A Modern Framework for Earth Sciences in a Christian Context

Summary

Geology and paleontology are disciplines concerned with the earth, its composition and processes, and the history of life on earth. Geologists and paleontologists are largely employed in the discovery and recovery of natural resources. Because of the importance of these natural resources, the work of geoscientists is crucial.

A variety of challenges stimulate continued research by professional geoscientists. Some of these challenging areas threaten key theories regarding the origin and history of the earth. However, scientists view challenges as opportunities for new research, and on this basis alone, research in the geosciences has an exciting future.

Science and the geosciences in particular have adopted a methodology that presupposes no supernatural influences. The great successes of science resulted in the spread of naturalism into many areas outside of science, including theology. This influence has profoundly affected Christian doctrine, particularly with respect to the nature of Scriptures and issues of origins. The successes have also led to a loss of openness to new ideas and to the possibility of a Reality outside of naturalism, a possibility with profound consequences.

The Disciplines of Earth Sciences.

Geology concerns itself with understanding the earth's composition and structure and its modifying agents and processes. Geologists study the formation of minerals and rocks, weathering, erosion, earthquakes, and crustal deformation.

Geologists find employment in a variety of environments. Today, as has been true for most of the past century, the oil industry is the single largest employer of professional geologists. The industry employs geologists and geophysicists in virtually every division from exploration and production to management. Many of the leaders in the petroleum industry are geologists who have worked their way up through the ranks. In the exploration division, geologists are responsible for discovering new prospects, for evaluating potentials of prospects, for directing and bringing in new discoveries, and for managing and overseeing production. The petroleum industry is one of the few areas of employment where a geologist can begin a career as an independent, although such ventures are generally undertaken after some incubation time with a major producer. At present approximately 37 percent of all graduates in geology are employed in the petroleum industry or in government agencies regulating or overseeing petroleum production. This figure includes geologists trained in a variety of subspecialties.

During the last twenty years our increasing awareness of and appreciation for the value and fragile nature of our environment has provided a another major opportunity for employment of geoscientists in environmental geology. These geologists either work for industry, the government, or for independent consulting firms that specialize in environmental concerns. They assess the impact of geology-related activities on the environment such as geological disturbances resulting from human activity (e.g. mining), or from natural forces (e.g. landslides or earthquakes). One graduate in three in the field of geology will work in the area of environmental geology.

The mining industry employs just less than ten percent of graduates in geology. As in the petroleum industry, these individuals are involved either directly in exploration, or in production, or management of the mining industry, or in governmental oversight of the industry. Geologist employed in the mining industry may be required to travel to remote areas of the globe, perhaps for extended periods of time, in search of mineral resources.

The university trains and educates geologists in preparation for employment. It is also the source of research activities that make possible an increasing knowledge and understanding of the earth. Those wishing employment in academia will take additional training, depending upon the level of education they wish to enter. For elementary or high school teachers, a bachelor's degree in geology with teacher certification is entry level. However, a professorial position at a university will require an advanced degree, generally a Ph.D. In this capacity, the geologist will be able to train students in the discipline, and to carry out independent research projects advancing the frontiers of knowledge. About eight percent of geology graduates enter professional education as a career.

The remaining graduates find employment in a variety of private and governmental jobs. Volcanologists study the behavior and origin of volcanoes. Remote sensing is a field involving the reading and interpretation of geological data contained in satellite images for use in government and industry. Hydrology is the exploration for and development and protection of water resources. Geophysicists study, among other things, the behavior and nature of the earth's crust, including exploration of the ocean floor and the deep earth. Seismologists study the activities resulting from movement of the surface of the earth. They are concerned with understanding the processes involved and seeking to predict earth movements in order to save lives and properties.

