Origins

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COVER PICTURES

Front Cover: A fossil whale in the Miocene/Pliocene Pisco Formation, in coastal Peru. The well preserved, articulated skeleton indicates the whale was buried and preserved rapidly. It is upside down, and the prominent, near part is the skull, with the rest of the complete skeleton behind it. **Back Cover:** A side view of an intact, right side up, fossil whale skull in the Pisco Formation with its complete set of baleen plates. The articulated post cranial skeleton of this whale is also present. The excellent preservation of the skeleton, buried with the baleen still in place, indicates it was apparently buried within days. Research on these Pisco Formation fossil whales is discussed in the article on "Naturalism" in this issue. Photos by Leonard Brand.

EDITORIAL

PLAYING THE GAME OF SCIENCE BY THE RULES

Suppose we consider science to be a game. What are the rules of the game, and what difference would this approach make? I will discuss five rules that have been proposed by various philosophers and scientists for the "game" of science, and suggest that this approach to science could be helpful in dealing with questions relating science and Christian faith.

Striving for statistical significance in one's results is a rule that is commonly followed in psychological science,[1] as well as other sciences in which two or more samples are compared quantitatively. Statistical significance refers to the idea that the results of a research project would be statistically unlikely to be obtained by selecting a comparable set of numbers randomly. Properly done, statistical significance requires a suitably large sample size. Unfortunately, sample sizes are often too small to justify the degree of confidence claimed. Bakker *et al*. report[2] that as many as half of all reviewed psychology studies had problems with sample size or other types of bias. This study echoes the results of a previous study finding a high proportion of unreliable claims based on the use of statistical significance in other types of studies.[3]

Simplicity is another rule of the science game, according to Kevin Kelly, a philosopher at Carnegie Mellon University.[4] The simplest explanation is probably the best explanation, an idea commonly called "Ockham's Razor," after William of Ockham (d 1347), the English philosopher who championed the principle. Often called the "principle of parsimony," this rule is not intended to be absolute, but is useful to avoid the temptation to make theories ever more complex in an effort to protect them from being falsified.

Another proposed rule is to use multiple hypotheses. One famous advocate of this rule, particularly in the study of human fossils, was Sherwood Washburn,[5] who was voted the leading American physical anthropologist of the twentieth century by the American Association of Physical Anthropologists. Washburn deplored the tendency of scientists to defend their own pet theories about human evolution, and suggested that the consideration and comparison of multiple hypotheses might release researchers from their love affair with their own discoveries and hypotheses. In doing so, Washburn was echoing the sentiments of geologist TC Chamberlin, who famously made a similar suggestion more than 85 years previously.[6]

The temptation to invoke "science" as an authority to buttress one's own views is still with us, as can be seen in the publicity attending each new fossil hominid discovery. I once attended a meeting discussing evolu-

tion in which one professor stated that each new hominid fossil discovery seems to result in a rearrangement of the hominid evolutionary tree.[7] The idea was met with some disapproval, but the frequency of claims that new discoveries will force a rearrangement of the human evolutionary tree shows the professor was correct.

Richard Dickerson, a molecular biologist in Los Angeles, claims that the defining rule of science is: "Let us see how far and to what extent we can explain the behavior of the physical and material universe in terms of purely physical and material causes, without invoking the supernatural."[8] This approach is generally called "methodological naturalism." Dickerson argues that explanations involving God's actions may be true, but they cannot be put forward as scientific explanations. This rule implies that science is truly a game with limited scope, and does not comprise the whole of reality, contrary to the claims of scientism so widely disseminated by the public media.

A final rule of science as a game is to consider all scientific conclusions as tentative. Karl Popper, the famous philosopher of science, wrote: "The game of science is, in principle, without end. He who decides one day that scientific statements do not call for any further test, and that they can be regarded as finally verified, retires from the game."[9] Here, the rule seems to be that science can never be trusted to provide final conclusions. There is always a possibility that new discoveries will overturn current scientific consensus, hence further study is always in order. This is a truth admitted by nearly everyone, but seldom put into practice when one's own ideas are at stake.

These five rules have been proposed[10] for the "game" of science: seek statistical significance; prefer the simplest explanation; consider multiple hypotheses; restrict explanations to physical mechanisms without recourse to divine activity; and never accept science as a final answer. What are we as creationists to do with these "rules?"

The need for care in the use of statistical tests is a point on which everyone can agree. Indeed, all aspects of data collection and analysis should be done with care and accuracy. The integrity of science depends on this, and the occasional incidences of fraud in science are rightly deplored.

The rule to prefer simple answers may be a good starting point, and caution is advisable when protecting a hypothesis from hostile data, but we must not allow ourselves to be prisoners of parsimony. The simplest explanation is not always the best. Conclusions that are chosen solely on the basis of parsimony should be regarded with caution. Evolutionary phylogenies often are chosen from a multitude of possibilities using the principle of parsimony.

Using multiple hypotheses is a good rule in research, especially when addressing historical questions.[11] It can always be useful to test a hypothesis, because this provides a basis for evaluating its probable truth. However,

hypotheses that have been rejected may turn out to be accepted when more data are available, so it may be useful to consider even those hypotheses that are thought to have been disproved when exploring a problem.

The rule of methodological naturalism (MN) is problematic (see article by Brand, this volume). MN seems to present a conflict with the rule of using multiple hypotheses because it excludes one type of hypothesis simply on the basis of philosophical preference. This is not a good methodology for advancing knowledge. Even if MN is recognized as only a working hypothesis that does not necessarily correspond with reality, it follows that there are many questions that science is not designed to address because there is reason to believe they involve supernatural activity.

Many Christians hold that science has suffered too much at the hands of MN. This may be because methodological naturalism in science has, in reality, morphed into philosophical naturalism, which at best denies the influence of any supernatural agents in the world and at worst denies they exist at all. Physical evidence of Intelligent Design (ID)[12] limits the appropriateness of methodological naturalism, which may be one reason so many materialistic scientists oppose ID with a quasi-religious fervor. Surprisingly, many scientists who believe in God are equally adamant that there is no evidence of ID in nature.

The problems with MN validate the rule that we should never take a scientific answer as final. Even experimental questions in science may be subject to dispute and uncertainty. How much more should historical questions be taken with great caution. We may be able to say that, unless God acted in a way unfamiliar to us, a particular explanation is the best we have at the moment. The Scriptures can serve as a means of identifying events in which God may have acted in ways not observed today. In such cases, the rule of multiple hypotheses should trump the rule of MN.

Perhaps creationists can be leaders in wisely using the rules of the game of science. One way we might do this is to describe questions in historical science in terms of multiple competing hypotheses, with an evaluation of their respective plausibilities. This would help the public think in terms of multiple hypotheses rather than uncritically accepting the current scientific consensus. The possibility of divine action should be included among our hypotheses, especially when the Bible identifies God as acting in a particular event. Naturally, we should be careful to attribute creationist ideas to their proper source, which may be either science or the Bible, or both. We must also show care in the use of data and analysis.

Creationists should keep in mind the tentative nature of scientific conclusions. We are not alone in wanting to verify our ideas by appealing to the supposed authority of science, but this entails significant risk. Science is constantly making new discoveries, some of which overturn previously

established ideas. When we use the claims of science as proof of the truth of the Bible, we run the risk that the "fact" we promote may soon be refuted, leaving observers with the impression that disproof of the scientific "fact" also disproves the biblical point to which the "fact" had been attached. We can have confidence in the Bible independently of the progress of science. We do well to investigate the discoveries of science and relate them to the biblical record, but we do so in a context in which the Bible is the standard by which all ideas, including the claims of scientists, are judged.

Regarding science as a game rather than a final authority can benefit us as we face the challenges brought to Christian faith by materialistic science. For example, it would help us resist the influence of scientism – the idea that science is the only source of real knowledge. Regarding science as a game would also help us see why we should not uncritically accept the latest scientific claim or fad and attempt to use them either to confirm or deny teachings of Scripture. The result of this approach should also make it less threatening to live with unresolved questions in integrating faith and science, and make us more willing to live lives of faith.

Jim Gibson

ENDNOTES

1 Bakker M, van Dijk A, Wicherts JM. 2012. The rules of the game called psychological science. *Perspectives on Psychological Science* 7(6):543-554.

2 *Ibid*.

3 Ioannidis JPA. 2005. Why most published research findings are false. *PLoS Medicine* 2: 124; doi:10.1371/journal.pmed.0020124

4 Kelly DT. 2007. Simplicity, truth and the unending game of science. In Bold S, Lowe B, Rasch T, van Benthem J (eds), p 223-270. *Foundations of the Formal Science. V. Infinite Games*. Carnegie Mellon University Research Showcase@CMU

5 Washburn SL. 1974. Human evolution: science or game? *Yearbook of Physical Anthropology 1973*. Yearbook Series 17:67-70.

6 Chamberlin TC. 1965. The method of multiple working hypotheses. *Science* 148:754-759 (reprint of article first published in *Science* 15 (7 February 1890):92-96.

7 Meeting of the Paleontological Society in Denver, October 1999, discussing the evolution-creation controversy.

8 Dickerson RE. 1992. The game of science: Reflections after arguing with some rather overwrought people. *Perspectives on Science and Christian Faith* 44:137-138.

9 Popper K. 1934, 1959. *The Logic of Scientific Discovery*, ch 2 Section XI Methodological Rules as Conventions. Oxford: Routledge.

10 Other "rules" for science could be added, but these five were proposed explicitly for science as a "game."

11 E.g., see discussion in Meyer SC. 2009. *Signature in the Cell*. New York: HarperCollins, p 324-348.

12 The Discovery Institute, headquartered in Seattle, WA, has published numerous books on Intelligent Design.

ARTICLES

WORLDVIEWS AND PREDICTIONS IN THE SCIENTIFIC STUDY OF ORIGINS

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ABSTRACT

In scientific research it is of value to be able to make predictions of what results are expected if a particular hypothesis is correct. In the study of historical events and processes, the scientist's worldview will influence some types of predictions in fields such as biology or geology. This article claims that both a naturalistic worldview and a biblical worldview can make predictions that can be examined by the methods of science. The worldview that is based on a literal reading of the biblical account of earth and biological history makes some inescapable predictions. Although science cannot examine any possible divine influences in history, science can often examine evidence for or against historical events suggested or required by a biblical worldview. To seek to test these predictions is not questioning the Bible, but is examining our predictions based on our reading of the Bible. A series of such predictions is described, and it is proposed that testing these predictions will lead to scientific progress, since a more accurate worldview is expected to lead to more accurate predictions.

SCIENCE AND PREDICTIONS

However one defines the scientific method, the role of predictions is of significance. A researcher, from his/her knowledge of a topic, makes a prediction of a phenomenon to be found or verified by future research. The scientist, of course, is not trying to be a prophet. Predictions provide practical ideas, hypotheses, to be tested. We cannot know ahead of time whether a given theory will withstand the test of time and accumulating data. If a prediction, based on a theory, is verified by continuing research it greatly increases confidence in the theory from which the prediction originated. The probability of making successful predictions is expected to be directly related to the correctness (in an ultimate sense) of a theory, paradigm, or worldview.[1]

The test of an individual hypothesis or theory may or may not turn out in the long run to be correct, depending on the adequacy of the design of the test and/or of the accessible data at that time. Theories and the paradigms

from which they come are really tested in relation to each other, and only over the long haul rather than in a given short interval of research.

The following discussion will only address these processes in the study of origins and history, and not in study of current, ongoing processes in biology, chemistry, or physics. I will compare predictions coming from two very different worldviews, one of which is anathema to many scientists. This analysis begins with the assumption that naturalism is not the only viable worldview,[2] and that an understanding of the Bible as a reliable document has worthwhile, factual things to say about geological history.[3]

Science cannot study miracles and does not properly invoke miracles to explain what happens, e.g., in the chemistry or physiology laboratory. But what about study of history – of events that occurred or are presumed to have occurred? Is there any good reason why we cannot consider that just maybe the events of earth history have been influenced by unique events (even supernaturally initiated events) which left a mark on the geological record? A mark that we can study with the methods of science.

