THE SCIENTIFIC METHOD: LIMITS AND FALLACIES

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The conventional presentation of the scientific method is of a simple process of making an observation or asking a question about the physical world, then proceeding to framing and testing a tentative explanation called a *hypothesis*, which may be elevated to a *theory*, and then testing the theory which may be recognized as a *law of nature*. **There is always the possibility that any hypothesis, theory or law may be overturned by further testing** (Hein and Arena, 2004, pp. 5-6; Young and Freedman, 2004, p. 2-3). The diagram below shows this simple concept of the scientific method.

- Making an *Observation*/Asking a *Question*
- Framing a *Hypothesis* and Testing It
- Elevating the Hypothesis to *Theory*; Testing It
- Elevating the Theory to a *Law*; Testing It

Conventional Process of the Scientific Method

This conventional view of the scientific method is actually simplistic. A more accurate description includes the influence of *philosophy* or *faith* on one's experiments, hypotheses, theories, and laws. Observations are the same for all, but hypotheses, theories, laws, and even the experiments made may differ depending on the person's philosophy or faith. In other words, in the diagram above, **the faith or philosophy – the *worldview* - of the investigator needs to be inserted between the observations made, and the hypotheses, theories and laws assumed to follow from them** (*below*).

- Making an *Observation*/Asking a *Question*
- IDEAS/ASSUMPTIONS OF ONE'S *WORLDVIEW*
- Framing a *Hypothesis* and Testing It
- Elevating the Hypothesis to *Theory*; Testing It
- Elevating the Theory to a *Law*; Testing It

Corrected Scientific Method with Influence of Worldview

But even this last statement may not go far enough to emphasize the importance of one's worldview in the scientific method. **One's worldview determines even the observations he is willing to make, and shapes the questions he thinks of asking.** A person living under one worldview may not even think of asking certain questions. For example, philosophers living under certain systems of antiquity did not *consciously* reject the possibility of making scientific observations. The possibility of experimentation simply never occurred to them. **The worldview under which they lived shaped their thoughts.** The next section discusses this idea in more detail.

I. Interaction of Worldview with the Scientific Method

Observations are the same for all. "The scientist enters into a study with certain preconceived notions and interprets the results of the study with the same preconceived notions. **True objectivity simply does not exist in the scientific world.** A creationist and an evolutionist can agree on the data, the physically observable phenomena (whether it be the distribution of radioisotopes in a given geological structure or the bone formation of a living animal or fossil). They will then proceed to interpret the data according to their own presuppositions ('God created this' or 'It all happened by accident'). Both employ the same data, but reach strikingly different conclusions" (Calbreath, 1980, p. 10).

But will everyone in different cultures and communities agree to make the same observations in the first place? The answer is *No*. One's world-view determines the *questions* he asks about the world and the *observations* he is willing to consider making. For example, around 1600, the astronomer Johannes Kepler asked how the sun governs the planets' motions, but as far as is known, nobody had asked this before. According to Kepler biographer Arthur Keostler (1960, p. 222):

"He had been searching for ... a correlation between a planet's *period* and its *distance* - since his youth. .... If the sun had the power to govern the planets' motions, then that motion must *somehow* depend on their distance from the sun; but how? Kepler was the first who saw the problem. ... The reason why nobody before him had asked the question is that nobody had thought of cosmological problems in terms of actual physical forces. So long as cosmology remained divorced from physical causation in the mind, *the right question could not occur* in that mind. ... "

The worldview in which Kepler matured was a medieval one influenced by the philosophy of Aristotle. *Aristotelianism* taught that one must look for the *purposes* of phenomena rather than their *natural causes*. **Divine revelation has much to say about God's purposes for the existence and workings of the natural world, but science can say little to nothing about ultimate purpose.** For example, science cannot really tell us why stars other than the sun exist. The idea that other stars support life on nearby habitable planets is merely a speculation without evidence so far. In contrast, biblical revelation says that God created stars to provide for certain needs of life *on the earth* (Genesis 1:14-18).

Under Aristotelianism, ancient Greek concepts of purpose, rather than biblical statements, were consulted. Before Kepler could begin investigating the solar system with a modern focus on *causation* instead of *purpose*, he broke free of Aristotelian thought. This was a staggering change in worldview. As Keostler (1960, p. 61) commented, "*Post factum* …it is always difficult to appreciate the originality and imagination it

required to ask a question which had not been asked before." The reason this is so is that we are all immersed in our worldview from birth, and much of it is held *subconsciously*. It is rare for a person to change worldviews, as Kepler did, because **one's worldview seems naturally the only right way to think about the universe.**

Even so, Romans 12:1-2 calls on Christians to experience a *continuous, lifelong transformation* to a biblical worldview. **This worldview transformation in the life of the Christian is part of the process called *sanctification*.** Some believers progress further in this transformation than others. This is why some Christians remain enmeshed in elements of a non-biblical worldview, with worldly patterns of money management, humanistic responses to anger, or evolutionary origins views, for example.

Subconcious or not, one's world-view influences the conclusions one makes about the meaning of observations. **Observations always must be interpreted to make conclusions about their meaning.** In other words, "Any observation has to be interpreted and can only be interpreted within the framework of theory [world-view], even if that theory consists of nothing more than the prejudices that make up common sense" (Harwit, 1982, pp. 431-432).