Paleontology is the scientific investigation of the past history of life on earth through the study of fossil remains of animals and plants. Four subdisciplines are commonly recognized in paleontology. Vertebrate paleontologists study the fossil remains of animals with backbones. Invertebrate paleontologists study all animal fossils without backbones. Paleobotanists and palynologists study the remains of fossil plants and microfossils of plants and animals, respectively. Paleoecologists attempt to synthesize the information from other fields of geology and paleogeography with the information of paleontology and biology in an attempt to reconstruct the past environmental history of life on earth. Paleontologists generally have training in biology and geology as well.

Some of our most valuable natural resources are either composed of fossils or derived from fossils. These include oil, generally believed to have been derived from the thermal alteration of the remains of plants and animals; coal, produced from the carbonization of plant fossils; limestone, derived from the skeletal remains of marine organisms; marble, produced by the metamorphic alteration of limestone; and diatomaceous earth derived from the skeletal remains of fossil marine organisms. The paleontologist must be knowledgeable not only about the fossils themselves, but also about the rocks that contain the fossils and the conditions of burial and subsequent modification.

As with geologists, the majority of paleontologists are employed in the petroleum industry. Paleontologists are responsible for developing the stratigraphy (the general ordering of the layers) and determining the depth to strata during the drilling of wells. They also have responsibility for mapping and assessment of petroleum potential based upon the analysis of fossils, generally microfossils such as pollen and spores or marine microplanktonic forms.

Another sizable contingent of paleontologists are employed in environmental geology, where they are responsible for the assessment of natural resources and the preservation of irreplaceable fossil forms. This work may include the development of environmental impact

statements in association with the construction of highways, pipelines, buildings and other construction projects.

Some paleontologists find employment as educators at the secondary levels and in colleges and universities. Because paleontologists deal with the fossilized remains of biological organisms, they are often found working in close association with biologists and may hold joint academic appointments in geology and biology departments.

Vertebrate paleontologists are most often employed in museums and in environmental projects where the bones of vertebrates are involved. Vertebrate paleontology has become an increasingly popular field in recent years because of the phenomenal popularity of dinosaurs. Vertebrate paleontologists may be involved in the acquisition of specimens in the field, preparation of the specimens in the laboratory, or curation of the collections and the production of displays for the museum. Occasionally, even small regional museums may have a vertebrate paleontologist on staff, especially in the southwest. Unfortunately, there are few other jobs for vertebrate paleontologists except for an occasional opening in academia.

Relating to professionals in the field as well as to the culture at large

Western society and to a large extent, the global economy, is built on the backbone of the petroleum industry. No other industry has generated so much wealth for so many people. Concerns about petroleum were a major factor in the defense of Kuwait during the Gulf War and continue to be a central focus in the Iraq war and other Middle Eastern conflicts. The price of oil is a major economic issue. If the price of oil drops, the country's economy booms, although hardship may result in the "oil patch" states. Geologists and paleontologists are particularly susceptible to job losses at these times. Inevitably, the price of oil rises, geologists are rehired, and the petroleum industry returns to prosperity, whereas society as a whole may suffer hardship as a result of the increased price of petroleum products.

Geologists and geophysicists are responsible for uncovering new petroleum resources. These discoveries, so important when the price of oil is high, become more and more essential as we continue to deplete our global reserves of petroleum. The future for exploration geologists appears to be a good one for the coming generation.

Geologists in the mining industry supply the raw materials and manage the production: iron and coal for the manufacture of steel, sand for making glass; copper, precious metals and rare earths for the electronics industry and for a multitude of other uses. Geologists are responsible for the discovery and exploitation of these resources, as well as the conservation of the environment in the wake of the mining activities. So long as the demand for new resources continues, geologists will be needed to discover and develop them.

The awakening of society to global concerns for the protection of our resources and our environment gives environmental geologists critical roles for guarding and seeking to understand the nature of the earth and its material resources. The work they are engaged in will continue to grow in importance as the depletion of our natural resources is threatened, and as the potential for contamination of our environment continues.

Geologists and paleontologists in academic settings work to develop an understanding of the past history of the earth and of life on the earth. Insofar as these theories impact theology, this aspect of the disciplines is of particular concern to Christians and to Christian education.

