebody who is interested in planet earth and its inhabitants. It is a sad piece of human history in the life of a great man.

Christians face the same problem in different ways. If God is omnipotent and in control of all history, ranging from the individual to the whole world, what is the point in praying? Does man have the responsibility to choose Christ as a personal saviour if it is predestined what he will do anyway? What do we understand by free will? If God is the original source of everything, how did evil arise in the universe?

Does the Bible have an answer to these problems, or does it at least indicate along which lines these baffling questions are to be dealt with? This author thinks so. However, he is aware of the fact that in seeking and providing answers in this difficult area, one might be raising even more questions.

Let us consider the origin of evil. At this point in time there is no answer to this problem. Whether one is an atheist, evolutionist (as defined in Essay 7), agnostic, Mohammedan, Hindu, Christian; there is no satisfactory answer available to mankind as to how evil originated. The Bible tells us about the nature and character of evil and who the perpetrators of evil are and how to overcome the problem, but it does not tell us about its ultimate beginning. In simple language, we have no answer to the question: Who or what tempted the devil?

Secondly, we must look at man's capacity to make voluntary decisions. If men and women were not capable of choosing between good and bad in a moral sense, irrespective of what circumstances they happen to be in, then mankind would have been just one more animal species. The latter's responses are determined by its environment and if the Creator had stopped short there we would not have had this qualitative, totally different species that can reason, hate, love, appreciate beauty and make decisions that may, or may not be consistent with what is best for the individual and society.

The problem we are facing, is now reduced to the following scenario.

The Almighty Creator God is responsible for bringing into being the whole universe and everything contained in it. According to the Bible He is personal, omnipotent, omniscient and He loves planet earth and its inhabitants. Man, on the other hand, has the capacity to make choices and his drive for self deification often results in selfishness, greed, hate and all the suffering we see around us. How can we reconcile God's sovereignty and man's responsibility? Has God relinquished His sovereignty in part and is therefore not in control over everything that takes place, which leaves man entirely responsible for the problems on planet earth? Or, is the whole of history really God's plan and man fills a role wherein he imagines himself free, but is in reality just an intelligent puppet?

In Christian dogmatics we find two streams of thinking associated with the terms Calvinism and Arminianism. In the former, the emphasis is placed on the sovereignty of God. Somehow man is not a mere robot, he will be held responsible by God for his bad deeds, but yet God's fore-ordination determines his eternal destiny.

Once one has settled for this view, the Bible is read in terms of this approach and those portions that seem to contradict it are rewritten in the reader's mind in order to comply. To illustrate: If the Bible states, as it does in many places, that Christ paid the penalty for sin on the cross for all of mankind and all are invited to accept and follow Him, then it should be understood that it does not mean literally "all", but only those who have been fore-ordained to do so.

In the second stream where the emphasis is placed on man's capacity to choose and settle his eternal destiny himself, those Bible verses which clearly state that one can only make the choice because God enables him to do so, are read to imply that God knew beforehand who would want to choose to follow Christ, and the fact that He enables them to do so, is simply a necessary result of their initial decision.

From the above very brief discussion one can immediately conclude that the Bible does lend itself to both points of view. These two lines of thinking have been illustrated for one particular aspect of Christianity, namely that of salvation. It can readily be extended to other spheres. If God is sovereignly in control then why is there so much pain and hurt in the world? Where does prayer enter into the equation, and will God interfere in the history of the individual or society if He knows the end from the beginning anyway? If man is entirely responsible for the state of affairs, can one then assign the entire flow of history to his decisionmaking? A straightforward reading of the Bible, without involving a particular theological bias, reveals that the sovereignty of God and the responsibility of man are repeatedly stated as if both concepts are the most natural thing imaginable. A few illustrations will suffice.

Consider Christ himself. He stated to his disciples: *You did not choose me, but I chose you ...* (John 15:16), and yet the same Christ said to the people of Jerusalem that He wanted to gather them like a hen her chickens, but they were not willing (cf. Matt. 23:37). In other words, their decision prevailed over His desire. Paul writes to Timothy and states ... *God our Savior who wants all men to be saved and to come to a knowledge of the truth* (1 Tim. 2:3, 4). In the next epistle he writes with calm conviction ... *God, who has saved us and called us to a holy life—not because of anything we have done but because of his own purpose and grace ...* (2 Tim. 1:8, 9). On another occasion he combines both lines of thinking in one text when he writes ... *work out your own salvation with fear and trembling, for it is God who works in you to will and to act according to his good purpose* (Phil. 2:12, 13). Peter addresses his first letter to God's elect who have been chosen. In his second letter he writes, *The Lord ... is patient with you, not wanting anyone to perish, but everyone to come to repentance* (2 Pet. 3:9).