Total personal transformation from one worldview to another may be rare, but **cultures regularly pass through slow but steady shifts in worldview.** A cultural shift in worldview, a *paradigm shift*, signifies a change in the mores accepted as valid by most of the culture. Many in Western culture – the culture of mainly Europe and the Americas – intuitively sense that Western culture has experienced a paradigm shift in recent decades. This shift can arguably be traced back to the cultural acceptance of evolution in the 1800s. Before this, the dominant Western view of origins was creation, and since then, evolution has dominated Western views on origins. **But origins concepts such as evolution shape the way we think about much of life beyond the mere beginning of things.**

Evolution is a random process with no predictable future. If evolution is true, the concept of a Creator *predictably preserving* His earth (Isaiah 45:18) cannot be true, so public policy makers must fear for every potential upset in the earth's environment lest an unpredictable and disastrous turn in terrestrial events doom the human race. *Fear reigns rather than trust in God*. Man is only another evolving animal with no special sanctity of life, so life becomes cheap with abortion and euthanasia being widely practiced. *Death reigns rather than a love for life*. Even the nature of existence itself becomes debatable, a point elaborated below. *Uncertainty reigns*. The Western paradigm shift driven at least partly by the rise of evolution has led to a surfeit of *fear*, *death* and *uncertainty*.[1] But one committed to evolution can dismiss this turn of events as at least preferable to the "repressive" Victorian mores once existing.[2,3]

Before the rise of evolution in the West, existence was thought to be characterized by things originating from the spoken word of the Creator with an *independent, objective* existence. But the rise of evolution changed the answer to the question, "If a tree falls in the forest, does it make a sound?" The pre-evolutionary answer would have been *Yes*. As an independent thing with an objective existence, the tree would make a sound even if no one were there to hear it fall. The fall of the tree did not require an "observer" to be heard.

But after evolution, there was no Creator, and thus no reason to assume that any thing exists independently of any other thing in the universe. Evolution teaches that all life came from the same cell and is therefore related, and according to cosmic evolution, all matter and energy had one "beginning," generally now taken to have been the Big Bang. Thus life, and matter and energy in general, have common origins and so are possibly *by nature* intertwined in other ways. In this view, maybe every thing in the universe affects every other thing, even if only a little. All the planets exert some gravitational force on the earth, and the earth in turn pulls on them. Is any thing really independent of any other? The answer post-evolution was *No*. The falling tree would make a sound only if someone – an "observer" – were present to hear it fall.

True, "No man is an island," but a total interconnectedness of all things does not exist. **Things can and do relate to each other, but this does not destroy their individual existence.** We know this from revelation, not from science. On the other hand, the ability of science to study things with apparently objective existences suggests that the post-evolutionary view of existence is false. And the rise of the interconnectedness concept has not been a good thing, even according to some evolutionists, such as the late physicist Herbert Dingle (1972, p. 117):

"I do not think it can be seriously entertained that the whole body of physical scientists has, within a generation or two, bargained its soul, Faust-like, for unworthy ends. ... I have no doubt at all that the great majority of physical scientists are genuinely unaware that they are not acting according to the strict requirements of their calling. How, then, can they behave as they do?"

The answer to Dingle's question is that **scientists, like any other people, adopt erroneous ideas if their worldview is flawed.**

This is because **one's interpretation of observations depends on one's worldview.** John 12:28-29 records the *divergence of interpretations* about events in the life of Jesus among people of different worldviews. Creationist Donald Chittick (1984, p. 30) explains that this passage begins with Jesus exclaiming: " 'Father, glorify your name!' Then a voice came from heaven, 'I have glorified it, and will glorify it again.' The crowd that was there and heard it said it thundered; other said an angel had spoken to him. In this instance a specific event is listed. After Jesus prayed, sound was heard from the heavens. Those who made the assumption that a Creator can act perceived a communication in the form of words. On the other hand, those who made the assumption that nothing supernatural was

involved concluded that the noise was thunder. They drew a naturalistic conclusion and tried to find a naturalistic explanation for the noise. ... The two groups of people had the same facts available to them. They agreed that something happened - a noise came from the heavens. Their conclusions about it, however, were quite different and depended on the assumptions they held."

Evolutionists Hammond and Margulis (1981, p. 56) also recognize that interpretations of observations depend on worldview, but their preference is for the evolutionary one:

"If chimpanzees were created independently from people, why do they have a common biochemistry down to such exquisite details as the amino acid sequence of particular proteins? For example, cytochrome c, a protein involved in cell metabolic processes, is identical in chimp and man. ... The genetic code itself is the same for all known forms of life. The nucleotides that form the four letters of the code could easily have been different from one species to another, but they are not. **A coincidence of special creation, or evidence of common origin?"**

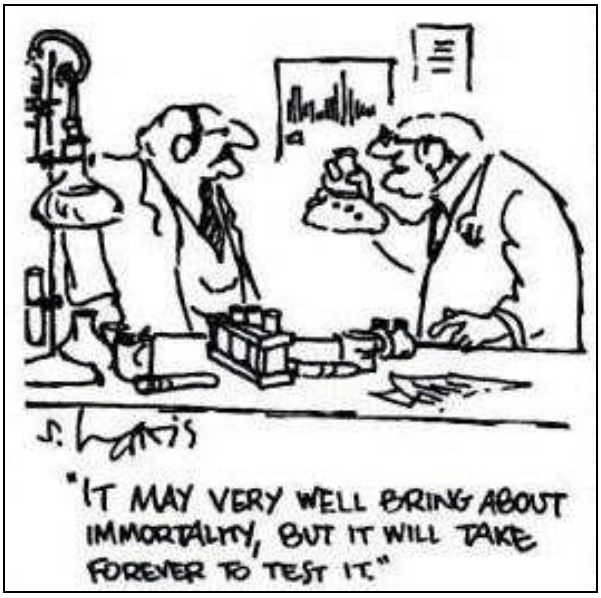
II. Valid Types of (Scientific) Reasoning