Important areas for future and contiued growth in the earth sciences.

Application of Plate Tectonics. The revolution in thinking concerning earth's moving lithospheric plates has had a profound influence in nearly every aspect of geology. The scale of the processes and the enormity of the consequences resulting from the shifting of lithospheric plates are difficult to comprehend. Unfortunately, many contemporary geological studies are being completed with little consideration of the potential impact from plate tectonics. As a result, the global significance of important observations may be overlooked. For example, recently geologists were able to reconstruct the largest volcanic event on record from flood basalts (molten rock that flows in great horizontal sheets) in South America, North America, Spain and West Africa. The flows covered an area of nearly 3 million square miles. Even though most of the individual flows had been known and studied for years, the magnitude of the event was not understood until the impact of plate tectonics was carefully considered. There are still great opportunities for reevaluating conventional ideas and for critical analysis of old geologic problems in the light of plate tectonics.

Environmental Geology. Geologists often work at the interface between natural resources and the exploiters of those resources. Advancing technology permits the economical extraction of lower grades of ore from greater quantities of source rock. However a commensurate price is exacted in greater impact on the environment. Larger oil containers mean a greater economy in transport and storage, but at an ever-greater risk to the environment. Man is expanding his habitat into areas of greater environmental hazard as the cost and availability of suitable building sites dictates. Risks to buildings and their occupants must be taken into account in the equation. The competition for water rights between burgeoning urban areas and agriculture requires careful planning and arbitration, as well as a thorough understanding of the sources and limitations of the water supplies. Increasing importance must be assigned to the development of sound and responsible policies for the use and management of global resources. A forward-looking policy must be formulated and implemented to protect and preserve the resources and the environment. Careful policies can make the difference between moral and economic bankruptcy and a prosperous future. These decisions must be made today in order to ensure that there will be a future.

Actualism as a construct. As used originally by Lyell, the term 'uniformitarianism' referred to the premise that past geological processes were more or less identical to processes occurring at present, and the geologic past could only be explained in terms of these observable processes. The concept is best expressed in the geological catch phrase, "the present is the key to the past." The concept of Lyellian Uniformitarianism provided a scientific basis for modern geology. If, for example, a modern meandering stream resulted in the formation of a certain type of sedimentary feature, then using uniformitarian principles, the conclusion would be that rocks containing that particular structure were formed in ancient meandering streams.

With time and additional data, it became clear to geologists that Lyellian uniformitarianism did not stand up to careful scrutiny. For instance, a consideration of the magnitude of certain geological phenomena, such as giant debris flows, implied that past processes must at times have involved forces far above the range of forces experienced on the earth today. At the same time, a careful study of present day-to-day geological processes indicates that those forces are hardly involved at all. For example, on the occasion of the centennial celebration of Powell's historic traverse of the Grand Canyon, attempts were made to reoccupy the photographic sites in Grand Canyon used by Powell 100 years earlier. The results were unexpected. In about seventy percent of the cases, the sites, mostly at river level, appeared virtually unchanged. In photographic sites where changes from the original photographs

were observed, the environment nearly always appeared catastrophically altered. Gradually, geologists confronted with the absurdity of strict Lyellian uniformitarianism rejected it. But they were unwilling to be called 'catastrophists', a phrase too closely linked with the flood of Noah for the comfort of most. As a result, geologists reworked a related phrase, actualism. The modern concept of actualism rejects the strict Lyellian uniformitarianism and in its place acknowledges two specific premises: geologic processes have varied in rates and intensities over time, and there have been many processes operative in the past that are not occurring in the present. Lyell's uniformitarianism was not all bad. It contained some good ideas and some that have not held up. His idea that ancient geological processes followed the same laws of nature that we observe today (water did not flow uphill in the past) is still a valid concept. What has been rejected is his belief that geological processes would always be slow and gradual. Unfortunately, with the rejection of strict uniformitarianism, geology also lost its most important scientific tool. As long as the present could represent the past, there was hope that with careful and protracted investigation of present processes, we could unravel the past. With actualism, present conditions may not pertain to the past, and conditions vastly different from those operating today may have formed rocks and affected life on the earth. Actualism provides little basis for anticipating that geology will ever be a rigorous science in the sense of chemistry or physics, but it does offer opportunities for creative and critical minds to reevaluate the wisdom of the past, and to posit processes perhaps radically different from conventional wisdom, with different explanatory values.