PREDICTIONS WITHIN A SECULAR, OR NATURALISTIC WORLDVIEW

Basis for making predictions in the naturalistic worldview

This worldview, or the scientific "standard model," is based on exclusion of a God or Creator from our explanations of nature. According to the standard model all of the processes of origins and earth history occurred essentially by processes observable today, through the unaided laws of chemistry and physics. This worldview includes the following concepts:

a. Life has been on earth for millions or billions of years.
b. All taxa of organisms originated through the evolution process.
c. Geologic history has proceeded by natural processes over many millions of years. Whatever catastrophic events may have occurred did not change the slow march of deep time (hundreds of millions of years).

Underlying philosophy for studying nature within this worldview

Secular or naturalistic research must follow the principle of methodological naturalism, and never consider whether creation or a biblical global flood was part of the historical process. They are ruled out by definition, because it is commonly believed that to consider such processes or events would not allow unbiased scientific study.

Predictions from the naturalistic worldview

If the philosophy described above is followed, it leads to a number of predictions, including the following:

a. Radiometric dating gives essentially a correct view of time for the history of earth, the universe, and life.
b. Biological phylogenies, even if not exactly correct, are at least approximate descriptions of the pathways of evolutionary change. Separate, polyphyletic origin of major taxonomic groups will not be supported by the accumulating evidence.
c. Geological deposits were formed over vast amounts of time, and the process can be best explained by comparison with geological processes observable on earth today. Although other processes could have occurred, hypotheses that imply a significantly different time scale or that question the overall evolution theory will not be successful.
d. Research that attempts to explain life or geology on a different basis (e.g., a Bible-based theory) will not succeed in the long run.

More detailed predictions could be made, but they will fall under one of the broad categories above.

MAKING PREDICTIONS WITHIN A BIBLICAL WORLDVIEW

We will now consider a very different worldview and whether it can be utilized as a foundation for at least some types of scientific research in the study of origins. This research will not try to study miracles, but will actively consider proposed events even if they carry the implication of being initiated by a supernatural process. If those events have left some evidence, that evidence can be analyzed by the scientific process.

The basis for making predictions within a biblical worldview

A Bible-based understanding of earth history since the creation week leads to several distinct predictions and hypotheses. The predictions result from biblical concepts (stated as descriptive accounts of nature. They imply a Creator, but that aspect cannot be explored by science). Some of these can be examined through careful geological or biological study. The predictions of a biblical worldview arise from the following concepts.

a. Life (and also the Phanerozoic [Cambrian to Recent] rock record) has been on earth only for several thousand years.
b. Many taxonomic groups of animals and plants were created during the seven-day creation week, before the formation of

the fossil record. Evolutionary change has occurred only within each of these groups.

c. A global flood catastrophe with significant geological effect occurred some time after the creation.

For those of us who accept the Bible as an inspired book, with a factual account of history, the above concepts lead to several very definite predictions of what science should be able to find, if we can access sufficient evidence. If it has only been thousands of years since the literal creation week, a number of specific predictions are inescapable. A process that takes hundreds of thousands or millions of years is incompatible with a Phanerozoic time span of thousands of years.

Is this a philosophically defensible methodology?

The approach described here involves the study of origins (history), and rejects the application of methodological naturalism to the determination of what questions can be asked about the past (e.g., can we ask whether life was created – science does not properly dictate whether or not that question can be asked), or what events are legitimate to be considered (e.g., a global flood – science must be free to consider all the options, or it becomes closed-minded).

Does this approach inappropriately mix science and religion? Will it introduce a religious bias into science? The answer becomes clear with some consideration of the logic that drives conventional science (the standard model).

Science always begins with some worldview (or paradigm), even though many scientists are not much aware of this. Predictions are made, based on the foundation provided by the worldview. This process puts the researcher's worldview or theory on the line, to be tested. Of course worldviews are not directly tested, but the theories or hypotheses derived from them are tested, one at a time, according to whether accumulating evidence supports them and the predictions are supported.

To use our biblical worldview as a basis for scientific predictions is compatible with the scientific process because it does exactly what science is supposed to do. It puts our theories and hypotheses out in the open to be discussed, to be supported by accumulating evidence, or refuted by the evidence. Some may object to this, but if we have confidence in the Bible and are seeking for truth, why should we not be brave enough to do it? We are not testing the Bible, but are testing humanly devised predictions that arise from our understanding of a biblical worldview.

Of course (because we don't understand nature adequately) anybody's predictions may not work out as expected. In our naïveté we may make un-

realistic predictions that leave us searching for better answers, but that can happen to any scientist, in any worldview. Science often follows a circuitous path before we find adequate explanations. We cannot expect the process to be a simple one, when we study complex topics.

When our predictions are correct or at least close, the result can be scientific progress. A novel worldview, like a biblical worldview, is likely to lead to new ways of thinking and new predictions, and thus to new discoveries. The new data may reveal aspects of geology or biology that were unexpected, and the predictions thus result in discoveries that may not have occurred without the new approaches coming from a different worldview. That statement can only be affirmed or refuted by experience in pursuing the research approach and the predictions suggested here. The more correct (accurately matching reality) the worldview, the more of its predictions we expect to be verified.

Predictions based on a biblical worldview

The following is a list of some representative predictions if a biblical worldview is followed:

1. Ratios of radiometric parent and daughter isotopes have changed through the geological column for some reason other than the passage of large amounts of time. Deep time for at least the Phanerozoic (Cambrian to Recent) is not real.
2. Many geological deposits will turn out to have been formed much more rapidly than currently interpreted. Deposits currently considered to be a long series of small sedimentary events, or the result of long, slow accumulations of sediments will eventually be seen as a smaller number of large-scale sedimentary events.
3. Since the Phanerozoic geological record formed rapidly, it can be expected that more sediment was unconsolidated (not cemented) when buried by additional sediments than would be expected in the standard model. Because of this we predict there will be many cases of structures formed by large-scale, soft-sediment deformation. There will be, e.g., more structures than normally expected that are, or are similar to, features such as seismites or injectites.
4. Some major portion of the Phanerozoic record was deposited by much more rapid and catastrophic processes than conventional theory expects. As this possibility is taken seriously, I predict it will be found that some, and maybe many, sedimentary deposits were formed by processes not seen, or at least not adequately seen, in modern analogues.

Example: Modern desert sand dune analogues are far from adequate for explaining ancient cross-bedded sandstones. To name one reason, in modern desert environments the wind blows the sand around and produces complex structures in some dunes, but does not make vertical series of laterally extensive multiple cross-bed sets as are seen in many ancient sandstone deposits, such as the Permian Coconino Sandstone or the Jurassic Navajo Sandstone in North America.

For much the same reason there will be more examples found of fossil assemblages that resemble a modern analogue, but were formed by a process very different from processes we observe today. The reason for this is the strong bias in the standard model to interpret ancient deposits by modern analogues. In this situation dependence on deep time may not stimulate deeper, careful study if a modern analogue appears to offer an explanation.

Example: This concept is illustrated by the Yellowstone fossil forests, that on first examination appeared to be a series of *in-situ* forests, each buried and killed, followed by growth of another forest on top of its remains. This explanation implies long periods of time for successive forests to grow and be killed and buried. However, more careful examination revealed much evidence for trees that grew somewhere else and were transported to their current location, deposited one layer one top of another.[4] The succession of tree levels was the result of water transport and accumulation in successive levels, which could happen in a short time.

5. Many structures that are currently interpreted as formed by biological or other slow processes actually have some other explanation.

Examples: Stromatolites (dome-shaped structures with layers understood as accumulation of sediment on growing cyanobacteria) are believed to take at least a few years to grow. If there are several levels of stromatolites, one above the other, this sequence could not form within a one-year flood. But it cannot be assumed that every sedimentary deposit containing stromatolites was formed some time other than during the one year of the flood, since there isn't assurance that we understand how all the structures currently labeled as stromatolites were formed.

Another such feature is evaporites – layers of chemical deposits believed to be the residue left after a large volume of water evaporates, which takes a very long time. The prediction is that many or most presumed ancient evaporites formed by some other process than concentration of salts by evaporation of water. Subaqueous brine

flows have been suggested as an alternative explanation for some evaporites. It will be scientifically productive to explore explanations such as this.

6. Features in the sedimentary record interpreted as Milankovich cycles (cyclic processes controlled by variation in solar irradiation of the earth, representing cycles of hundreds to tens of thousands of years each) did not result from such long cycles. They formed rapidly from some other process. Other geological features or cyclic processes that seem to require long time periods were also formed by some rapid process.
7. Fine laminations that are interpreted as varves (one lamination per year over long time periods) will be found to not be annual layers. Other explanations will be found that will explain these finely laminated rocks (example – the laminated parts of the Eocene Green River Formation).
8. A global flood theory will be far better at explaining modern land forms than contemporary conventional geological theory (in the field of geomorphology). Some land forms not currently adequately explained (e.g., the Straight Cliffs and the Grand Staircase in Utah) will be understood as best explained by massive water flow, not by the slow erosion processes that normally occur in the modern world.
9. Better understanding of land forms will allow analysis of erosion events from massive water flow at the end of the flood or at some later time, in contrast to slower processes over longer time periods. We predict that as these features (and other data) are better understood it will be possible to identify the sediments deposited during the year of the flood, and those formed before or after that event.
10. Plate tectonics and the movements of continents in much of the past occurred orders of magnitude faster than at present.
11. In the study of biological evolution there will be increasing evidence that evolution does not produce changes beyond the genetic potential created in each group of organisms. Much or most of this microevolution and speciation is not primarily the result of random mutations, but is facilitated by the genetic potential already present in organisms from the beginning.
12. The theory that the sequence of appearance of fossil groups in the fossil record was the result of large-scale evolution will eventually be refuted by new evidence. This prediction may not be an easy one to test, because we have limited prospect of determining what processes would occur during a global flood.

13. As research proceeds in biochemistry and molecular biology, it will be increasingly evident that the likelihood that life ever arose without an intelligent Designer is roughly inversely proportional to the growing body of data.
14. As genomic studies yield more details of genetic processes and genomes of more types of organisms, evolutionary phylogenies or evolutionary trees (above the family level, roughly) will be shown to be wrong.

Fulfilled predictions

a. For decades all DNA was considered to be either coding DNA (defining the structure of a protein) or junk DNA (functionless leftovers of the evolution process). Human DNA was interpreted as about 98% junk DNA. Until recently only creationists have predicted otherwise. In the 1970s molecular biologists, friends of mine at Loma Linda University, were predicting that "junk DNA" will turn out to be functional and important. This prediction resulted from their belief that life is the result of the work of a very intelligent Creator. In recent years it has become evident that some junk DNA is functional regulatory genes, and in September 2012 the results of the massive ENCODE genetic study revealed that most or all human DNA is functional, and "junk DNA" is no longer a useful concept.[5] This is one of the key predictions based on a biblical worldview that has been confirmed using the methods of science.
b. In 1992 a paper in *Spectrum* by Gary Gilbert claimed that the same pseudogene (a gene like a functioning gene but with many mutations, making it useless) in humans and chimpanzees demonstrated that they had a common ancestor.[6] Even at that time there were reasons to question that interpretation, and some creationists predicted that it would not turn out to be a pseudogene. In 2012 and 2013 new research has demonstrated that it is not a pseudogene at all, but is actually functional and essential. Even one mutation in this gene causes abnormalities in humans.[7]

   Claims like Gilbert's pseudogene explanation have led some persons to unfortunate conclusions. Some have lost their faith in God and the Bible because they accepted too quickly the initial interpretation of the "pseudogene" in humans and chimps or the Yellowstone "fossil forests."