The question arises: How did Christ, when on earth, and his apostles reconcile these two lines of thought? The answer is—they did not, but accepted both as truths, without attempting to integrate or assimilate them. It is great to know that a Christian serves, and is in the hands

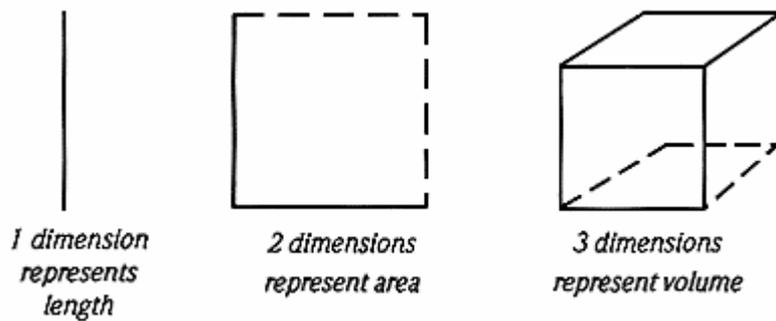
of a sovereign almighty God, but at the same time he is always reminded of his personal responsibility².

Recognizing two seemingly opposing truths is not foreign to scientists. Let us repeat a previously mentioned illustration. Over the past century two models for the nature of light were simultaneously accepted. The wave theory, which states that light is propagated like waves in a hypothetical medium called the aether, can be proved by straightforward experiments conducted in an undergraduate laboratory. With the advent of quantum theory, which states that light is propagated as tiny packets of energy called quanta, experiments were devised which unequivocally demonstrate the quantum theory of light. Somehow physicists are sometimes more tolerant than theologians. The physicists did not form two separatist camps, the wave camp and the quantum camp. It was intuitively recognized that here we have two aspects of a far more complex model which will eventually be developed. And this is exactly what happened with the advent of quantum electrodynamics developed over the past three decades.

To return to Einstein's dilemma of God's sovereignty and man's responsibility. One truth does not have to be submerged at the expense of the other. Both can be accepted with the assurance that when we move into the presence of God after death, we will clearly understand how it all fits together.

Just to make sure that the reader really does follow the above line of reasoning, a simple illustration will now be employed. Bear in mind that it is merely an illustration.

In geometry a single line represents one-dimension, viz. length. Length x breadth, two-dimensions, represent area. A third dimension takes us to volume.



Dimensions

We humans are three-dimensional beings because we have volume. (Some have more than others but we need not discuss that here.) Consider now a flat surface which represents a two-dimensional world, and in it live flatlanders. They cannot conceive three-dimensional objects. On occasion one of them, Jimmy Flat, communicates with a person such as the reader and tells him that they have heard of an object called a watermelon. Could he please describe it to

2 On one occasion (Rom. 9) Paul tries to argue the problem of God's sovereignty versus man's responsibility and speaks himself, as it were, into a corner. This writer believes that the Holy Spirit allowed that portion of Scripture to be penned down in order to illustrate the intractability of the debate when approached from a human standpoint

him. The reader attempts with a show of hands to meet Jimmy Flat's need, but fails because Jimmy cannot conceive three-dimensional objects. Sensing the problem the reader slices the watermelon in half and shows Jimmy the cross section. He now understands and goes away happily, knowing a watermelon is elliptical in shape. (See sketch Fig. A.)

A while later another flatlander, Bobby Flat, accosts another reader with the same problem. After going through the same attempt to explain what a watermelon is, this second reader also presents a two-dimensional cross section by cutting across the watermelon. (See Fig. B.) Bobby Flat is equally satisfied, knowing that a watermelon is round in shape. After a few days Jimmy and Bobby meet up in flatland. They tell each other with great enthusiasm about the results of their search. Immediately a serious debate ensues. Both insist that they have evidence for their respective views. The flatland society is in deep perplexity. How can a watermelon be elliptical and round? They start setting up two churches, the round watermelon church and the long watermelon church, or maybe two political parties answering to such a description.