Time: An understanding of time is of great importance to the geologist. Geologists obtain estimates for the passage of time from two distinctly different sources. So-called 'absolute' radiometric dates are derived from the decay rates of various radioactive isotopes in igneous (volcanic or molten) rocks. Although the underlying theoretical basis for 'absolute' or radiometric dating appears to be sound, there are some troubling issues arising from its application that are yet to be resolved. For example, a recent careful study based on zircon crystals in basalts (lavas) from cores taken nearest the Mid-Atlantic Ridge yielded uranium-lead dates ranging from 330 million to 1.6 billion years in rocks expected to give dates of at most a few thousand years. The authors had no coherent explanation for the anomalous dates. Furthermore, the uranium decay series itself exhibits some curious properties. In the series, a number of isotope pairs can be used for dating. However, the different pairs nearly always give different dates for the same rocks, and these differences themselves appear to be systematic. Numerous other anomalies exist, but these are still exceptions to the overall apparently coherent pattern of radiometric dates in the geologic record.

'Relative' dates are derived from the relative distribution of fossils in sedimentary rocks, the study of which is known as biostratigraphy. Dating by biostratigraphy allows temporal horizons to be traced over long distances, given certain assumptions. Relative dates can be associated with radiometric dates when biostratigraphic zones are underlain or overlain by datable igneous rocks. Once such an association is established, the biostratigraphic horizon is assumed to carry that date wherever it occurs. Unfortunately, a sort of geochronological uncertainty principle often applies, since suitable igneous rocks are often absent from regions where good biostratigraphy is available.

Sedimentary deposits can provide evidence for the relative time required for deposition. Careful analysis of sediments may reveal evidence for the passage of little time, even during accumulation of vast thicknesses of sediment. In other cases, the passage of large amounts of radiometric and/or biostratigraphic time has left an almost imperceptible impact on the rock record. These data present challenges for both radiometric and biostratigraphic dates. There are significant opportunities for careful, open-minded examination of all of the evidence for the passage of time.

Origin of Life. Without doubt, the present scientific endeavours focused on understanding the origin of life on this planet in naturalistic terms constitute one of the greatest frustrations

in science. The studies have been particularly frustrating because as time has lapsed, and the database has expanded, the objective of understanding the origin of life in naturalistic terms has become increasingly elusive. This is opposite of the expected outcome. For example, it has recently come to light that the progenitor(s) of all modern forms of life contain the same complement of enzymes for producing energy in an oxygenating environment. It was formerly believed that the first living organisms arose in an anaerobic environment and that the ability to utilize oxygen arose much later. This and many other recent observations make even more remote the possibility for a period of earth history when oxygen was absent or rare. It is virtually certain that the required perecursors for life could not have arisen in the presence of free oxygen. This is an area of science particularly ripe for some fresh insights. See this NASA lecture for a recent update on the state of Origin of Life research.

Cambrian Explosion. Within Lower Cambrian strata (the first layers of rock containing the remains of complex multicellular animals), representatives of nearly all of the modern phyla of living organisms are found. This phenomenon is so marked and unexpected in the naturalistic evolutionary paradigm that it has been widely referred to as the "Cambrian Explosion." Various authors have used adjectives such as "riotous diversification" or "sudden and abrupt appearance" to describe the state of biological diversity found in these rocks. Other authors have gone to great lengths to deny the significance or the explosive nature of the Cambrian record, having no ready explanation for the phenomenon. The explosion is real. The underlying Precambrian rocks are often similar rock types, such as sandstone or shale, but are devoid of multicellular animal fossils. This dramatic change cannot be accommodated in any naturalistic model, because it involves not only the appearance of multitudes of life forms representing nearly every modern phylum, but more pointedly, it involves the appearance of virtually all of the molecular biological complexity present in modern forms. Contemporary evolutionary models are unable to account for the origin of this diversity and information without invoking principles outside of the domain of science. Naturalistic evolutionists repeatedly acknowledge this condition, without offering a viable alternative. Here, perhaps more than in any other area in geology, there is a pressing need for innovative research and creative suggestions.