15. Biological features considered to be suboptimal, or mistakes, will be fruitful areas of study. Organisms do have problems caused by mutational damage, but more careful study will show that most seemingly suboptimal features appear that way because of our lack of knowledge about their structure and function. Most "suboptimal" features will be seen as the evolutionary equivalent of the "god of the gaps." They are best described as "evolution of the gaps," since the evolutionary claim of their being suboptimal disappears as we learn more about them.

    Examples: There are numerous examples of the superficiality of the suboptimal explanation. Human structures formerly interpreted as vestigial structures included the thymus, middle ear, and thyroid glands and many more.[8] Bats wings have been called suboptimal, since their bone structures are just modified from small mammal feet, rather than being uniquely designed for flight. This explanation fares poorly compared to a bat's skill in flying and using its hand-like wings for catching and eating insects in mid flight without missing a wingbeat, as seen, e.g., in slow motion video. A bat's wing is exquisitely well designed for its life style.

    The vertebrate retina has been commonly seen as poorly designed because the light must pass through layers of cells before reaching the photo receptors. However, research has now shown that Muller cells in the retina are living optical fibers that take the light through the outer layers of cells, to the photo receptors with high efficiency.[9] It is now evident that the retina is a superb example of sophisticated engineering.

    Suboptimal features or vestigial structures have always been an argument from ignorance; if we didn't understand them adequately, they looked poorly designed. As many of these structures have been studied in more detail the ignorance was removed, and it became evident how well designed and functional they are.

16. In recent years there has been recognition that microevolution can occur far faster than previously thought, even occurring in a few years instead of thousands of years. The beaks of Darwin's finches in the Galapagos Islands went through a cycle of size change in a few years, in response to climate variation and change in availability of the types of seeds which they eat.[10] I predict that this trend will continue in the future.

17. Scientists who use Bible-based predictions have the potential to be very productive, because it opens the way for discoveries that are

often overlooked by those using the false philosophy of naturalism, especially as applied to the study of origins.

18. There are many specific discoveries that can't even be predicted, because nobody knows enough to predict them. But they are more likely to be found by those whose thinking has been opened up by their worldview to recognize things not likely to seem important within a conventional naturalistic framework.
19. Even if all or most of these predictions are verified, most of the scientific community will still hold to the theory of evolution through deep time, and its supporting paradigm or philosophy of methodological naturalism.[11] This deeply held philosophy results in too much dependence on chance, deep time, and naturalistic assumptions, which have the effect of shielding large areas of origins science from rigorous thought.

DISCUSSION

Several questions need to be addressed to adequately understand this topic.

1. How do we come to the point of determining if our worldview is wrong?

Testing a worldview only happens over a long time, and maybe, in reality, never (in relation to individual life spans). Changing one's worldview too quickly is not wise. Our life span is too short to truly test our worldview. It is best to take the worldview we have confidence in, and without apology use it to guide our research. That is what most scientists do.

When one of the options in question (one of the research approaches and its predictions) is a biblical worldview there is a critical but subjective factor involved. The Bible is only of value if it is divinely inspired in the way that it claims to be. Do we know the One who inspired the Bible? Do we know Him so well that we are confident in the inspired reliability of the Bible? Does this give us confidence to pursue research in a biblical worldview? If a friend gives us a map to a hidden treasure, do we know that friend so well that we will, with confidence, search for the treasure?

Two prominent contemporary philosophers of science, Larry Laudan[12] and Imre Lakatos, have developed similar concepts, which may be the most realistic understanding of the scientific method. We will briefly consider the view of Lakatos.[13] He believed the history of science is best described as competition through time between competing research programmes (roughly comparable to theories or paradigms). A research programme consists of a

core theory and a set of auxiliary hypotheses. The core theory is central to the research programme, and is protected from falsification by the "protective belt" of auxiliary hypotheses.

Why would we want to protect a theory from being falsified? According to Lakatos it is in order to give the core sufficient opportunity to be fully developed. When potentially falsifying data appear, it is the auxiliary hypotheses that are modified or replaced. The theory that all life has arisen by evolution is an example of a core theory, with its protective belt of changeable auxiliary hypotheses of specific evolutionary mechanisms.

Lakatos' philosophy can be compared to the worldviews we have discussed. It is not realistic to think that worldviews (compare with Lakatos' core theories) can be easily tested and confirmed or rejected. Rather than fully testing them, we can, according to Lakatos, consider a research programme as progressive or degenerating according to several criteria, the most important of which is whether it is successful in predicting novel, hitherto unexpected findings, at least some of which can be successfully corroborated. Thus, in the study of science, the choice between competing research programmes (or worldviews) is not based on our ability to determine which one is more true, but on the programmes' relative ability to increase scientific knowledge. Success in making predictions will be a part of this process.

Lakatos perceives science as a rational activity, but he and others recognize that science is affected by sociology, economics, assumptions and other very human factors.[14] Because of these human factors, theories at times seem more strongly supported than they really are.

The history of science shows that a theory may be successful in stimulating scientific progress, and consequently be widely accepted by the scientific community, and yet later be rejected because the accumulating evidence no longer supports it. Consequently, if at a given time there is a strong consensus among scientists regarding the truth of a particular theory, this consensus may result from philosophical factors (assumptions; worldviews), rather than from a body of evidence demonstrating the truth of the theory.[15] For example, could the scientific consensus that all life forms resulted from evolution, result from a common commitment to the naturalistic philosophy, rather than from the adequacy of the evidence?[16]

In this paper I am proposing that the biblical worldview will do just what Lakatos suggests – if we use it with confidence (developing the core, by investigating and testing the belt of "protective hypotheses and predictions") – it will lead to significant scientific insights and discoveries. In time I predict these will outstrip the standard model, because they are based on a more correct worldview.

2. Is it necessary to know a different worldview from one's own?

Yes, knowing both primary worldviews is necessary in order to think of how to test our ideas. It is obvious from the writings of many anti-creationists that they know little or nothing about how an educated creationist thinks. Consequently they say many foolish things. This awkward situation can be avoided by knowing both worldviews very well, what is their basis, and what implications and predictions they both make. If we have that broad perspective it facilitates effective critical thinking and helps us avoid the blinding effect of being unaware of how others think and what evidence they utilize. Not every Bible believer needs to know all about the standard model, but it is necessary to understand that model for those attempting to use a biblical worldview as a basis for scientific research.

3. Will the research method be different under a biblical worldview?

No, the research method will not be different. We still use the same methods for collecting data and analyzing biological or geological samples with analytical equipment. The difference will be primarily in the questions we ask, the assumptions we begin with, and in the things we notice in our research. We must be aware of the widely differing biblical and naturalistic worldviews and the differences in their predictions. If we are thus aware we will be free to ask questions not allowed or at least not predicted by some worldviews. We will be much more likely to notice things in the geological outcrops or biological lab that would be missed by a researcher who only knows and understands one worldview. Comparing the predictions of opposing worldviews can open one's eyes to see things in nature that might not seem important otherwise.

A Christian also has another advantage, not acceptable to many other scientists. We can ask Him for wisdom and insight in our research. We then must do our part – careful, thoughtful work and critical thinking. If we do sloppy work both God and our fellow humans will be disappointed, but careful research honors our Creator and encourages others to trust Him.

CONCLUSIONS

The standard model is believed, by many, to be the most successful approach for science. It has been very successful in various fields of science. But we know from study of history that theories or paradigms now known to be wrong were successful in guiding science, in some cases for a long time. The most famous example is the geocentric theory of cosmology, which inspired successful science for 1800 years.

I suggest that serious cracks are appearing in the naturalistic view of biological and geological history. The standard model in these fields gener-

ally works well, but only if one's thinking is limited by the methodological naturalistic worldview. If our thinking is also open to a biblical model (or we are at least open to asking critical questions), serious problems in the standard model become apparent. The predictions discussed above point to the possibility of research that can explore these "cracks" and find the new insights revealed within their depths. Thus I predict that if we follow this approach the biblical worldview will be not only spiritually valuable, but can also be a "progressive scientific research programme," as defined by Lakatos. To most scientists this is not evident at present, and it will take much more research effort to demonstrate it more adequately, as I predict it will.

ENDNOTES

1. Some definitions as used in this article:

   Worldview – an overall understanding of life and the universe. Examples are biblical creationism, naturalism, Darwinian evolution.

   Paradigm – a large-scale explanatory theory, used in science. Examples are naturalistic Darwinian evolution as an explanation for all life forms, or a paradigm of earth history incorporating a short time since the life forms were created before the Cambrian explosion, followed by a global flood catastrophe. These are descriptive scientific statements, and do not involve the spiritual meanings that may be part of the corresponding worldview.

   Theory – a portion of a paradigm. The evolution theory is a part of the broader paradigm that includes, e.g., the geological context of evolution.

   Hypothesis – an idea to be explored and tested.

2. Brand L. 2015. Naturalism: its role in science (see this issue).
3. (a) Pearcey N. 2005. *Total Truth: Liberating Christianity From Its Cultural Captivity.* Wheaton, IL: Crossway Books. (b) Brand L. 2006. *Beginnings: Are science and Scripture partners in the search for origins?* Nampa, ID: Pacific Press. (c) Brand LR. 2009. *Faith, Reason, and Earth History: A Paradigm of Earth and Biological Origins by Intelligent Design*. 2nd ed. Berrien Springs, MI: Andrews University Press.
4. (a) Chadwick AV, Yamamoto T. 1984. A Paleoecological Analysis of the Petrified Trees in the Specimen Creek Area of Yellowstone National Park, Montana, USA. *Palaeogeography, Palaeoclimatology, Palaeoecology* 45:39-48. (b) Coffin HG. 1976. Orientation of Trees in the Yellowstone Petrified Forests. *Journal of Paleontology* 50:539-543. (c) Coffin HG. 1983a. Erect Floating Stumps in Spirit Lake, Washington. *Geology* 11:298-299. (d) Coffin HG. 1983b. Erect Floating Stumps in Spirit Lake, Washington: Reply. *Geology* 11:734.
5. ENCODE. 2012. Thirty papers published at the same time in scientific journals, including eight articles and reports in *Nature* 489 (7414):45-113, September 6.
6. Gilbert G. 1992. In search of Genesis and the pseudogene. *Spectrum* 22 (4):10-21.
7. (a) Balakirev ES, Ayala FJ. 2003. Pseudogenes: Are They "Junk" or Functional DNA? *Annual Review of Genetics* 37:123-151. (b) Pink RC, Wicks K, Caley DP, et al. 2011. Pseudogenes: Pseudo-functional or key regulators in health and disease? *RNA* 17:792-798. (c) Giannopoulou E, Bartsakoulia M, Tafrali C, Kourakli A, Poulas K, Stavrou EF, Papachatzopoulou A, Georgitsi M, Patrinos GP. 2012. A Single Nucleotide Polymorphism in the HBBP1 Gene in the Human β-Globin Locus is Associated with a Mild β-Thalassemia Disease Phenotype. *Hemoglobin* 36 (5):433-445. (d) Hirotsune S, Yoshida N, Chen A, Garrett L, Sugiyama F,

Takahashi S, Yagami K, Wynshaw-Boris A, Yoshiki A. 2003. An expressed pseudogene regulates the messenger-RNA stability of its homologous coding gene. *Nature* 423:91-96. (e) Wen Y, Zheng L, Qu L, Ayala FJ, Lun Z. 2012. Pseudogenes are not pseudo any more *RNA Biology* 9:1, 27–32.