A. Inductive Reasoning

Inductive reasoning uses specific examples to draw general conclusions. The conclusions may be hypotheses, theories, or laws. **Induction is the classical "scientific method."**

Induction places experiments (observations) *above* conclusions (hypotheses, theories, laws). **With induction, the theory should be made to fit the facts, rather than making the facts fit the theory.** As Isaac Newton (1979, p. 404) wrote, "The investigation of difficult Things by the Method of Analysis [inductive reasoning] ought ever to precede the Method of Composition [deduction; discussed below]. This Analysis consists in making Experiments and Observations, and of admitting of no Objections against the Conclusions, but such as are taken from Experiments, or other certain truths. For Hypotheses are not to be regarded in Experimental Philosophy [science]."

But inductive reasoning has limits. Drawing *totally* correct conclusions all the time from experiments would require perfect perception and no prejudices. Further, making *totally* correct generalities would require observations (experiments) at all times and places. That is, the investigator must be *eternal* and *omnipresent* or at least there must be a perfectly preserved compilation of observations among many investigators spanning all points in space at all times. **But only God has eternality and omnipresence, so only God can make absolutely true statements.** To the extent that Scripture speaks to physical topics, we have certain knowledge *via revelation* which inductive reasoning can never acquire. For example, inductive reasoning can show that the laws of thermodynamics *appear* to be true. But only revelation can certify these laws as absolutely true, as in passages such as Genesis 2:1 and Ecclesiastes 3:14.[4]



A Limitation of Inductive Reasoning: We Are Not Eternal

In other words, **inductive reasoning cannot find absolute truth.** The belief that science can find truth is actually an empty hope, as Nobel Laureate Peter Medawar explained: "In the early days of science [after the Reformation], it was believed that the truth lay all around us - was there for the taking - waiting, like a crop or corn, only to be harvested and gathered in. The truth would make itself known to us if only we would *observe* nature with that wide-eyed and innocent perceptiveness that mankind is thought to have possessed in those Arcadian days before the Fall - before our senses became dulled by prejudice and sin. Thus the truth is there for the taking if only we can part the veil of prejudice and preconception and *observe things as they really are*. ... Only be experimenting in this fashion can we build up that majestic pile of factual information from which ... our understanding of the natural world will necessarily grow" (Medawar, 1979, p. 70).

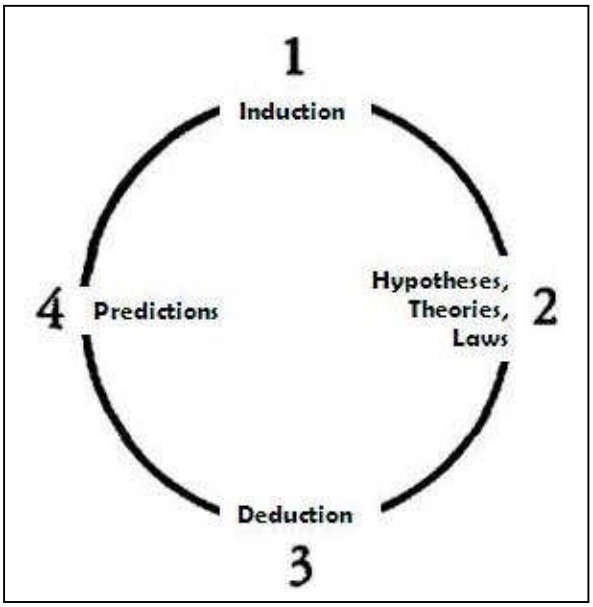
Saying we can construct *totally* correct generalities by induction is the same as saying we can discover absolute truth by scientific investigation. This is impossible.

B. Deductive Reasoning

Deductive reasoning uses general statements (hypotheses, theories, laws) to make specific conclusions (predictions). **The need for deduction stems from the limitations of induction.** In the words of science writer Timothy Ferris (1981, p. 71),

"Induction argues for keeping your eyes open, for remembering, as Francis Bacon put it, that 'the subtlety of nature is vastly superior to that of argument.' To many, this is the ideal working method - to accumulate cold facts from observation and experiment conducted in a dispassionate state of mind and only as a last step to fashion the data into theory. But pure induction has its limits. The world is so full of data that no one can hope to understand through experience alone. ... [A]stronomers are confronted with a universe so prodigal

that galaxies crowd the photographic plate lie grains of sand on a beach; to keep your eyes open to everything would be more dazzling than gazing at the sun. If induction is the right hand of science, its left hand is the creation of a theory from which deductions can be made." In other words, **induction and deduction are related,** as shown in the diagram below.



Induction Must Have Priority Over Deduction

But induction *must* have priority over deduction. Further, a predicted result obtained by deduction *must* match observations, or the deduction is false. In short, **deduction cannot stand alone; induction must have preceded it.**

The danger of deduction is the deception of believing that one's theories are *reality*. Addressing this danger, Einstein wrote, "To him who is a discoverer in this field the products of his imagination appear so necessary and natural that he regards them and would like to have them regarded by others, not as creations of the mind, but as given realities" (Bernstein, 1973, pp. 173-174).