Origin of other life forms. When lesser taxonomic categories (class, order, family, genus) down to the species level make their appearance, wherever that may be in the fossil record, these forms nearly always appear suddenly, without the transitional intermediate forms required and predicted by the evolutionary paradigm. In Darwin's day and beyond, these so-called "gaps" were inferred to be due to inadequacy of our knowledge of the fossil record. One hundred and fifty years later this argument can no longer be offered as an explanation for the scarcity of intermediates. Some groups can be interpreted as intermediate forms, such as the early whales with back limbs, the Triassic fossils with mammal and reptile characteristics, etc. However, these exceptions do not change the overall pattern of lack of intermediates between forms. Paleontologists who knew the fossil record and its inadequacies well proposed the theory of Punctuated Equilibrium as an alternative to gradualistic evolution of species. The theory acknowledges and seeks to capitalize on two features of the fossil record: the absence of intermediate or bridging fossils between species (i.e. they appear 'suddenly'), and the seeming stasis of species once they make their appearance (i.e. once they appear, they don't change). Although the theory is good at describing what is seen in the fossil record, it offers no legitimate explanation for the observations. There is a critical need for a coherent theory that will not only describe what is observed, but will yield logical and consistent explanations for the data.

Creation-Evolution controversy. There can be no doubt that geologists and especially paleontologists, are concerned about origins. The possibility that some theory other than naturalistic evolution may be the correct explanation for the origin and development of life on the earth is a matter of serious concern to geoscientists, who may have built careers around naturalistic evolutionary assumptions. Generally, these scientists have been able to

deflect the impact of creationists, who have tended to be poorly informed about paleontology and geology. There is much concern, some of it legitimate, among professional geologists and paleontologists that creationists might negatively influence the already inadequate science education of our youth. More recently, a small number of well-informed and well-trained active scientists who are creationists have completed professional training in the disciplines of geology or paleontology. These creationists are not so easily dismissed, but their numbers at present are so small that they are more a curiosity than a threat to the current model of origins. The debate over origins will continue to generate great interest and controversy until a new theory is developed that better accommodates the data of science, particularly with respect to biological organisms.

Areas where Christian perspective makes a difference in earth sciences.

Scripture as a primary source of inspiration. Since the 'Enlightenment', Scripture has repeatedly been subordinated to science when conflicts have arisen between the ideas of science and those of religion. The scientist declares the world to be billions of years old, and the theologian adjusts his or her interpretation of Genesis. The scientist declares there was never a global catastrophic flood, and the theologian again adjusts Genesis. The scientist declares man to be a product of mindless evolution, arisen by tooth and claw, and again the theologian adjusts the interpretation of scripture to accommodate. There is no conflict between science and Scripture, so long as the theologians can continue to adjust the interpretations to keep up with the science. Is this what God had in mind when He communicated with man through His Word? Unless we hold to a high view of inspiration, we are left with nothing but chaff. Stephen Gould recently expressed his perspective by proclaiming that religion and science occupy separate and independent domains that do not overlap. He used the term "non-overlapping magisteria," inferring that both have domains of understanding in which they properly have dominion, but these domains are mutually exclusive. Religion has nothing to say about science, and science has nothing to say about religion. But in seeking to build his case, Gould demonstrates its weakness when he calls upon religion to do all of the accommodating to the teachings of science. We must recognize and appreciate the unity of Truth and the importance of revealed truth to our understanding of the world. The integrity of Scripture, which believers acknowledge as the revealed will of God, must not be surrendered in seeking harmony with natural science or any other subject.