8. Wiedershiem R. 1895. *The Structure of Man: An Index to His Past History*. London: McMillan and Co.
9. Franze K, and 9 other authors. 2007. Muller cells are living optical fibers in the vertebrate retina. Proceedings of the National Academy of Sciences (USA) 104: 8287-8792.
10. (a) Grant PR, Grant R. 2014. *40 Years of Evolution: Darwin's Finches on Daphne Major Island*. Princeton, NJ: Princeton University Press. (b) Cabej NR. 2012. *Epigenetic Principles of Evolution*. London: Elsevier, p 670-679.
11. Brand (see Endnote 2).
12. Laudan L. 1977. *Progress and its Problems: Towards a Theory of Scientific Growth*. Berkeley, CA: University of California Press.
13. Lakatos I. 1978. *The Methodology of Scientific Research Programmes*. Philosophical Papers Volume 1. New York: Cambridge University Press.
14. (a) Murphy N. 1990. *Theology in the Age of Scientific Reasoning.* Ithaca, NY: Cornell University Press. (b) Lakatos (see Endnote 13).
15. (a) Kuhn TS. 1970. *The Structure of Scientific Revolutions*. 2nd ed. Chicago: University of Chicago Press. (b) Lakatos (see Endnote 13).
16. This section is largely from Brand L. 2006. A biblical perspective on the philosophy of science. *Origins* 59:6-42.

ARTICLE

NATURALISM: ITS ROLE IN SCIENCE

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ABSTRACT

The philosophy of Naturalism dominates scientific thinking, for reasons that can be understood from review of the history of scientific thought. This article evaluates the nature and implications of Naturalism when several components are examined separately. Philosophical Naturalism rejects the possibility that God exists. It is clearly a philosophy, cannot be tested by science, and will not be discussed further in this paper. Methodological Naturalism (MN) is simply a method for doing science that does not accept any supernatural explanations. It seems, on the surface, to be harmless and a necessary part of the scientific method. However, since modern scientists working in areas of experimental, observational science do not seem to puzzle over whether they should invoke the supernatural in their explanations, it seems difficult to claim that MN is necessary in this part of science. However, in the study of history (geological or biological history, e.g.) it is important to decide what to do with MN. This article claims that when we can examine evidence for certain historical events, they are legitimate subjects for science, even if science cannot examine all the possible causes for those events. An example would be evidence for very rapid and extensive geological processes that may suggest a (divinely initiated) global flood as the cause.

Naturalism, the worldview[1] in science that explains everything in terms of material, law-bound processes known to us, will not accept any miraculous or supernatural explanations. The history of that concept in recent centuries provides clues to help us understand it. There was a time when great scientists, like Isaac Newton, believed their scientific work was guided by an understanding of the Creator and His work. But today Naturalism is the ruling paradigm in science. Why did this change? Some features of the historical context help to explain why the change occurred.

In centuries past there were many phenomena in nature with no evidence-based explanations available. This lack of explanations applied to many functions in our bodies, like what makes the blood flow, or how the universe operates. It was common in those early times to invoke miracles or mystical processes as explanations for these challenging physical or

biological features. For example, before the heart was adequately understood it was thought that some mystical force moved the blood through the body. Even Newton suggested that God at times adjusted the orbits of the planets.

As knowledge advanced during recent centuries it was discovered that more and more of these puzzling features could be explained by natural physical and chemical laws, without reference to the supernatural. William Harvey's research showed that the heart is a pump that moves the blood through the body. When this gap in our biological knowledge was filled, it became evident that the blood flows by a mechanism that can be understood. The direct, miraculous action of God or the spirits was replaced by a law-bound process.

As more discoveries of this type occurred, the "god-of-the-gaps" was no longer needed to fill the gaps in our knowledge. Many scientists moved away from Newton's theistic worldview. They thought their discoveries had pushed the supernatural farther and farther away, and in time they replaced it with purely law-bound, naturalistic explanations. It seemed to them, at the time, that God was no longer needed to make the universe work. With hindsight we can now think more deeply about Naturalism, what its role in science is today, and what effect it has on scientific conclusions. In this article I will seek to understand Naturalism and the reason for its existence, and I will suggest that it needs a reevaluation. Alvin Plantinga suggests that Christians should, in their thinking about science, make use of all that we know as Christians.[2] Is there a way that we can appropriately do that?

In centuries past, as those facile supernatural or mystical explanations were finally removed from our thinking, it resulted in increased incentive to search for natural, law-bound, evidence-based explanations. The increasing dominance of naturalistic scientific thinking was associated with the modern era of impressive progress in science. The success of this new mindset, at the time, appeared to eliminate the need for any miraculous actions anytime in the history of the universe. If there was a God, His role in the universe was in question. There developed a growing optimism that science could explain everything by ordinary physical laws and by naturalistic, materialistic processes. It is the thesis of this article that the shift to Naturalism has not received sufficient critical analysis. Has the change has gone too far, and missed some limiting factors along the way? Why would I suggest this? Didn't I just say that Naturalism coincided with a growth in scientific progress? Yes it did, in some ways, but that is not the whole story.

The change away from supernatural explanations occurred in a cultural context that helps to explain the timing and the manner of the change. At the same time that science was moving toward its modern era, attitudes toward authority of various kinds were changing. There was a growing weariness

of autocratic, authoritarian abuses of power by both church and state. For centuries the state and the cultural caste system prevented much of the population from experiencing freedom of thought and action. The Christian church in its Middle Ages form had demanded adherence to its belief system and power structure, often with the support and power of the state.The result of "heretical" thinking could be, and very often was, death. The people were ready for a change; ready to reject the dominating authority of both church and government.[3] As part of this urge for freedom the scholarly world was ready to move away from the Bible as a source of authority, with its stories of miraculous events. Methodological Naturalism (MN) became the expected foundation for scientific thinking.

CRITICAL ANALYSIS OF WORLDVIEW CONCEPTS

Some may think I am questioning Naturalism as a definition of science because it keeps creation from being taught in schools. In this article I will not discuss the contentious political question of what should be taught in public schools. My purpose is different from that; my only interest is to consider how naturalistic philosophy affects research and discovery in science.

As we seek to understand Naturalism and its role in science it will be helpful to break down Naturalism into its logical components and analyze them individually. Another example of this analytical process can be seen in historical analysis of Charles Lyell's concept of geological uniformitarianism. Before and during the time of Lyell, in the 17th to early 19th centuries, it was common for geologists to explain geological features as the result of rapid, catastrophic processes. Lyell differed with these catastrophists, and his geological theory expected that geological explanations would follow the principle of uniformitarianism; no catastrophes were allowed; ancient geological events must be explained, if possible, by processes observable today.[4] Lyell was a lawyer, and his convincing logic resulted in eliminating catastrophic processes from geological thought for a century.[5]

But trouble was brewing. The rigid hold of uniformitarianism in geology was finally weakened by the geological work of independent-thinking J Harlen Bretz, in the Channeled Scablands of Washington State.[6] Bretz saw that the evidence required catastrophic erosional process to explain the Scablands. The rigid hold of Lyell's uniformitarian principle resulted in very persistently strident objections to Bretz's interpretations. After several decades of conflict it became evident that the objections were assumption-based (uniformitarianism), not evidence-based. It was finally clear that Bretz was right and Lyell was wrong.

Careful analysis of Lyell's concept of uniformitarianism revealed that it actually contained several separate principles, some of which are still

valid and some are not. I will summarize Stephen Gould's analysis of these principles.[7] He identified four concepts in Lyell's use of uniformitarianism. The following list gives each of Lyell's geological principles, and an evaluation of them.

1. Uniformity of law: this is a part of science in general, and not unique to geology. It is still accepted that natural law is indeed uniform. Water never flowed uphill in the past.
2. Uniformity of geological processes: the present is the key to the past. The application of this means we do not invent unique processes if modern processes can explain the observations. But this is only partly valid; it is now known that in some ways the geological past was very different from what we observe today.[8]
3. Uniformity of rates of processes: geological processes have always been slow and gradual. There have not been any catastrophic geological events. This is now known to be false.[9]
4. Uniformity of conditions: conditions on earth have always been the same. This is not true. Conditions when the Cambrian sediments were being deposited, e.g., were quite different from conditions today. For example, our existing continents were largely covered with shallow seas during the Cambrian.

ANALYSIS OF NATURALISM

It is also helpful to divide Naturalism into its components and consider each one individually. It could be that all components are equally beneficial to science, but on the other hand some components may be strong assets to science, some may not be helpful at all, or perhaps none of it is helpful.

Our first step will be to distinguish between two forms of Naturalism:

(1) Philosophical (metaphysical or ontological) Naturalism (PN), and

(2) Methodological Naturalism (MN).

Philosophical Naturalism (PN) includes the rejection of any belief in the existence of God. There can be no supernaturalism because there is no divine being to perform these miraculous actions. In contrast, Methodological Naturalism (MN) makes no claims as to the existence or non-existence of god (or God).[10]

What set of experiments could be done to demonstrate that no god exists? Until a set of conclusive experiments can be done, science cannot properly make any claims of whether any god exists. What if God exists, but does not do anything that alters the effects of physical laws in ways that we can observe today? How could science perceive such a God's existence? The

existence or non-existence of god is not a concept that can be analyzed by science. If someone chooses to believe God does or doesn't exist, that is their personal business, but, as things stand at this time, scientific research can't tell us if He exists. Most Christians believe that God has revealed Himself to us, and if this claim could be *scientifically* examined, that would open the possibility that philosophical naturalism could be tested by science. Until such tests can be done, PN remains clearly as philosophy, not science.

MN, on the other hand, only claims that naturalism is a practical approach to doing science; science only uses natural, material explanations, because that is all that science can study. Theists and others can agree on part of that; we have no way of investigating *how* supernatural actions could happen. Consequently, science will only accept explanations that depend on the operation of known laws of physics and chemistry. But this still leaves us with an ambiguity. MN, as it is commonly used, goes a step farther and denies that any miracles that could affect things that science studies – *have ever* happened in the past. Although it may not be stated that way in print, that is one effect of the way Naturalism is applied in practice. Is that a claim (no supernatural actions have ever happened) that the scientific method can test? That is an issue that we will discuss later. In any case, if we are going to logically question the validity of the principle of MN, we must have good reasons for doing so.

To summarize, MN can be argued to be, in principle, consistent with current scientific practice. In contrast I find it necessary to conclude that PN is philosophy, not science. From here on I will discuss only MN.

METHODOLOGICAL NATURALISM

MN may sound reasonable, and for many decades has been almost universally accepted as a primary rule that must be followed in the practice of science, because it is the accepted definition of science, or because it is thought to be the only method that works.[11] But it will not damage science to look more closely at MN and its actual influence on the practice of science. In fact, if we are not willing to continue applying critical thinking to the concept of Naturalism we must answer the question "why are we not willing?"

Methodological Naturalism (MN) in two aspects of science

To examine how MN is used in science we will consider how it functions in two different types of scientific pursuits:

1. Experimental/observational study of ongoing processes – what happens in the laboratory today.
2. Study of history – events in biological and geological origins and history.

Experimental science

It is routinely claimed that science can only function if we follow the principle of MN.[12] Is this really true? Is it true in principle, and also in a practical way? The first category above includes use of experiments and carefully designed observations to study processes we can observe. These may be, e.g., studies of chemistry in a laboratory, or perhaps study of physiological processes in lab animals. Since these involve processes that occur right now, in front of our eyes, we can do the experiments over and over again, to verify the reliability of our findings. Then we seek to explain our data, in reference to what is known about chemistry or physiology. In our interpretations of daily, *ongoing* processes which are evidently governed by physical or chemical laws we all recognize that it is essential to base our explanations on the evidence, if our interpretations are to be valid. We cannot use supernatural explanations for our observations of *ongoing, law-bound* processes, even if we believe in a miracle-working God.

Naturalistic thinking (MN) is portrayed as essential for the success of science, in order to keep supernatural explanations out of science. But let me ask some questions of you readers. If you are a scientist doing these experimental studies, are you tempted to use supernatural explanations? Do you have to remind yourself not to do that? Do you know of any active scientist who is tempted to think that God is tinkering with the chemicals in his/her experiments, or a physiologist who is tempted to think that their routine observations have a supernatural cause? If the answers to these questions are no, then what is the practical role of MN today in experimental science? Is it needed at all?