As long as the investigator is aware of this danger, he can rely on hunches about a theory's correctness to weed out observations that he feels may not be valid. Jeremy Bernstein, an Einstein biographer, for example, claimed that Einstein "was able, because of his intuition about general principle, to sort out experimental results he felt [i.e., believed] must be correct from the rest, which he more or less ignored." (Bernstein, 1973, p. 187)

But there is also the danger of rejecting data that *disagree* with theoretical predictions. "As physicist Murray Gell-Mann [said], 'Frequently a theorist will even *throw out* a lot of the data on the grounds that if they don't fit an elegant scheme they're wrong.' ... Said Crick, 'When we confront problems today, we're in exactly the same situation. We have three or four bits of data; we don't know which one is reliable, so we say, now, if we discard that one and assume it's wrong - even though we have no evidence it's wrong - then we can look at the rest of the data and see if we can make sense of that. **And that's what we do *all the time*.** The ... ideal of the scientist as creative artist can lead to disaster if pushed too far" (Ferris, 1981, p. 72).

Aside from our lack of eternality and omniscience, there are other limits on valid experimentation. Some of these limits are imposed by biblical revelation. For example, experiments must not violate the sacredness of human life. But as the Western paradigm slides into an evolutionary-driven worldview continues, this limit is disregarded more and more:

"Many researchers today continue to demand that more studies ... be done on pregnant humans. Not satisfied with the wealth of supporting evidence from animal experiments conducted over the past fifty years, they propose studying the effects of drug therapy, protein restriction, mineral restriction, etc. - all for the purpose of 'seeing what will happen!' Their demands for 'control' and 'experimental' groups of pregnant mothers is clearly inhumane. ... Persisting in subjecting more pregnant women and their unborn to hazardous deprivation experiments, or refusing to improve the diets of 'control' mothers known to be suffering malnutritional deficiencies in their daily diets, is criminal. Because of mounting criticism of such projects from a few lone voices in the scientific community and the public at large, many American researchers associated with prestigious universities and international health agencies have moved their projects out of this country. A baby who dies or is damaged in Guatemala provokes less outcry than one whose life is taken in Boston." (Brewer and Brewer, 1977, p. 27)

Experimentation must also make use of available biblical revelation. The mathematician Leonard Euler (1802, p. 74) wrote, " ... [I]n our researches into the phenomena of this visible world ... how wretched must we have been had God left us to ourselves with respect to things invisible ... [A] Revelation was absolutely necessary to us; and we ought to avail ourselves of it with the most profound veneration."

We need revelation because **some questions are not answerable by experimentation, and attempting to search for their answers by the scientific method is futile.** Two such questions are the origin of consciousness, and the origin of the cosmos. As evolutionist Dietrick Thomsen (1984, p. 124) surprisingly observed:

" 'There are two problems rooted in science but inassimilable as science, consciousness and cosmology.' ... Objections will be raised by those who want to insist that the material universe is all the reality there is. Materialism of this kind is a doctrine that anyone may choose as a working hypothesis or as a religion, but I am unaware of a proof of it. On the contrary, the scientific method, which was designed on a basis of materialism in a deliberate attempt to exclude nonmaterial considerations, has led other prominent scientists, from Newton and Galileo on down, to conclude that there were problems 'rooted in science but inassimilable as science'."

Most people intuitively understand that **a correct theory will always yield a correct prediction** (its deductive result will always be true). But most people also believe that a false theory will always make false predictions. ***This is not true.***

Contrary to what most people believe, ***a wrong theory can also make a correct prediction*** (deductions from it may also be true). This means that **a correct deduction does not confirm the truth of a theory;** it simply makes the theory more certain, and **the theory can still be disproved by just one violation.** In other words,

"A true prediction may be derived from a false hypothesis as well as from a true one. Thus **true predictions do not constitute proof of the truth of a hypothesis.** ... *A true hypothesis can never give rise to a false conclusion*. In other words, predictions derived from a true hypothesis should never lead to contradictions. ... Also ... we can never *prove* that an hypothesis is true. For, while a true hypothesis always gives rise to true predictions, *so also may a false hypothesis*. The importance of this last fact cannot be overemphasized, for it shows that science can only deals with its 'truths' in terms of probabilities, and never in terms of certainties. ...

"In the past, many false hypotheses have been held by scientists and laymen alike, simply because accurate predictions could be made from these hypotheses despite their falsity" (Baker and Allen, 1967, pp. 29, 31).

It is pleasing to believe that our ancestors stumbled over this fallacy and that we do not, but human discernment has not improved with time, and **false hypotheses are held to this day for the same reason.** The *phlogiston theory* was held for many decades in previous centuries because it made correct predictions about how things burn (Holmyard, 1931, pp. 152-144).[5] Evolution is constantly justified by appeal to true predictions it has made, a topic discussed below.

The fallacy of the scientific method is to believe that if a theory makes a true prediction, the theory itself must be true. Calling the prediction the *consequence*, and the theory the *antecedent*, this fallacy can be stated as follows:

THE FALLACY OF THE SCIENTIFIC METHOD
Thinking That the Occurrence of a Consequence Confirms the Antecedent

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But the expected consequences of a theory – the antecedent – do *not* confirm the theory. The negative of this fallacy is true and is perhaps one of the least recognized facts in science:

A FACT RECOGNIZED TOO SELDOM
The Occurrence of a Consequence Does NOT Confirm the Antecedent

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Since false theories can make the same prediction as the true theory, "Phenomena do not uniquely determine the theory. **There may be several theories that give reasonable agreement with experiment** [but only one, and maybe none, is correct]. .... Such theories may be formulated in terms of concepts. ... Because these concepts are to some extent 'free creations of the human mind' we do, to some extent, impose the creations of our minds onto the workings of nature. We make experiments to fit our descriptions of nature as often as the other way around" (Bernstein, 1973, pp. 19-20).