Fig. A



Fig. B



Fig. C

We, the three-dimensional ones, smile good naturedly. If only those chaps could think in three-dimensions they would see that they are both right. If one day they get promoted to a three-dimensional world they will see the full picture as illustrated in Figure C. In the meantime they will have to accept that they are dealing with two facets which are both true, but different because of their dimensional limitations.

On that day when a follower of Christ passes into the presence of God, free from the limitations and boundaries of space and time, he or she will see the full truth. The seeming paradox of God's sovereignty and man's responsibility will be solved. St. Paul's words will be fully grasped: We now look into a dull mirror and see an uncertain image, but one day we will see the full picture (cf. 1 Cor. 13:12).

SOURCES FOR FURTHER READING

There are scores of books and hundreds of articles that could be listed relating to the fields touched on in this book. The limited number below is presented for those who would fall in the category of the average reader. The extensive reference lists in the books and articles named will easily provide the serious searcher with all the material that he or she could possibly require. Most of the titles given can be obtained from bookstores. A few of the books may be out of print and only available from libraries. Only one important article from a science journal is mentioned. It would be available in academic libraries.

A brief comment on each book or article is given. Please note that where terms such as pro-Christian, pro-theistic, religiously neutral etc. are used, this is simply a guide and refers only to the book as such. No judgment on the author in question, is intended. The list is given in alphabetical order.

1. DAVID L. BLOCK. *Our Universe: Accident or Design?* "Starwatch" P. O. Box 60, Wits 2050, South Africa, 1992.

The author is a university lecturer and researcher in the area of theoretical astrophysics. This publication deals in spectacular fashion with the findings of modern cosmology and the necessity of accepting design. The photographs are beautiful. The approach is pro-theistic and pro-Christian.

2. R.E.D. CLARK. *The Universe: Plan or Accident?* Paternoster Press London, 1961.

This book deals with the origins of the universe, planet earth and biological life. While it obviously cannot contain the scientific findings of the last three decades, it is an outstanding example of clear reasoning on the religious implications of modern science. Pro-theistic and pro-Christian.

3. PAUL DAVIES. *God and the New Physics*. Penguin Books, 1986. *The Cosmic Blueprint*. Simon and Schuster, 1988. *The Mind of God*. Penguin Books, 1992.

Davies is a well-known and highly respected author of popular books, especially in the realm of cosmology. Because this Professor of Theoretical Physics is also an outstanding scientist, his books carry a clear ring of knowledge. The three books listed here show a progressive line of thought towards theism.

4. MICHAEL DENTON. *Evolution: A theory in Crisis*. Burnett Books, 1985.

The author is a molecular biologist and in this book sets out, on a purely scientific basis, the weaknesses of the Darwin model of evolution. It presents no pro or anti-religious bias, but certainly contains a most comprehensive collection of scientific evidence demonstrating the shortcomings and failures of the Darwin model.

5. WILLIAM GARNETT. *Heroes of Science*. London. Society for Promoting Christian Knowledge, 1885.

Garnett, an engineer and former Fellow of St. John's College, Cambridge, has gathered in this book the biographies of a number of famous physicists, such as Robert Boyle, Michael Faraday, James Clark Maxwell and several others. The purpose of the book is to demonstrate unequivocally that in the world of classical physics, many of the leading figures were committed Christians.

6. FRANCIS HITCHING. *The neck of the giraffe, where Darwin went wrong*. Ticknor and Fields, 1982.

Hitching, as an exponent of popular scientific writing, has written a book in layman's language printing out the failures of the Darwin model. He obviously investigated the field

thoroughly and presents his case well. The book indicates no religious bias one way or another.

7. STEPHEN HAWKING. *A brief history of Time*. Bantam Press, 1988.

Hawking, Professor of Physics at Cambridge University, is known world wide, partly because of his successes as a scientist and partly because he so bravely overcomes his physical disabilities. The book deals with the origin and development of the universe from the author's theoretical perspectives. It is very well written and informative. The book refers several times to God, but in a general hypothetical way.