I suggest that over the last couple of centuries we have learned that ongoing, observable daily processes in nature reliably follow the laws of chemistry and physics. Even scientists who actively believe in an all-powerful God realize that however God manages the universe, He doesn't normally do so by tinkering with the routine law-bound operations of nature. That principle has been taught to us by the accumulated experience of science. It is apparent that God has established a set of laws by which He manages the ongoing daily processes in nature, and He doesn't normally alter those. Our scientific findings have revealed that God must be a mathematically oriented super scientist type, using His laws to run the universe. He is not a capricious magician who tinkers with the daily processes we study in our experiments.

If we recognize the predictability of physical and chemical laws that govern the subjects of our experiments, how does that affect the common claim that MN is necessary for the successful functioning of science? It does not seem that any scientist engaged in experimental study of natural processes finds it necessary to ponder whether they should use supernatural

explanations for their research findings. Recognition of the reliability of physical/chemical law is an adequate guide. If this is so, then what is the practical role of MN in experimental/observational research? Does it have any essential role at all? It seems to be irrelevant, a relic of history, a lesson we needed to learn, but that lesson now has made MN obsolete and unnecessary in this part of science. That doesn't mean that the concept of MN will damage experimental study of ongoing processes, but MN just isn't necessary.

Some nagging questions

Several questions remain. What if there are claims that, for example, a person dying of cancer was supernaturally healed? How does science deal with this? If it could be demonstrated that the person was full of cancer one day, and the cancer was absent the next day, the physicians would need to decide what to do with these observations. However, even if the healing was real, it would be a unique event, and tells us nothing about normal disease processes. Whether the healing was real or just a phony claim, it would have no potential to help us in a scientific study to understand how to cure cancer. I do not personally know any theistic medical scientist who does not recognize this difference between normal, natural processes that science can study and purported miraculous healings. Thus, even if miraculous healings occur, they don't alter the nature of experimental science.

Are there any other exceptions that require us to consider if we still need MN? One other that is likely to be suggested is the claim of Intelligent Design (ID). ID claims evidence requiring the action of an intelligent agent in biological origins, but makes no claims of whether this agent uses supernatural processes.[13] However, since the supernatural could be a part of the proposed process, we must consider how this relates to MN. The relevant issue here is that ID does not propose supernatural involvement in *ongoing* processes of nature that we can study in a laboratory. What ID addresses is history, the *origin* of complex biological features, not how they function. We will come back to that in the next section.

A comparison can help to explain why I am saying that it is not necessary to invoke MN in experimental science. I could make a rule for myself that today I will not shoot anyone. That rule is certainly a good practice to follow, and it could be important for a person with a damaged mind to be reminded of that every day. However, for a person with a normal, healthy respect for the value of a human life that rule will be quite superfluous, for the same reasons I am claiming that MN is superfluous.

To summarize this discussion, for scientists either working in mainline science or as a scientifically educated creationist researcher in the study of the

daily operations of nature, MN is no longer needed. It is a relic of history, and we have learned not to use supernatural explanations for the daily, ongoing processes in nature. Our recognition of the consistent operation of natural law in processes we study in the laboratory is an adequate guide, and MN is superfluous or even misleading.

You may respond – why are you concerned about this? In experimental research MN may not be necessary, but nothing will be hurt if we follow it. Isn't that true? Yes, I think that is *partly* true, but the question is more complex, and an adequate answer will only come after additional factors are considered.

ORIGINS: THE STUDY OF HISTORY

In the study of history and origins there are some issues that differ significantly from experimental research of ongoing processes.[14] *In the study of history the decision of what to do with Naturalism is not so straightforward.* As we ponder questions about history there is a need to consider, for example, whether the processes that govern the *functioning* of a living cell are also adequate to explain the *origin* of living cells, or if an intelligent agent is needed for their origin.

Can science answer questions like this with evidence-based work? If so, what would be required to do so? How could science determine empirically that intelligence is not needed for the origin of life? That seems like an important issue, because if we can't depend on evidence-based work, how can it be science? If science is going to be objective it must be willing to ask any question, and be willing to consider any answer. That doesn't mean we will *accept* any answer, but if we are not willing to *consider* any answer, without excluding it *a priori* then some factor outside of scientific observations is in control. In practice no scientist will spend time thinking of all the (sometimes unreasonable) answers that could be suggested for a scientific question. However, if pressed for an explanation, can we give evidence-based reasons for excluding a possible answer? How well does the evidence support excluding that answer (e.g., origin by intelligence) from consideration? That may not be easy to settle, because there will be arguments about the evidence, and the meaning of the evidence, but it is still an important principle to not *arbitrarily* exclude a possible answer. And there may be some historical questions that science won't be able to answer, for practical reasons – we were not there to observe.

On the other hand, if someone, perhaps with a preference for MN, chooses to spend his/her career examining the possible natural processes that could initiate the origin of life, I would be the last person to discourage him/her from doing so. Science has a bright future if all scientists have the

freedom to think for themselves, within the worldview they choose, as long as they practice quality scientific work. In spite of my doubts about the validity of MN I will not condemn anyone from pursuing origin of life research, but I won't choose to practice that line of research because my worldview does not recommend such research as the most productive use of my time.

There may be some who are too convinced of the absolute necessity of Naturalism to see anyone question it, and I will not object to that. But for those who are confident that truth will withstand critical thinking and questioning, we will explore if and how science can work even if Naturalism is not taken as an absolute. I am recognizing that experimental science should not use supernatural explanations, and yet I also am objecting to the use of MN. Is this a contradiction? After discussion of one foundational issue, we will answer that question and propose such a scientific procedure that does not try to study the supernatural, but also does not depend on MN as it is usually practiced.

Events and ultimate causes

In study of the past, there are questions about whether or not certain events happened. I am using the term *event* as something that has happened, or is claimed to have happened. For the purpose of our discussion it could be a single event (such as the burial of a particular set of fossils) or a series of events (the sequence of processes in the origin of life). This discussion is dealing only with history, not with events that can be observed in our experimental or observational study of ongoing processes that we can observe today. As we study historical events we are likely to also encounter a deeper question: a question that addresses the *cause* of an event. We will first discuss what I am calling *events*.

Science seeks to understand events and their causes, but our ability to understand causes may be very different from evaluating the reality of events. Science can commonly determine if an event happened, even if we can't study the ultimate cause. Did General George Custer attack an overwhelming force of Native Americans because he had presidential ambitions? The cause of that disaster was an "intelligent" cause – hatched in the mind of Custer. Since it was initiated by an "intelligent" decision, does that mean science can't study the battle and its outcome? Although there has been much advance in understanding the brain, we can't fully comprehend the mind of Custer. But that doesn't keep us from looking at the evidence and testing whether the event, the Battle of the Little Bighorn, happened. We can also study the secondary causes of the actual deaths.

In other historical studies, in geological and biological history, science can ask whether an event happened, whether or not we can understand the

ultimate cause. We seek to understand what events occurred in history and what suggested events did not occur. We also wish to understand the causes of these events, if they are amenable to the methods of science. It is valuable to know if there really was a mass extinction of life forms at the end of the Cretaceous, even if there has been much uncertainty about the cause of that event. That event can be evaluated by study of the evidence left behind, even if we cannot observe and be absolutely sure of its cause.

We can study some potential causes with the methods of science, but some others can only be acknowledged as possibilities that cannot, at least at this time, be studied by science. As we study the events and sequences of events in past history, and their causes, it seems that unknown or even possibly untestable causes should not be rejected as false by assumption alone. Open-ended evaluation seems more worthy of the name science.

I suggest that the same concepts should be applied to more controversial issues in study of the history of the earth and the history of life. How did life begin? Did life begin through a sequence of essentially random encounters of molecules over time? Or was it because of an intelligent cause,[15] maybe even an intelligent plan by a supernatural cause? Many readers will immediately respond – wait a minute, don't you know that is exactly what Naturalism rejects?! Yes I do know, but that concept is exactly what I am seeking to evaluate.

Why should any of us care about this? Why am I going though all the trouble to analyze Naturalism? An analogy will help to explain.

Picture a soldier in wartime in some desolate landscape who becomes separated from his company. He becomes good at avoiding discovery by the enemy and this skill serves him very well in preserving his life. When the war ends he is not aware of the change in circumstances and he keeps on using his skill at avoiding detection while hoping to find his companions. He continues this determined strategy for a considerable time, while his life becomes more difficult. His skillful strategy seemed to work in one situation, but it fails him at a time when he needs a different strategy if he is going to survive. There is a story like this from World War II. Some well-entrenched strategies may seem to work for awhile but they spill over into a different situation and lead to trouble.

The key application of this analogy is that following MN in experimental science can seem neutral, but that philosophy is likely to spill over into the study of origins, resulting in the rejection of any biblical insights in biological or geological history (e.g., creation or a global flood), whether or not that is the right strategy.

We can all agree that science has no way to explore a supernatural process. That is beyond the range of scientific study. But science can still examine evidence to determine if an *event* happened – even the event of the beginning

of life on earth. Is the evidence compatible with life's origin occurring by strictly natural causes? Or does the rapidly accumulating biochemical evidence make that too unlikely to be worth serious consideration? Do we wish to know the answers to questions like that, without basing the answer on an assumption irrespective of the nature of the evidence? If not, why not?

If science is objective and open minded it can explore that question and at least evaluate the probabilities for different postulated events of life's beginning. That is, it can do so if not blocked by a thought stopper – the rigid application of MN that refuses to allow that question (was life designed?) to be asked. Why should science be controlled by dogma – including the dogmatic use of MN? If science doesn't yet have an evidence-based answer to how life began, can we be candid enough to say that? Some do have the candor to say that, and they are worthy of our respect.[16]

A research procedure

Any worldview can introduce a bias into research, but our task is to define an approach to research that does not bring with it a bias against Naturalism or a bias against an interventionist view.[17] It simply seeks to allow scientists with various worldviews to ask questions and suggest hypotheses to be tested by the methods of science. If we succeed in this plan, then we can show that arguments against use of interventionist (creationist) worldviews in scientific study are not valid.

Our research plan may begin with observations from science, including field or laboratory observations, or observations from published literature in science. These observations, along with our worldview, may prompt new questions about the phenomena under study. The new questions could arise from any source (science, philosophy, religion) but they must be questions that can be addressed with the methods of science (as illustrated in the example below). After learning from the scientific literature what is already known about the topic, a research plan can be defined with clear methods of data collection and analysis, and the (science) research can begin.

An example will help to explain this concept. The Miocene/Pliocene Pisco Formation in the coastal plain of Peru is a thick succession of layers of sediment. These sediments contain a rich assemblage of fossil marine vertebrates, including a large number of whales. A high percentage of these are very well preserved, articulated skeletons, with the bones undamaged by invertebrate scavengers. Many of the whales even have their baleen food-filtering apparatus (keratin, not bone) preserved and in its normal position in the mouth.[18]

In modern environments such good preservation of a whale would require burial within weeks or months at most. However, the Pisco sediments that entombed the whales were interpreted as accumulating on the sea

floor at rates of only a few centimeters per thousand years – far too slow to preserve the whales. Geologists and paleontologists who had studied the Pisco whales during at least 20 years either had not noticed this glaring inconsistency or had not taken it seriously enough to seek an answer and discuss it in published scientific papers.