An openness to new ideas. Each individual develops a basis for his or her philosophy by accepting as 'givens' certain premises about the world and existence. The basis for these premises for the Christian is, among other things, the Word of God. For the secularist the basis may lie in some other authority. While one cannot begin without premises, we can be careful and thoughtful about the premises we accept. The Christian, no less than the secularist, must continue to test and review these fundamental beliefs from time to time, and should constantly seek to enlarge that domain. There is great danger in feeling that one has encompassed all Truth. It is one of life's paradoxes that those who believe they have arrived at Truth, lose all chance for obtaining it, for it is in the continued pursuit of Truth that new possibilities are encountered and a philosophical base is broadened and strengthened. The Christian, with a strong commitment to this pursuit, should, even more than the naturalist or secularist, seek to maintain a mind open to new possibilities and explanations of the natural world that might be unthinkable to the secularist. Our philosophy determines to a large degree what questions we can ask. The Christian community asks different questions than the secular community, and as a result may go in directions the secular community would not. In the case of the history of the earth, the Christian has freedom to explore possibilities that the secularist cannot see, as a result of insights gained in the exploration of God's Word. This should be seen and exploited as a great advantage.

A fundamental belief in the Creatorship of God. Regardless of how one may choose to read Genesis, a belief in God as the Creator is fundamental to the Judeo-Christian worldview. Scripture distinctly and repeatedly associates the Creatorship of God with His worship. The reason we worship God is because He created us and we are indebted to Him for our existence. False gods were false because they could not create, and because they claimed that ability without substance. Isaiah 44 (14-21) is a polemic against this. The connection between God's Creatorship and His worship is emphasized in many places in Scripture (cf. Rev 4:11, Romans 1:20-25, Eph 3:9,14). To disallow God as Creator is to disallow God. More importantly to the scientific enterprise, God as Creator and Designer is the most viable and rational explanation for the origin of life and for the origin of information in living organisms. It is good science and good sense to work within this framework.

Honesty and integrity. The Christian geoscientist will bring honesty and integrity to his or her work. This is not an option for the Christian. This includes honesty in financial matters, both personal and corporate, and integrity in dealing with danger, dishonesty or potentially hazardous situations in the workplace. Furthermore, the Christian scientist will deal honestly with data, and will give careful consideration to possible alternative explanations and theories, realizing that one's paradigm can and does affect the conclusions one reaches. The science done by Christian geoscientists will be of the highest quality and integrity.

Stewardship of the earth. Christians are stewards of the earth and have responsibility for caring for it. Unfortunately we have too often been accused of malfeasance in this regard, and often with cause. The Christian geoscientist will have in mind the preservation of the resources of the earth and will pursue policies of conservation, in the best sense of the word.

Areas of particular concern to the Christian Earth Scientist.

Naturalism. Naturalism is a philosophical/religious system proposing that everything that exists can be explained in natural terms (as opposed to supernatural terms) without the intervention or need for intervention of a supernatural being. Methodological naturalism is an adoption of naturalistic principles, with or without fully subscribing to naturalism, for the purpose of carrying out scientific investigations. Science has often been characterized as a naturalistic enterprise, an activity that uses the tools of methodological naturalism exclusively. Because of the unparalleled success of science in western society, the prevalent methodology of naturalism has achieved great status. Naturalism has not, however been confined to science. Theologians have seemed almost eager to embrace the methods and philosophy of naturalism, without regard to the consequences. If all of Scripture can be explained without recourse to Divine intervention, then what significance do Scriptures have? The results of embracing naturalism have been devastating to the Church, weakening understanding of the nature and meaning of inspiration. If the books of the Bible are not a revelation of the intervention and involvement of God in the affairs of men, but are merely man's feeble efforts to create a deity, Christianity is a farce. Many have no awareness of how dangerous or pervasive naturalism is in the Church. Naturalism is an intentionally atheistic philosophy antithetical to the fundamental values of Christianity and it has no business whatsoever in the Church. The application of the principles of naturalism to our understanding of Scripture leaves us without a clue to the answers of the really important questions in life: Where did we come from? Why are we here? Where are we going?