In other words, we cannot *know* – unless we are guided by revelation in the topics to which revelation speaks – which of several theories may be true, so **the one we prefer is determined by our worldview.**

We now consider some examples of this fallacy, starting with a humorous and obviously silly one. Suppose we theorize that "Shakespeare wrote the 46th Psalm." Such a theory might predict that this psalm would have internal evidence of Shakespeare's authorship. And in fact, the 46th word from the beginning of this psalm is "shake", and the 46th word from the end is "spear." According to the fallacy we have been discussing, this is reasonable internal evidence that the theory is correct, so the theory is proved: Shakespeare wrote Psalm 46! Of course this theory is preposterous, but how is reading the supposed "internal evidence" of evolution in living things any less ill-founded than the reasoning in this example?

Christopher Columbus figures in an example of this fallacy from history. **Before Columbus, it was commonly believed there was land west of Europe, but the basis for this belief was false:**

"During the Dark and Middle Ages there was much talk of land in or beyond the Atlantic Ocean, some based on fact and some on fancy. ... There was for instance the tale (which first appeared in the fifteenth century) of seven bishops who fled Spain with their flocks in 734 A.D., at the time of the Saracen conquest and, sailing westward, found an island on which they erected seven cities. This island was sometimes identified with the large rectangular island called Antilha, Antillia, or Antigla ('the counter-island') which appeared upon many pre-Columbian maps. Antilla corresponded so closely in size, shape, and direction with the real Cuba that when the latter and its neighbors were finally found they were promptly named the Antilles" (de Camp, 1970, p. 21).

In an example from modern science, extinct dinosaurs may well have been brightly colored (no one really knows what colors they had), but this belief is sometimes based on the false assumption of an evolutionary relationship between dinosaurs and birds: "Contemporary illustrators [of extinct dinosaurs] have started to use more vivid colors: mauve, oink, metallic blues and reds. While there is no direct physical evidence to show that dinosaurs were indeed colorful creatures, 'this makes a lot of sense,' says Bakker, 'because dinosaurs are closely related to birds. Colors were undoubtedly used, especially in the mating season" (Weisburd, 1986, p. 217).

Confirmation of consequences is routinely invoked to justify cosmic evolution. For example, outer space is filled with microwave radiation. Big Bang cosmology predicts the existence of similar radiation. So the eventual discovery of the microwave radiation in space is often cited as proof that the Big Bang occurred, as in the following:

"The Big Bang theory received remarkable confirmation with the discovery of the microwave background radiation in 1965 by Penzias and Wilson. It had been predicted by Alpher and Herman in 1948 that the hot fireball of the Big Bang should leave an 'echo', a glimmer of its former self, in the present-day Universe. They calculated that the expansion of the Universe should have cooled the heat radiation from the hot initial state down to a level ~5K or thereabouts by the present, some fifteen billion years after the initial 'Bang' " (Barrow and Tipler, 1986, p. 368). This statement overlooks the facts that (1) the radiation could result from any of a number of causes, not just the Big Bang; and (2) the radiation may not really have the properties predicted by Big Bang cosmology.[6]

Another justification of cosmic evolution is the fact that the universe contains mainly H and He, as predicted by Big Bang cosmology. A typical claim is that, "The other observational cornerstone of the Big Bang model is its successful prediction that the Universe should contain particular abundances of the lightest elements: hydrogen, deuterium, and helium. ... Detailed calculations predicted that the present Universe should contain about 75% of its mass in the form of hydrogen and 25% as helium-4 with about one part in a million ending up in the form of all the other elements. ... These predictions have been strikingly confirmed by observations. Even in sites where the heavy elements like carbon, produced locally by the stars, have anomalous abundances reflecting peculiarities in the local environment, the abundance of helium is universal, witnessing to its origin in the early stages of the Universe and also to the essential accuracy of our cosmological model" (Barrow and Tipler, 1986, pp. 368-369).

This statement overlooks the facts that (1) the H/He abundances could have a number of explanations besides the Big Bang; (2) heavy element abundances in stars *consistently* violate Big Bang predictions; and (3) in reality, **the H/He abundances were known before the Big Bang "prediction" was made,** and the calculations were done so that the "prediction" would match the observations (Henry, 2006b, pp. 55-56).

As another example of this fallacy in action, the planets may all have dense cores. The Big Bang model predicts this, but the Big Bang cosmology still is not proved by this prediction. The dense cores (1) could result from causes other than a Big Bang; and (2) upon close examination do not really match Big Bang predictions anyway; they all appear to be uniquely different, a feature which is more characteristic of special creation.[7]

IV. Invalid (Scientific) Reasoning: "Thought Experiments"

A *thought experiment* is supposed to be an exercise in imagination in which we rationalize a possible outcome under certain conditions. **But thought is not an experiment.** The phrase *thought experiment* is a blending of mutually exclusive concepts, an oxymoron.

Thought experiments are generally invalid in everyday life. The reasoning of a thought experiment runs something like, "I think such-and-such is happening from such-and-such a cause. Therefore, since I can imagine how it could be happening from this cause, it *must* be happening from this cause." Ordinarily this type of reasoning is labeled "jumping to conclusions," and in the study of logic is the logical fallacy *post hoc, ergo propter hoc* (after this, therefore because of this).