Along with other earth scientists, I studied the Pisco Formation and we quickly noticed the contrast between assumed sediment accumulation rates and the rapid burial necessary to preserve complete whales. Why did we notice it? In contrast to previous researchers, we approached the research from a worldview that did not assume long ages of time for the geological record. We began with an open question, "how long did it take for these sediments and fossils to be deposited here?" Our thinking was not controlled by uniformitarian assumptions, but it allowed the option of a short time period for the Pisco (consequently also questioning the accuracy of radiometric dates). Our hypothesis proposed a much more rapid process than the chronology based on MN would allow (since much time is thought to be needed for the inferred evolutionary changes in some of the vertebrate fossils in the Pisco). Our goal was to test that hypothesis in the part of the Pisco that we studied, not to force our data into our hypothesis whether or not it fits. If we are seeking truth (as science should) we will not be satisfied with any effort to force the data into a preconceived idea.

The evidence from the whales and the diatomaceous deposits did support rapid burial of the whales and rapid accumulation of the sediments that entombed them.[19] So what did this research accomplish? Which of these options are correct descriptions of our work?

1. We proved the biblical flood – NO. The word proof should not be used here; and the Pisco is only one rock formation out of many.
2. We showed the entire Pisco Formation formed very rapidly – NO.[20] We did not eliminate the possibility that some parts of the Pisco formed more slowly.
3. We disproved MN – NO. We simply didn't use it.
4. We used different research methods from other scientists – NO. Our data collection and analysis used standard research procedures.
5. Our hypothesis was scientifically productive; it led to discovery and understanding of evidence that others had not recognized – YES.
6. This research is compatible with the proposal that questions and hypotheses not utilizing the principle of MN can be scientifically successful - YES.
7. The evidence supports our hypothesis of rapid burial - YES.

8. We tried to study a miracle – NO; we studied a sequence of depositional *events*, not their ultimate *cause*. Rather than trying to study any miracle, we simply allowed our worldview to open up our thinking to a broader range of options. Could the rapid deposition burying the whales be part of a larger process initiated by intelligent action? It could be, but the scientific process could not evaluate that.

In our research and interpretation of data are we entirely unbiased? No, we are human like everyone else. But we do have a couple of advantages over many others. One advantage becomes evident when reading the abundant anti-creationist literature, which clearly reveals that those who write that material know little or nothing about how a scientifically educated creationist thinks.[21] They only understand their own worldview. However, those of us interventionists who are deeply involved in research and publication are very familiar with our own point of view and also with the mainline scientific research literature and theories in our field. Thus we are constantly comparing and thinking of how we can test between specific concepts from these different worldviews. The other advantage is that since we don't constrict our thinking to MN-based interpretations, we are more likely to notice features that can appear, from a mainline MN mindset, to be just oddities with no significance, like well-preserved whales in slowly forming sediments. When we pay attention to them, some turn out to be very significant. In this and other research, keeping our thinking free from the artificial restrictions (presuppositions) of MN opened our eyes to see things that others had not seen. This convinces us that MN as it is used today is mostly a detriment to science, not an asset.

Interpreting published data

The principles illustrated in the example above also apply to how an interventionist worldview may evaluate evidence from the published literature. For example, consider the numerous cases of preserved biomolecules like proteins or DNA in ancient fossils.[22] These same biomolecules in the modern world have short half lives of hundreds or thousands of years. However, the chronology based on MN requires, and radiometric dating provides, ages for the fossil biomolecules of many millions of years. The short half lives of biomolecules and the radiometric dates are two conflicting lines of evidence, and the conflict needs an explanation.

The conflict between these two lines of evidence indicates there is something that we don't yet understand. Are the fossil biomolecules very ancient, in violation of their half lives observed today? Or are the accepted dates wrong, and the fossils are actually quite young? Which interpretation is correct? MN allows only one of those interpretations – the fossils must

be very ancient, but we don't understand how they lasted so long. MN does not allow consideration of both possibilities – it does not allow an open minded search for scientific truth. As Plantinga says, "A Christian therefore has a certain freedom denied her naturalist counterpart: she can follow the evidence where it leads."[23]

Of course if the fossils were formed within the last few thousand years (too short a time for the evolution process), that points ultimately to miraculous actions in regard to the short time span, and science can't examine the nature of that cause. The question here is, do we want to know what is truth about the *events*, even if we can't verify their ultimate cause? Or do we allow an assumption or presupposition, MN, to dictate what is truth about the events?

Science can't study miraculous causes, so many persons consider the idea of miracles to be science-stoppers. But miraculous causes like Intelligent Design and creation of life or the initiation of a global flood catastrophe could have happened. If they did, will it improve our science if we pretend they did not happen? Do we want to know true answers, even if they don't fit our preferred philosophy? If the evidence indicates that a materialistic, naturalistic origin of life is not a realistic possibility, will our science be better if we ignore the evidence and insist that an explanation consistent with MN is the only acceptable explanation? Do theory and assumptions trump evidence, as would be the case if we refuse to even consider the postulate that life may not have arisen by a naturalistic process?

I conclude that the only constructive thing MN has to offer is to remind us that science can't study *how* miracles happen. It is not valid for MN to deny that some miracles could have happened in the course of origins. In some cases the evidence (which we can study) may tell us that *events* have occurred that point back to the likelihood of miraculous or at least intelligent *causes* (and science can't study how those happen). Science has a definite limitation in that it cannot determine if miracles have happened in the past, and it also cannot determine if they did not happen. It seems wiser for scientists to recognize this limitation than to deny it. There will always be qualified, careful scientists who follow the principles of MN, and some who do not. The difference is philosophical, not scientific, and I predict that those who favor interventionism, not MN, will ultimately be more successful. That may seem to be a rash prediction, but as time goes on, we will see.

CONCLUSIONS

A Christian who engages in science should be able to devise hypotheses making use of the information we as Christians have. Methodological Naturalism does not allow that to happen.[24] There is one factor that all,

those who accept MN and those who do not accept it, can agree on: science cannot examine *how* purported miracles happen. We can't know the process involved in such things. So what is the difference between MN and a worldview that rejects MN? The difference, for both sides of that divide, is a religious difference. Science can't test either of these hypotheses: 1) A miracle-working god has been active in the history of origins, or 2) No miracle-working god has been active in history. The choice between these hypotheses is a philosophical or religious choice, not a scientific choice. If there is a miracle-working god, and MN declares that he is not allowed to ever have done any miracles, will that change history? Not likely. We can see that modern processes reliably follow the laws of chemistry and physics, but what about beginnings?

There once was a time when MN was needed, to teach us not to rely on mystical explanations of daily operations of nature. We have learned that lesson, so the only constructive thing MN does now is to remind us that no human can understand *how* miracles happen. MN has no ability to tell us *whether* miracles have occurred in connection with origins, nor does it have a right to dictate that to us. If a miracle did occur in the past, science can't study the miracle, but it can study any evidence that it may have left behind in regard to events that may have resulted from the miracle.

It doesn't seem that this distinction between the results of events in history (resulting from secondary causes), which can be studied, and the ultimate causes of such events, which may not be amenable to our research, has been clearly recognized in previous discussion of MN. If this factor is put on the table it can have an influence in opening up the discussion of geological and biological history and origins.

Just as it is not appropriate to assume there have been no miracles in history, we should also not *assume* that miracles have affected our research site. But our research will be more objective if we are aware of, and open to, the possibility of an earth history different from the history required by MN. In other words we seek for our research and conclusions to be evidence-based, not assumption-based.

Some evidence seems to support long ages for earth history, but other evidence says the opposite. When two lines of diligently studied evidence point in opposite directions, this does not necessarily mean that someone is doing careless or biased science. Maybe they are, or maybe they aren't. The contradiction is quite likely telling us there is something still to be discovered that can bring clarity and consistency to our understanding of the subject under study. I predict that this clarity will be enhanced if we are not limited in our thinking by MN.

In conclusion I must return to what is probably the biggest question about the issues in this article. Why is it so important to challenge the use of MN, especially in experimental science? I have stated that MN is not beneficial to science, but also that "science has no way to explore a supernatural process." Is that an outright contradiction? Is it saying that MN is bad but we can't get along without it? The answer to those questions describes the essential reason for this article. MN is a problem in the modern scientific world because it is a deeply held philosophy with implications that inevitably go way beyond any valid basic application. If it were only applied to experimental science it could be fairly harmless. But the most serious problem with MN is that it inevitably spills over deeply into discussions of history, where in practice it tries to dictate answers that science cannot provide.

Scientific research, for example, *cannot* demonstrate that life originated by naturalistic processes. Yet MN dictates that only naturalistic processes can be considered. That is science overstepping its legitimate bounds, and that always seems to happen when MN, as a philosophical position, is used. Instead, it is better to simply recognize that using supernatural explanations in experimental science is not helpful, and if miraculous events have happened *in history* science can't tell us how the supernatural works, and leave it at that. Beyond that our explanations should be based on the available or accessible evidence, not controlled by philosophical assumptions like MN. Genuine science must be fully evidence-based, not assumption-based.

ENDNOTES

1. A worldview is a set of assumptions that provide a framework for answering the significant questions about life and our universe; is there a God, where did we come from, where are we going, etc. These assumptions also influence how we understand the scientific process.
2. Plantinga A. 1997. Methodological naturalism? *Origins and Design* 18:1.
3. (a) McGrath A. 2004. The Twilight of Atheism. New York: Doubleday. (b) Froom LF. 1946. *Prophetic Faith of our Fathers*, vol 2, p 723-782. Washington, DC: Review and Herald Publishing Assn.
4. Lyell C. 1830-1833. *Principles of Geology.* 3 vols. London: John Murray.
5. Gould SJ. 1984. Lyell's vision and rhetoric. In: Berggren WA, Van Couvering JA (eds). *Catastrophes and Earth History: The New Uniformitarianism*. Princeton, NJ: Princeton University Press.
6. Soennichsen J. 2008. *Bretz's Flood.* Seattle, WA: Sasquatch Books.
7. Gould 1984 (see Endnote 4).
8. Valentine JW. 1966. The present is the key to the present. *Journal of Geological Education* 14(2):59-60.
9. (a) Ager DV. 1981. *The Nature of the Stratigraphical Record*. 2nd ed. New York: John Wiley and Sons. (b) Berggren and Van Couvering (eds.) 1984 (see Endnote 4). (c) Albritton CC, Jr. 1989. *Catastrophic Episodes in Earth History*. New York: Chapman and Hall; (d) Huggett R. 1990. *Catastrophism: Systems of Earth History*. New York: Edward Arnold.
10. Pennock RT. 1999. *Tower of Babel.* Cambridge, MA: MIT Press, p 189-194.

11. (a) Miller KB. 2009. The Misguided Attack on Methodological Naturalism. In: Schneiderman JL, Allmon WD (eds), *For the Rock Record*, p 117-140. Berkeley, CA: University of California Press. (b) Pennock 1999, p 191-206 (see Endnote 9). (c) Pennock RT. 2009. Can't philosophers tell the difference between science and religion? Demarcation revisited. In: Pennock RT, Ruse M (eds), *But is it Science?* (updated edition). Amherst, NY: Prometheus Books, p 546-565.

12. (a) Miller 2009 (see Endnote 10a). (b) Pennock 1999, p 191-206 (see Endnote 9).

13. (a) Behe MJ. 1996. *Darwin's Black Box*. New York: The Free Press. (b) Behe MJ. 2007. *The Edge of Evolution*. New York: Free Press. (c) Meyer SC. 2009. *Signature in the Cell.* New York: HarperOne.

14. Thaxton CB, Bradley WL, Olsen RL. 1984. *The Mystery of Life's Origin: Reassessing Current Theories*. New York: Philosophical Library.

15. Meyer 2009 (see Endnote 12c).

16. (a) Shapiro J. 2011. *Evolution: A View From the 21st Century*. Upper Saddle River, NJ: FT Press, p 125. (b) Meyer 2009 (see Endnote 12c).

17. Interventionism is a worldview that accepts the possibility of intervention in history by intelligent beings, divine or otherwise.