Because of the success of methodological naturalism in solving scientific problems, its weaknesses have largely been overlooked. Science claims to be an open-ended search for Truth. But if Truth lies outside the realm of naturalistic explanations, science can never

reach Truth so long as the only methodology is naturalistic. For some this is irrelevant because they have made naturalism the end of science. But for those fair-minded individuals for whom Truth is more important than a strict adherence to naturalism, science should be defined with breadth to accommodate other possibilities. Methodological naturalism cannot hope to provide answers to some problems, particularly in science dealing with origins. Presently there is no satisfactory explanation for the origin of life, or for the origin of the information content of organisms, within the realm of methodological naturalism. This makes it necessary for naturalists to bend logic in an effort to accommodate data that cannot be explained within the tenets of naturalism. Adhering exclusively to methodological naturalism also stifles inquiry by prohibiting investigation not only of those areas where science cannot adequately explain observations, but also in areas in which the Scriptures suggest God has intervened in man's affairs.

Naturalistic evolution. The application of the principles of naturalism to the fossil record leaves only one reading possible: All organisms alive on the earth today or preserved as fossils, are the result of the impersonal, mindless, amoral process of evolution. There was no Creator, no Information Provider, no Designer, only chance and time. This view has, in various permutations, made its way into the Church, again with perilous consequences. It is inevitably accompanied by a loss in confidence in Scripture and a more or less impersonal view of God. The crafters and promoters of the naturalistic views recognize full well the significance of their position: Whether there is or is not a Divine Being, one was not necessary for the origin or development of life. Within the Church, purely naturalistic evolution may be palliated with theism, or some other form of non-random evolution, but this position is a compromise that will ultimately lead to a less personal view of God.

A proscribed view of earth history. Geologists tend to have a very proscribed view of earth history. Certain perspectives are allowed, but many others are disallowed. Christians within the community who might like to explore new ideas such as the concept of Intelligent Design within the geologic record, or the possibility of a global catastrophe, are discouraged from doing so. As a consequence, geoscientists who are Christians can themselves be intolerant of new ideas, perhaps because they feel vulnerable or have a desire to conform. Christian geoscientists tend not to like to discuss their Christianity with colleagues, except on a spiritual level. A sharp separation sometimes exists between geologists and their Christian faith. Christian colleagues in geology have confessed that they deal with the conflicts by doing their geology during the week and their religion on Sunday. Thus possible alternatives to the conventional views are sometimes not given careful consideration, even by Christians. This lack of openness is regrettable.

The "Yahoo" problem. Perhaps at the other extreme, but fully as dangerous as the inroads of naturalism in the church, are the uses of unsupported assertions by well-meaning, enthusiastic, but uninformed Christians who make extravagant claims "disproving" conventional theories of geology and paleontology. Gould has referred to such individuals as "Yahoos". These individuals and their claims constitute one of the most problematic concerns for the professional geologist, and are a large factor in discouraging many geologists and other scientists from taking a closer look at Christianity. Claims of "giant fossil men", "dinosaur and human tracks", "out of order fossils" and many other unsupported assertions are a positive hindrance to the exploration of alternatives to conventional views, and are responsible for the loss of faith and discouragement of many. It is the responsibility of Christians to prevent outrageous and unsubstantiated claims from being used in "support" of Christianity. Our search for Truth is not helped by assertions, however sincere, that are false or pretentious.

Approaches I have taken to integrate my faith with my scientific discipline.