The apostle Paul condemned thought experiments in human relationships, and commends the use of love instead, though we may not understand why others act the way they do (1 Cor. 13:12, "For now we see through a glass, darkly; but then face to face: now I know in part; but then shall I know even as also I am known"). We can conduct thought experiments that convince us we have divined a person's motives, but Matthew 7:1 warns against such presumption. **Thought experiments are dangerous in human relationships.**

Thought experiments are also invalid substitutes for real experimentation in scientific work. The thought experiment was the common mode of reasoning among ancient pagan cultures, such as ancient Greece, the culture of Aristotle. After the Reformation, scientists in the 1600s rejected this type of reasoning. One was "Joseph Glanville, [who] in common with many of his contemporary Fellows of the Royal Society had the utmost contempt for Aristotle, whose teachings he regarded as major impediments to the advancement of learning. In *Plus Ultra* he wrote of such experiments thus: 'Aristotle ... did not use and employ Experiments for the erecting of his Theories: but having arbitrarily pitch'd his Theories, his manner was to for Experience to suffragate, and yield countenance to his precarious Propositions' " (Medawar, 1979, pp. 70-71). In other words, **Aristotle's mode of reasoning all too often was to make the facts fit his theories.**

Fruitless, useless thought experiments, known in the Dark Ages as *Scholasticism*, were abandoned as the Reformation began. People began to *observe* the physical creation, instead of merely *imagining* how it should operate. About this time Isaac Newton stated what is perhaps the most famous rejection of though experimentation. He wrote, "I frame no hypotheses" (i.e., my science is based only on observation, not on vain imagination about how the creation should operate"). (Anthony, 1961, p. 143)

A revival of thought experimentation occurred in the centuries following, during the Enlightenment. The philosopher Kant was an influential advocate of this revival. Medawar explains that due to Kant's influence, "There [were] thought experiment[s] ...; Kantian, I have called them in honour of the most breathtaking conceptual exploit in the history of philosophy: Kant's suggestion [was] that instead of acquiescing in the ordinary opinion that our sensory intuitions are patterned

by 'objects' - by that which is perceived [i.e., observations] - we should take the view that the world of experience is patterned by the character of our faculties of sensory perception. ... *A priori* knowledge - knowledge independent of all experience - can exist; he reasoned that both space and time are *forms* of sensory perception and as such are only 'conditions of the existence of things as appearances" (Medawar, 1979, p. 73)

In other words, according to Kant, "only my imaginings are real; an objective universe as a thing to be observed does not really exist." **Thus the human mind is exalted above all input from without.** In the late nineteenth century the physicist Minkowski took Kant's ideas to their logical conclusion.

"Minkowski went much further [than his predecessors]. 'I should like to show,' he says 'how it might be possible setting out from the accepted mechanisms of the present day, along a purely mathematical [non-observational] line of thought, to arrive at changed ideas of space and time.' ... **The return to medieval Scholasticism, against which the protest of Bacon and the other pioneers of modern science was thought to have been finally successful, was now complete.** With Minkowski's work physics had escaped from experiment and had been captured by mathematics [i.e., theoreticians]" (Dingle, 1972, pp. 170-171).

By Einstein's time, the revival of the thought experiment was complete. Einstein claimed that a reliance on thought or reason, as opposed to observation, is good: "We now know that science cannot grow out of empiricism alone, that in the constructions of science we need to use free invention which only *a posteriori* can be confronted with experience as to its usefulness. This fact could elude earlier generations, to whom theoretical creation seemed to grow inductively out of empiricism without the creative influence of a free construction of concepts. The more primitive the status of science the more readily can the scientist live under the illusion that he is a pure empiricist. In the nineteenth century, many still believed Newton's fundamental rule 'hypotheses non fingo' should underlie all healthy natural science" (Pais, 1982, p. 14).

Einstein also claimed that physical reality can be known through thought alone, *without experimentation*: "Our experience hitherto justified us in believing that nature is the realization of the simplest conceivable mathematical ideas. I am convinced that we can discover, by means of purely mathematical constructions, those concepts and those lawful connections between them which furnish the key to the understanding of natural phenomena. Experience may suggest the appropriate mathematical concepts, but they most certainly cannot be deduced from it. Experience remains, of course, the sole criterion of physical utility of a mathematical construction. But the creative principle resides in mathematics. In a certain sense, therefore, **I hold it true that pure thought can grasp [physical] reality, as the ancients dreamed"** (Bernstein, 1973, pp. 126-127). One of Einstein's biographers noted, "But Einstein refuses to let the 'facts' decide the matter. ... This is the characteristic position - the crucial difference between Einstein and those who make the correspondence with experimental fact the chief deciding factor for or against a theory. ..." (Bernstein, 1973, pp. 96-97)

Einstein's thought-experiment approach is used in evaluating relativity theory today: The claim has been made that, "Starting from the two postulates [of relativity], Einstein derived a number of interesting but strange results. ... We shall examine these consequences of Einstein's theory. ... Indeed, we will use a technique that Einstein himself used: **we will imagine very simple ... situations. ... In this way we can see what the consequences of relativity theory are ..."** (Giancolli, 1980, p. 627). This kind of thinking overlooks the possibility that physical reality might not conform to what we suppose to be true.

In modern cosmology, the science is also inverted, with facts (observations) being forced to fit theory, instead of theory fitting facts. Astronomer Martin Harwit approvingly remarks, "We can approach the problem [of building theories] in two distinct ways. The first is the observational approach. We attempt to observed what the universe is 'really' like. The other approach is synthetic. We construct hypothetical models of the universe and see how the observations fit the models. The second procedure might at first glance seem superfluous. **It might seem that all we need are observations. That is not so!"** (Harwit, 1982, p. 431).