18 . (a) Esperante-Caamano R, Brand LR, Chadwick A, Poma O. 2002. Taphonomy of Fossil Whales in the Diatomaceous Sediments of the Miocene/Pliocene Pisco Formation, Peru. In: De Renzi M, Alonso M, Belinchon M, Penalver E, Montoya P, Marquez-Aliaga A (eds), *Current Topics on Taphonomy and Fossilization* (International Conference Taphos 2002. 3rd Meeting on Taphonomy and Fossilization, Valencia, Spain, 2002), p 337-343. (b) Esperante R, Brand L, Nick K, Poma O, Urbina M. 2008. Exceptional occurrence of fossil baleen in shallow marine sediments of the Neogene Pisco Formation, Southern Peru. *Palaeogeography, Palaeoclimatology, Palaeoecology* 257:344-360.

19. Brand L, Esperante R, Chadwick A, Poma O, Alomia M. 2004. Fossil Whale Preservation Implies High Diatom Accumulation Rate in the Miocene-Pliocene Pisco Formation of Peru. *Geology* 32:165-168.

20. The sediments that buried the whales were deposited rapidly, but we did not demonstrate that there were no other sediments that accumulated more slowly.

21. Examples: (a) Pennock 1999 (see Endnote 9). (c) Coyne JA. 2009. *Why Evolution is True*. NY: Penguin Books. (c) Miller KR. 2000. *Finding Darwin's God: a scientist's search for common ground between God and evolution*. New York, NY: Harper Collins.

22. (a) Schweitzer MH, Zheng W, Cleland TP, Bern M. 2012. Molecular analysis of dinosaur osteocytes support the presence of endogenous molecules. *Bone*, 2012; DOI. 10.1016/j. bone.2012.10.010. (b) Also see news story: Analysis of dinosaur bone cells confirms ancient protein preservation, *Science Daily*, October 23, 2012. (c) Hofreiter M, Collins M, Stewart JR. 2012. Ancient biomolecules in Quaternary palaeoecology. *Quaternary Science Reviews* 33 (6 February 2012), p 1-13.

23. Plantinga 1997 (see Endnote 2).

24, Ibid.

ANNOTATIONS FROM THE LITERATURE*

BIOLOGY: FRAGILE PHYLOGENY

Kristensen NP, Hilton DJ, Kallies A, *et al*. 2015. A new extant family of primitive moths from Kangaroo Island, Australia, and its significance for understanding early Lepidoptera evolution. *Systematic Entomology* 40:5-16.

Summary. A new species of moth discovered on Kangaroo Island, Australia, has resulted in major changes in the theoretical relationships among moths and butterflies. The newly described species, *Aenigmatinea glatzella*, belongs to a group of moths with similar venation in forewings and hindwings ("homoneurous"). The new species has an unexpected combination of morphological traits, including degenerate mouthparts. However, genetic evidence and some morphological evidence indicate it should be classified with the tongue moths (Glossata). This analysis causes changes in the arrangement of some other families in the classification, and implies loss (reversals) or parallel gains (convergences) of several traits thought to be reliable indicators of phylogenetic relationships. It also indicates that the "Myoglossata" are not monophyletic.

Comment. The observation that the addition of a single new species caused major changes in the hypothesis of the interrelationships of moths indicates the rather fragile basis of postulating evolutionary relationships in these groups, especially at taxonomic levels above the family. The fact that morphological data are usually the only kinds available in studying fossils should suggest caution when evaluating claims of evolutionary relationships among fossil groups.

BIOLOGY: GENETICS OF GALAPAGOS FINCH BEAKS

Lamichhaney S, Berglund J, Almen MS, *et al*. 2015. Evolution of Darwin's finches and their beaks revealed by genome sequencing. *Nature* (19 February) 519:371-375. doi:10.1038/nature14181.

Summary. The Galapagos Islands are inhabited by a group of 14 species of finches, known as "Darwin's finches" in honor of his visit there. A fifteenth species inhabits Cocos Island, some 400 miles distant. All 15 species are believed to have descended from a common ancestor from South America. Whole-genome sequencing was conducted on 120 individuals representing all fifteen species. Results showed evidence of extensive interbreeding among the different "species," and indicate that some "species" are the result of

hybridization. The "species," *Geospiza difficilis*, present in the highlands of six islands, appears to be three separate "species," each of which is more closely related to other species than to other populations of *G. difficilis*. A similar situation obtains for the species, *Geospiza conirostris* . The population on Genovesa Island is more similar to a different species than to the population on Española Island. Darwin's finches are distinguished phenotypically largely by the shape of their beaks. The genetic basis of beak shape is not well known, but a gene, *ALXi*, is correlated with beak differences and thought to be an important genetic factor in determining beak shape.

Comment. Interbreeding, hybridization and speciation among Darwin's finches may provide a small window into the kind of diversification of species into different habitats after the flood. As species dispersed from the ark, they would encounter different environmental conditions, and would have to adapt or go extinct. Undoubtedly, many did go extinct, but many others spread out across the earth, moving into and adapting to different habitats and developing morphological differences. The results may be seen in the frequent examples of clusters of similar species in different areas, collectively inhabiting whatever portion of the earth's surface they were able to colonize and survive in.

BIOLOGY: PSEUDOGENES, RETROTRANSPOSONS AND GENE REGULATION

Watanabe T, Cheng E-c, Zhong M, Lin H. 2015. Retrotransposons and pseudogenes regulate mRNAs and lncRNAs via the piRNA pathway in the germline. *Genome Research* 25:368-380.

Summary. Eukaryotic protein-coding sequences are often separated by sequences of unknown function, such as pseudogenes, transposons and repetitive sequences. These sequences are transcribed into long non-coding RNAs (lncRNAs) and Piwi-interacting RNAs (piRNAs), but the function of these RNAs, if any, has been mostly unidentified. This study reports that piRNAs produced from pseudogenes and transposons regulate the degradation of mRNAs and lncRNAs in mouse spermatocytes. Regulation of mRNA stability by piRNAs means that these pseudogenes are part of a complex network of RNA sequence regulation.

Comment. Because no function had been identified for pseudogenes and repetitive sequences, evolutionary theorists postulated them to be evolutionary remnants of ancient genes no longer needed ("junk DNA"). Proponents of Intelligent Design, including creationists, suspected they were functional in some way not yet discovered, possibly relating to gene regulation. Several pseudogenes have been shown to have functions, but

the mechanisms of gene regulation are still not well understood. This report adds to our understanding of how pseudogenes are involved in regulating RNA levels in the cell during spermatogenesis in mice, and suggest that other such examples should be sought.

BIOLOGY: SCRUB JAY BEAKS VARY WITH HABITAT

Langin KM, Sillett TS, Funk WC, *et al*. 2015. Islands within an island: Repeated adaptive divergence in a single population. *Evolution* 69(3):653-665. doi:10.1111/evo.12610

Summary. A species of scrub jay, *Aphelocoma insularis*, is endemic to Santa Cruz Island, about 30 miles off the California coast. The island is mostly covered with oak woodland, with three relictual patches of Bishop pines. Jays living in the pine habitats have longer, shallower bills than jays living in the oak habitat. These differences are similar to those in mainland scrub jay populations that inhabit different habitats, but it is somewhat surprising to find such differences within a single population. This observation suggests the possibility of finding more examples of small-scale environmental variation in species, and may provide insights into the possibility of sympatric speciation.

Comment. The potential for minor morphological variation within a species is a useful concept in creationist thinking. Such variation is necessary for species to survive changes in environmental conditions during dispersal from the ark and during changes in climate since the flood.

BIOLOGY: SYNTHETIC CHROMOSOME WORKS IN YEAST

Annaluru N, Muller H, Mitchell LA, *et al*. 2014. Total synthesis of a functional designer eukaryotic chromosome. *Science* 344(4 April):55-58. doi: 10.1126/science.1249252.

Summary. The yeast *Saccharomyces cerevisiae* is used in baking and winemaking, and as a model laboratory organism. It has been studied extensively, and was the first eukaryotic organism to have its complete genome sequenced. It has 16 chromosomes, with around 6,000 genes. The third smallest chromosome has 316,617 base pairs and probably around 200 genes. Scientists have constructed an artificial chromosome, called synIII, consisting of 272,871 base pairs, and have shown that it is functional in a living yeast cell. The artificial chromosome lacks some portions of the native chromosome, and has certain additions that enable scientists to disable specific genes in experiments. This will permit scientists to determine which genes and gene combinations can be deleted and which are essential.

Future plans include construction of an entire yeast artificial genome with provision for manipulation of individual genes to facilitate determining their functions and gene interactions, and the eventual ability to design and engineer synthetic organisms.

Comment. The ability to manipulate gene activity continues to increase, and we are now approaching the technical ability to design organisms for specific purposes, and even to "create" new kinds of organisms. At least three issues arise from this situation. First, some creationists have held the belief that God would not permit humans to "create" new forms of life. This belief needs to be reconsidered. It appears to be within human technological capacity to modify organisms intentionally. Second, some creationists have insisted that God would not permit Satan to genetically modify (or "create") new types of organisms. The ability of humans to do this should put to rest such notions. Third, underlying all these concerns is the question of bioethics. To what extent is it ethical for humans to manipulate the genomes of the Creator's handiwork?

GENETICS – GENES OUT OF PLACE

Crisp A, Boschetti C, Perry M, Tunnacliffe A, Micklem G. 2015. Expression of multiple horizontally acquired genes is a hallmark of both vertebrate and invertebrate genomes. *Genome Biology* 16(50):1-13.

Summary. As more species genomes are sequenced, more genes are discovered that do not appear to be the result of normal "vertical transmission" of genes from one generation to the next. Two main explanations have been offered for these anomalies: multiple gene loss or horizontal gene transfer.

Multiple gene loss occurs when a gene is lost from some species but retained in other species sharing the same common ancestor. It is identified when the phylogenetic pattern of gene presence and absence appears to indicate multiple independent events. Horizontal gene transfer (HGT) occurs when a gene is transferred from one species to another, and is identified when the phylogenetic pattern of gene presence and absence is readily explained by a single, or a few, gene gains. Multiple gene loss is considered more likely than multiple gene gain by HGT.

Three groups of species were studied in this report, the nematode genus *Caenorhabditis*, the fly genus *Drosophila*, and the order of primates. Gene sequences from these three groups were compared with sequences from other groups, including non-metazoan groups such as bacteria, protists and fungi. Genes from the study groups that aligned better with non-metazoans than with other metazoans were interpreted as "foreign" genes that most likely were acquired by HGT.

Horizontal gene transfer appears to be common among bacteria, and a few examples have been described in metazoans, but claims of HGT in humans have been controversial. This study reported a much higher incidence of HGT than previously recognized. *Caenorhabditis* species have an average of 173 "foreign" genes for which HGT is a potential explanation. *Drosophila* species have an average of 40 such genes, while the primate species studied averaged 109 genes of this type.

Comment. While the evidence suggests that HGT is a real phenomenon, the authors failed to consider the possibility that some genes may be present in different groups because of design. If different taxonomic groups were created for particular environments, one would expect them to have the genes needed for those environments, regardless of whether the genes were present in some other group. "Foreign" genes are actually genes that do not fit the conventional ideas of evolutionary ancestry, and could readily be interpreted as evidence against common ancestry. In addition, numerous "orphan" genes have been identified that appear to be restricted to a single species or group of closely related species. These cannot be due to HGT if they are absent in all other species, as appears to be the case. Genes that do not fit phylogenetic hypotheses may be indicating separately created origins.

PALEONTOLOGY: JURASSIC SNAKE FOSSILS

Caldwell MW, Nydam RL, Palci A, Apesteguia S. 2015. The oldest known snakes from the Middle Jurassic-Lower Cretaceous provide insights on snake evolution. *Nature Communications* 6(27 January):5996. doi: 10.108/ncomms6996.