When I chose graduate studies in molecular biology, it was because, as a new Christian, I was interested in understanding better the concepts involved in Darwinian evolution. I thought an understanding of molecular biology would facilitate this. When I had completed my studies, I was somewhat surprised to realize that molecular biology was antithetical to Darwinian evolution. I thought that perhaps in my quest to understand the meaning of Genesis in terms of my new-found faith, I should look into geology, since it was now clear to me that geology must provide the support for evolution that was missing from my studies of molecular biology. I began studies in geology that have developed into a life-long pursuit of understanding of the Genesis account of origins.

I had set out nearly as soon as I had finished my degree program, to investigate several bold claims made by Christians with respect to the history of the earth. One of the prominent claims was that modern types of pollen could be recovered from Precambrian rocks in the Grand Canyon, demonstrating that the geological column was meaningless, and that modern plants were on the earth in the region of Grand Canyon during the Precambrian. The Bible was right, geologists were wrong. Thinking that such claims, if true, ought to be established with scientific rigor, I set up a palynology lab under stringent conditions to test the assertions. The rocks were recovered with exceptional care (we packed a gasoline powered diamond core drill down into the Canyon and back in order to assure uncontaminated samples!). The samples were processed under the most stringent conditions. After several years work, we concluded that the original claims were not substantiated. I published the results and was branded as an evolutionist by some of my fellow Christians, because my data did not support their contentions.

Along with a couple of colleagues, I next traveled to Glen Rose, Texas. The Paluxy River in Glen Rose reportedly contained human and dinosaur tracks side-by-side. These reports were being used widely as evidence to support the coexistence of humans and dinosaurs, which according to conventional geology were separated in time by 100 million years. Thus the Bible was right, the geologists were wrong. We concluded that if there were such tracks in the riverbed, it should be relatively easy to settle the matter. We arrived in late summer when the river was dry, and carefully analyzed the exposed trackways for evidence that human tracks were present alongside those of dinosaurs. We found the expected dinosaur tracks and a trackway composed of curious elongated tracks made by a dinosaur walking on its anklebones. The trackway did superficially resemble an elongate 'human' track. But occasionally the trackway showed all three of the dinosaur's toes. We also analyzed "human tracks" reported to have been removed from the riverbed, and compared the characteristics of these "tracks" with a genuine dinosaur track taken from the riverbed. We concluded on the basis of several lines of evidence that the "human tracks" were all carvings. The hypothesis that the

trackways were human was falsified. We published the results, but for ten years those Christian colleagues using the trackways to promote their views on origins ignored our results.

Other cases could be cited. In every case we investigated, the evidence being used to promote the validity of the Bible was either being misrepresented or was absent altogether. This could have discouraged us. Instead, it led us to recognize and avoid the pitfalls of those who wished to use the prestige of science without understanding the methodology of science. Christians trained as scientists can be good scientists and can use the methods of science to investigate whatever they wish, irrespective of their views on origins. They can even investigate the validity of hypotheses derived from Scripture, using the methods of science, so long as experiments can be done to differentiate among the possible outcomes. Christian scientists should be at the forefront in promoting careful work and publication in peer-reviewed journals. But what Christian scientists cannot do is depreciate science or scientific research while attempting to use science to defend their Scriptural views. They cannot have it both ways. If methodological naturalism is not valid for studying God (and it is not), neither can it be a valid method for defending Him.

We then focused our attention on the use of hypotheses, derived from our understanding of scripture, that we felt would give us unique insights into scientific issues related to origins. Our approach has been a rewarding one. In every case we have investigated to date, we have been able to propose a testable hypothesis consistent with our understanding of scripture. We have carried out the necessary research to uncover the data, and have found data to be consistent with our hypotheses. We have then published the results in peer-reviewed scientific journals. Our efforts have not been directed toward 'proving' anything we think the Bible says to be true. Rather we have focused on attempting to identify information in Scripture that might offer unique insights into problems in the natural world. In science an idea is a good idea, not because of where it came from, but because it correctly predicts the outcome of experiments in advance. On this basis, we believe our methodology has worked exceedingly well. A possible consequence of this success might be that other scientists are attracted to our model for doing science. That, in my opinion, would not be bad.