As a result of thought experimentation, the universe is assumed to conform to a Big Bang cosmology, despite the fact that the Big Bang model cannot possibly be proved. Trefil (1983, p. 183) acknowledges the lack of observational confirmation of the Big Bang when he writes:

"The early history of the Big Bang ... has most of the attributes we expect of a great scientific theory. it is beautiful, elegant, and intellectually satisfying, and it gives us insights into the workings of nature that no previous theory has been able to provide. Only one ingredient is missing from this list of attributes. **We demand that every scientific theory be buttressed by a mass of direct experimental confirmation, and there is precious little of that in what we have been discussing."**

But in Trefil's view this is not really a problem after all. He continues, " ... That this should be the case is not surprising. We have seen that the most crucial period in the early universe - the one that determined much of the later course of evolution - was ... 10^{-35} second after the Big Bang. The collision energies characteristic of that time were so high that there is no chance that we can produce them in our laboratories. Consequently, we are prevented from performing direct laboratory tests of the processes. ... **The classical sequence of prediction, direct test, and confirmation to which physicists are accustomed simply cannot be done in this case"** (Trefil, 1983, p. 183).

The mentality that thought experiments can replace observation has produced the belief that theory does not require observational confirmation if one can imagine thought experiments predicting it. This is not science but philosophy.

Not only is the Big Bang routinely assumed, but then observations are interpreted by it, and the possibility of doing this is then used as "proof" that there was a Big Bang. **The framing of interpretations themselves becomes a kind of thought experiment.** Trefil approvingly describes this thought process:

"From .001 second back to the moment of creation ... the temperatures involved are so high, and the particle energies so large, that we cannot reproduce them in the laboratory. ... Consequently, .001- second marks a point of major change in our thinking about the processes following the Big Bang. From now on, we will be exploring a world so strange and unfamiliar that our only guide will be our theoretical ideas about the behavior of matter and energy. ... The theories we develop will give us a very definite picture of the behavior of matter and energy at high energies. ... In this way, **we can test the theories without having to reproduce the actual conditions of the early universe in our laboratories"** (Trefil, 1983, p. 32).

Likewise, with the Big Bang theorized as fact, then galaxy formation is "explained" by it; the possibility of doing this is taken to prove that evolutionary philosophy can explain the formation of galaxies:

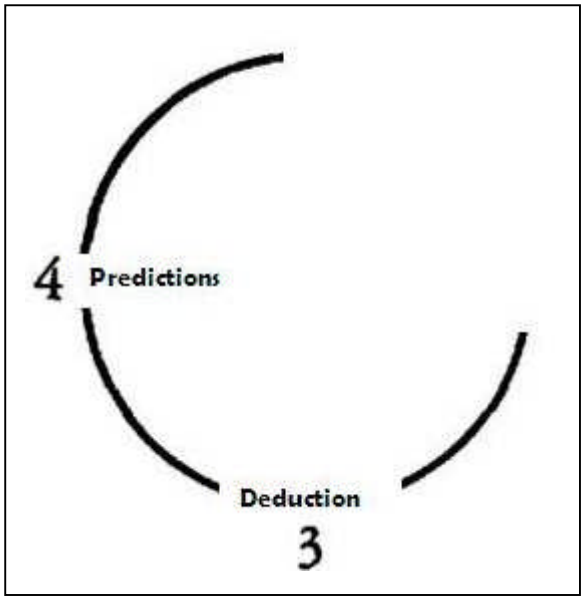
"These studies show that it is theoretically possible that defects formed during the [condensation of the nebula] ... would ... be just massive enough ... to start the condensation of the galaxies. ... The galaxy formation problem, like the antimatter problem, is solved by a better understanding of the behavior of the universe during its first 10^{-35} second of life. ...

"There is an important lesson from this result, not just for physics but for science in general. Since the early 1970's there has been a resurgence of biblical creationism in the United States. Going under the name *creation science*, this movement has produced a large body of arguments about the failings of evolutionary theory. These arguments have not been restricted to criticisms of Darwin but have been expanded to include the whole concept of the evolutionary universe as well. An important element in their argument has been the failure of conventional cosmology to solve the problem of galaxy formation.

"However, **we have seen that galaxy formation is no longer a problem at all but simply one more natural phenomenon with a perfectly natural explanation.** The creationist argument fails because it tacitly assumes that if a process cannot be explained now, it will never be explained in the future" (Trefil, 1983, pp. 177-178).

But the conclusion that galaxy formation is no longer a problem for evolution is simply not true. "There are still many unanswered questions with the theory that galaxies arose from gravitational instabilities. Theoreticians can't even agree whether individual galaxies formed first and later combined into clusters, or whether clusters of galaxies formed first, with individual galaxies condensing out of the larger bodies" (Pasachoff, 1985, p. 269).

Coming back to earth, as a result of thought experimentation, magnetic monopoles are intricately described *in the present tense* though none has ever been observed: "Grand unified gauge theories predict that very massive, stable magnetic monopoles should exist. ... The monopole mass ... is ~10^{-8} gm. Monopoles are not point-like particles as we imagine quarks and leptons to be. Rather, they possess a nested internal structure resembling a series of Chinese boxes" (Barrow and Tipler, 1986, p. 655). **With thought experiments, imaginary concepts – even those not liable to eventual observation – can seem real.**



Thought Experiments: Only Part of the Scientific Method

Thought experimentation is the deductive portion of the scientific method, with the inductive process missing (*above*). Yet as mentioned, the inductive process must have priority for the scientific method to function. The modern revival of thought experimentation is a re-emergence of the stagnating reliance on human reasoning practiced by Aristotle and other ancient pagan philosophers. In cosmology, for instance, not only the Big Bang but other concepts such as the so-called *missing mass* cannot be observed. **Cosmological observations are said to imply the existence of these un-observables, but this claim is merely a re-wording of the fallacy discussed in the previous section, that the Occurrence of a Consequence Confirms the Antecedent.** This is not an auspicious development, according to creationists Susher and Ramirez (1984, pp. 80-81):

"In modern-day cosmology ... the universe is no longer the observable world that for so long was the object of astronomical study but a hypothetical entity of which we can observe is almost a negligible part. The assertions many cosmologists make about it seem rarely susceptible of test since they would require much time into the past and are obviously beyond any practical test. ...