Summary. Newly identified fossil snakes are the oldest yet discovered. Four new snake species are described in this article. All of them are based on fragmentary fossil material that was not recognized as belonging to snakes. Three species are from Jurassic sediments. The oldest is named *Eophis underwoodi*, collected in a quarry in England (Middle Jurassic, Bathonian). *Portugalophis lignites* was recovered from coal deposits in Portugal (Upper Jurassic, Kimmeridgian). A third species, *Diablophis gilmorei*, was discovered in Colorado (Upper Jurassic, Kimmeridgian). The fourth fossil snake, *Parvivraptor estesi*, was found in England, in the Purbeck Limestone Formation (Lower Cretaceous, Berriasian). It was originally identified as a type of lizard (anguimorph). Before this study, the oldest known snake was *Najash rionegrina* from Argentina (Upper Cretaceous, Cenomanian).

Comment. The material is quite fragmentary, leaving room for caution in interpretation, but the discovery of fossil snakes in Jurassic sediments should not be a surprise. Whether the snakes had vestigial legs or were en-

tirely legless is difficult to determine from skull fragments, so reports that these snakes had legs should be considered with caution. The oldest fossil snake known before these newly identified species, *Najash rionegrina*, did have tiny but functional hindlimbs. Vestigial hindlimbs are present in some living boas and pythons, but are too small to be of use in locomotion.

PALEONTOLOGY: STASIS IS EVOLUTION?

Schopf JW, Kudryavtsev AB, Walter MR, *et al*. 2015. Sulfur-cycling fossil bacteria from the 1.8-Ga Duck Creek Formation provide promising evidence of evolution's null hypothesis. *Proceedings of the National Academy of Sciences (USA)* 112(7):2087-2092. doi: 10.1073/pnas.1419241112

Summary. Sulfur-cycling bacterial communities are known from the modern deep sea off the west coast of South America. Similar fossil communities have been discovered in Paleoproterozoic sediments in Western Australia. A community dated at 1.8 billion years was previously described, and this report adds a second fossil community, dated at 2.3 billion years in the Duck Creek Formation. Comparison of cellular morphology, community structure and chemical analyses in fossil and modern communities supports identification of the Duck Creek fossils as a sulfur-cycling bacterial community, and shows no evidence of evolutionary change. This is a remarkable example of stasis, and may be attributed to the physical stability of such sub-seafloor environments. More such fossil communities should be sought in order to evaluate the conclusions made here. Cyanobacteria involved in stromatolite formation also show stasis, but probably due to different factors. Cyanobacteria evidently have sufficient genetic plasticity to be ecologically flexible and adapt to many different habitats.

Comment. Stasis – the lack of morphological change – is a common feature of the fossil record. Stasis at the species level was the basis for the "punctuated equilibria" model famously proposed by Eldredge and Gould. This observed fossil pattern is directly contrary to Darwin's predictions that every geological stratum should show evidence of slow, gradual changes revealing the course of evolution. These sulfur-cycling bacteria, along with the cyanobacteria to which they are compared, are striking examples of the failure of Darwin's prediction. This point is not deflected by the proposed explanation that one group of bacteria (sulfur-cyclers) shows stasis because its environment is stable, while another group of bacteria (cyanobacteria) shows stasis despite the fact it inhabits many different environments because it has "genetic plasticity." The appeal to search for more sub-seafloor communities throughout the geologic record may have interesting implications. We can predict that such sub-seafloor communities should be expected in

pre-flood rocks and in the modern environment, but are unlikely to be found within sediments deposited by the flood.

PALEONTOLOGY: SWIMMING TRACES CONCENTRATED IN THE TRIASSIC

Thomson TJ, Droser ML. 2015. Swimming reptiles make their mark in the Early Triassic: Delayed ecologic recovery increased the preservation potential of vertebrate swim tracks. *Geology* 43:215-218. doi: 10.1130/G36332.1

Summary. Tetrapods such as reptiles or mammals may leave marks in the sediment while swimming, as their feet contact the substrate. Fossil traces made by swimming tetrapods are found throughout the world, from the Carboniferous to the Pleistocene. This study is based on a compilation of 143 localities in some 61 geologic formations (supplementary material with the article). Tetrapod swimming traces are not evenly distributed throughout the stratigraphic record, but spike in Lower Triassic sediments, even when corrected for area of outcrop. This may be explained by the lack of bioturbation in Lower Triassic sediments, perhaps due to the destruction of bioturbating organisms in the end-Permian mass extinction event.

Comment. Patterns in the fossil record can be of great value in interpreting the processes involved in deposition of the geologic column. In the context of a global catastrophic flood, the abrupt change in the kinds of fossils at the Permian-Triassic boundary might be interpreted as due to a change in source area, bringing in new types of organisms from different habitats. A spike in swim traces might be consistent with a change in water currents associated with a change in source area. However, the Lower Triassic spike in swim traces is the result of a large number of such traces in the Moenkopi Formation of Utah (32 of 40, supplementary material), so the pattern may not apply globally. Lack of bioturbation might reflect either the lack of bioturbators or the deposition of sediments at rates faster than bioturbators could disrupt. More effort should be put forth to identify and interpret patterns in the fossil record and interpret them in a biblical context.

PALEONTOLOGY: TREND TOWARD INCREASING HABITAT DIVERSITY

Knope ML, Helm NA, Frishkoff LO, Payne JL. 2015. Limited role of functional differentiation in early diversification of animals. *Nature Communications* 6(4 March):6455. doi:10.1038/ncomms7455.

Summary. The Cambrian Explosion is a well-known pattern in the fossil record, whereby all the major body plans were present, either as fossil or

inferred on the basis of theory. The question pursued here is to what extent Cambrian fossils occupied most "ecological modes," or only a small subset. To answer this question, 18,621 marine animal genera were assigned to different ecological modes, based on their position in the water column or sediment, mobility, and feeding strategy. Diversity of ecological mode, termed "functional differentiation," was found to be low for Cambrian organisms, increasing in the Ordovician, and with large increases after the end-Permian and end-Cretaceous mass extinctions. Thus, although the Cambrian Explosion involved many different phyla and classes, most of them represent a relatively small number of ecological functions.

Comment. How might a creationist interpret these results? One possibility might be that animals were created in numerous body plans, which were designed with variation for different habitats. For example, the phylum Mollusca is characterized by similarities in body plan, but different mollusks inhabit different ecological zones, from the seafloor to the shoreline, and even in terrestrial settings. With such a system, a small sample, such as the Cambrian fauna, would contain a large sample of the body plans (mollusks, echinoderms, arthropods, etc), but a relatively small sample of the ecological diversity. Increasing the size and stratigraphic range of the sample would probably increase the ecological diversity represented in the record. Mass extinctions could be interpreted as changes in sources of fossils and sediments. Jumps in ecological diversity would be expected after mass extinctions, as new sources, and new habitats, were added to the stratigraphic column. A global catastrophe, in which different habitats are sequentially destroyed and buried, might produce a pattern similar to that reported in this paper. This explanation admittedly has a significant speculative component, but it hopefully will suggest new possibilities for interpreting patterns in the fossil record from a creationist perspective.

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*Other annotations are available on our website: ***www.grisda.org***

LITERATURE REVIEWS

Readers are invited to submit reviews of current literature relating to origins. Mailing address: ORIGINS, Geoscience Research Institute, 11060 Campus St., Loma Linda, California 92350 USA. The Institute does not distribute the publications reviewed; please contact the publisher directly.

SOME IMPLICATIONS OF BIOLOGICAL INFORMATION

Biological Information: New Perspectives. Robert J Marks II, Michael J. Behe, William A. Dembski, Bruce L. Gordon, and John C. Sanford, editors. 2013. Singapore: World Scientific Publishing. 584 p. Hardcover, $178USD.

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This is an unusual book, as will be described later. It is a collection of papers presented at Cornell University in 2011 on biological information. The subject matter is interesting to those who want a deeper knowledge of the Intelligent Design controversy and are willing to put in the requisite effort. The papers are all critical of the current neo-Darwinian synthesis. Although most of them are from intelligent design advocates (including a few creationists), two papers are specifically from advocates of self-organizational theory who do not believe in intelligent design.

The book is divided into four sections. Each section has an introduction written by one of the editors. The first section is on information in biology in general, and has a fairly strong chapter by Gitt, Compton, and Fernandez on information itself, and another one by Dembski, Ewert, and Marks on expanding the "no free lunch" theorem to searches where various locations will have different probabilities of finding a given target in them. After a couple of interesting papers of lesser significance, another paper by Ewert, Dembski, and Marks on the computer program Tierra, an especially good paper on multiple overlapping genetic codes by Montañez, Marks, Fernandez, and Sanford, and two papers on entropy, by Sewell and by McIntosh, round out the more noteworthy papers of Section 1.

Section 2 contains a review of junk DNA by Wells, written before the ENCODE papers had come out but agreeing with them, which shows that ID has predictive power. Following that is a series of papers reporting the results of using the computer program Mendel's Accountant, and reasonably

demonstrating that natural selection under reasonable circumstances is not only unable to detect most beneficial mutations, but cannot even purify the genome from deleterious mutations. Brewer, Smith, and Sanford then apply these principles ("Genetic Entropy") to the influenza virus, with stunning results, and experimental confirmation of their predictions are documented in a later paper referenced in the appendix to the chapter, and available online. This chapter and the accompanying paper are worth a read if one does not read anything else in the book. A couple of papers comparing genetic information to computer code close out the section.

Section 3 starts with a paper by Macosko and Smelser pointing out that the genetic code is at least in the top millionth of all possible codes, and possibly completely optimal. The difficulty of doing this by natural selection is perhaps obvious. Next is an interesting but experimentally unsubstantiated proposal by Dent looking for high-frequency communication between cells. A mathematical approximation by Behe shows that in most cases adaptations that lose information are more likely to be selected for than those that gain information. Wells writes another excellent chapter on the membrane code, which is separate from the DNA code, and finally there is an excellent chapter by Axe and Gauger on the multiple difficulties with explaining the origin of metabolic pathways by any unguided evolutionary process, and deducing the general properties of an adequate explanation of those pathways.

Section 4 has an introduction by Gordon that comments on the similarities and differences between ID and self-organizational theory. Kauffman proposes that "life bubbles forth", and since the probabilities are unknown, ID arguments are off-base. His critique of standard evolutionary theory seems to be based on the proposal that this theory requires evolution to be inevitable. Weber appeals to emergent behavior, but spends a good deal of his time arguing that the origin of life can be accounted for without design, without much comment as to exactly how emergence explains that origin. Neither author spends much time arguing against current evolutionary theory. One may quibble with their theories, but their attitude of dialogue is far preferable to that of some advocates of neo-Darwinism described below.

Perhaps the most unusual and important aspect of the book is the story of its publication. The conference was held in May and June of 2011. The book was contracted to be published in 2012 by Springer Verlag (a page is still up as of 4 June 2015—see *http://www.springer.com/us/book/9783642284540*), but some loyal Darwinists found out that this would happen and threatened the company with a business boycott

if they published the book. Springer Verlag then backed out of the deal, and as enforcing the contract would have required a trial in Berlin and would have resulted in delay of publication of the papers for years, the editors opted to go with another publisher, World Scientific Publishing, instead. This involved over a year's delay in publication. The story can be found, complete with links to the views of some opponents, at *http://www.evolutionnews.org/2013/08/on_the_origin_o_3075521.html*.

The publication is unusual in that, although a hardcover copy will cost $178.00 at World Publishing and lists for $90.00 to 160.30 new at Amazon.com (again as of 4 June 2015), the e-book can be downloaded in chapters for free at *http://www.worldscientific.com/worldscibooks/10.1142/8818#t=toc*. Some of the illustrations of the e-book are in color where the hardcopy has only black and white for those illustrations. So if one only wants the information, buying the book is essentially giving a donation to the publishing company. Some may wish to do exactly that given the above controversy.