8. R. HOOYKAAS. *Religion and the Rise of Modern Science*. Eerdmans, 1972.

Hooykaas, as Professor of the History of Science, is eminently suitable to demonstrate the role Christianity played in the development of science. Moreover, the book is rather typical of the profound philosophical approach of Dutch writing in the area of science and belief. This book is pro-theistic and pro-Christian.

9. FRED HOYLE and CHANDRA WICKRAMASINGH. *Evolution from outer space*. Dent and Sons, 1981.

Fred Hoyle is a world renowned astrophysicist. Together with Wickramasingh, Professor in Applied Mathematics, the book represents a very strong attack on the Darwin model, especially as seen from a mathematical perspective. The authors reintroduce the concept of extra terrestrial influence in the form of organic matter transferred to planet earth under the direction of what one might call a universal theistic intelligence.

10. PHILIP JOHNSON. *Darwin on Trial*. Intervarsity Press, 1991.

Johnson, a professor of law at the University of California Berkley, takes the position of a judge assessing all the evidence for and against the Darwin model, and comes up with an extremely well reasoned negative verdict. It is one of the most telling recent publications in the field. The author refers to himself as a philosophical theist and a Christian.

11. JACK J. LISSAUER. *Planet Formation*. Annual Review Astronomy and Astrophysics, 1993.

This is an extensive review discussing the most recent developments in the theory of how the solar system came into existence. It is a purely scientific publication devoid of any particular religious views or bias.

12. SIR NEVILLE MOTT. *Can Scientists Believe?* James, 1991.

Mott, a famous physicist and Nobel prizewinner, edited this volume containing the approach to religion of fifteen well-known living scientists. The views vary from general theism to profound Christian commitment.

13. JOHN POLKINGHORNE. *One World—The Interaction of Science and Theology*. SPCK, 1986.

Polkinghorne is a well-known physicist in Britain who has become a minister of religion in a traditional established church. The essential thrust of the book is to establish that we need not compartmentalize our thinking on science and theology. The book is clearly pro-theistic and pro-Christian. Orthodox Christians may find some of the views somewhat liberal, but the sincerity comes through very clearly.

14. E.K. VICTOR PEARCE. *Who Was Adam?* Paternoster Press, 1970.

Pearce is a well-known evangelical in England, originally trained as an anthropologist. The book provides a great deal of anthropological evidence that supports the historic soundness of the first chapters in the Bible. It may be controversial on some points, but as a source of relevant information, it is valuable. It is clearly pro-theistic and pro-Christian.

15. HUGH ROSS. *The Fingerprint of God*. Promise Publishing Co., 1989. *The Creator and the Cosmos*. Navpress, 1993. *Creation and Time*. Navpress, 1994.

Hugh Ross has a doctorate in astronomy and did astrophysical research for a number of years, after which he became director of an institute called Reasons to Believe. All his books are highly recommendable. His writing is well researched and clear. His books can be regarded as some of the very best publications illustrating how modern science supports belief in a Creator God. They are Christian in approach.

16. P.A.J. RYKE. *Evolusie*. Potchefstroom University, 1987.

Ryke, a well-known zoologist in South Africa has written a book, in Afrikaans, giving an objective and sober exposition on the evidence for evolution, and expounding the various models that attempt to explain the observations. The book's closing chapter is clearly theistic in approach.

17. JOHN MAYNARD SMITH. *Evolution Now. A Century after Darwin*. MacMillan, 1982.

This book contains a number of chapters by different authors dealing with the various aspects of evolution. The writing is mainly evolutionist and pro-Darwin in presentation, except for the chapters on cladistics and Gould's chapter spousing punctuated equilibrium.

18. P.J. WISEMAN. *Clues to Creation in Genesis*. Marshall Morgan and Scott, 1977.

This book deals with the nature of the ancient writings. Its primary contribution is Wiseman's interpretation that Genesis 1 should be read as a six day period of revelation and not as a historical account. It is pro-theistic.

19. STEVEN WEINBERG. *The First Three Minutes*. Flamingo, 1977, 1983.

Weinberg, a world renowned Nobel Laureate, gives a brilliant and fascinating account of how the birth of the universe developed in the first three minutes of its existence. However,

the very last paragraph of the epilogue ends rather sadly, displaying the unconvincing grasp for satisfaction in life without faith in God.¹

¹