"Modern cosmology ... seems nothing but a fantasy of mathematicians who find it agreeable that the world should be made in this way. We should abandon Aristotle's approach to the study of the cosmos, forsaking mathematical artifice, and develop a cosmology based on observation."

Conclusions. The scientific method is a valuable tool for giving us *ways of thinking about* the abundance of data in the physical world.[8] But the scientific method does not guide us into truth. This is because it is limited, and is liable to misuse in the minds of fallible human beings. A *limit* of the scientific method is that no person or persons can collect data at all times and places, because no human is eternal or omniscient.[9] A *danger* of the scientific method is believing that our hypotheses, theories, or laws must be true. The *fallacy* of the scientific method is believing that occurrence of the consequence confirms the antecedent. The scientific investigator must remember that no matter how many times the predictions of a hypothesis, theory or law may be confirmed by physical observation, there is always the possibility of disproof.

A related topic not considered in this paper is that although the scientific method may indicate that a hypothesis, theory or law – a scientific *model* – is false, scientific models *can be* and *are* buttressed by *ad hoc assumptions* framed by their advocates to preserve the viability of such models (Henry, 2009a, p. 4-15). This means that **even though the scientific method is supposed to lead to disproof of false models, this may not be permitted to happen in practice.** Science and the scientific method *alone* cannot *force* the acknowledgement that a model has been falsified. A model can only be labeled superior or inferior depending on the extent of the ad hoc assumptions needed to make the model agree with otherwise contradictory observations. For example, evolution continues to be advocated though a straightforward application of the scientific method has repeatedly disproved it. But through the use of ad hoc assumptions,[10] its apparent viability has been maintained, at least in the minds of its believers.

Only revelation from God can guide us away from falsehood and into truth. For example, we know that creation is true, not because it can be proved by the scientific method, but because biblical revelation says so. To prevent straying into falsehood, the scientific community – and our culture at large - must consult biblical revelation *first*, and the scientific method *second*.

Notes

1 The abortion holocaust has resulted in some 2 billion pre-born babies being sacrificed since the end of World War II, a development linked with the rise of evolution in the West (Henry, 2007, p. 6).

2 Historian Gertrude Himmelfarb (1994, pp. 15-16) criticized "the popular conception of Victorianism as obsessively puritanical. 'Victorian virtues' conjures up images of piano legs modestly sheathed in pantaloons, table legs (as well as human legs) referred to as 'limbs,' and books by men and women authors dwelling chastely on separate shelves in country-house libraries – all of which were thought to exemplify the repressive, inhibited view of sexuality that is presumed to be typically Victorian. In fact, these and other niceties of taste were not the normal (or even abnormal) practices of real Victorians but were as often as not the inventions of satirists, foisted by the English on gullible Americans and perpetuated by unwary historians."

In contrast to the modern Victorian stereotype, the "overwhelming testimony of workers" then was that work was "was essential to their self-respect," and "children shared this work ethic." The number of very poor shrank as the Victorian century progressed so as to be no longer "a major social problem. … Drunkenness, so far from being a major social problem in the last decades of the century, had become a much less pressing one" and "there had been a substantial decrease of crime in every category …" The proportion of unstable families declined over the century, and the single-parent family "was not a serious problem" (Himmelfarb, 1994, pp. 35-42). The typical marriage, contrary to stereotype, appears to have been relatively happy and intimate, and the typical childhood was pleasant with "[r]arely … a complaint about overdiscipline, overwork, cruelty, or repression …" (Himmelfarb, 1994, pp. 75-76, 80).

3 A cultural paradigm shift occurs slowly and may require centuries for completion. During the transition, vestiges of the previously dominant worldview survive. For example, Christmas is still celebrated in the West though with less and less understanding of its significance as the years pass. But even avowed atheists such as Richard Dawkins participate in Christmas observances (Aaronovitch, 2007, paragraph 1).

4 By saying that the earth and cosmos were *finished* after the six days of creation in Genesis 1, Genesis 2:1 amounts to a statement of the *Law of Conservation of Matter and Energy* ("Matter and energy can be neither created nor destroyed"), otherwise known as the *First Law of Thermodynamics*. By claiming that "whatsoever God doeth … nothing can be put to it, nor any thing taken from it," Ecclesiastes 3:14 expresses the same principle. The curse on the ground (Genesis 3:17-18), described in Romans 1:16-20 as bringing universal degradation and death (Henry, 2006a, pp. 161-165), has the same effect on physical systems as the steady cosmic increase in disorder or *entropy* recognized in the *Second Law of Thermodynamics*.

5 "For centuries combustion was regarded as a decomposition of the burning substance into its constituents" rather than a combination with oxygen (Holmyard, 1931, p. 144). One of the substances released came to be called *phlogiston*, and the phlogiston theory took on its final form in the hands of Becher (1669) and Stahl (1702), but "Becker's theory was only a re-expression of older ideas in language a little less vague" (Holmyard, 1931, p. 146). Even so, "[the] phlogiston theory … offered a rational explanation of the formation of metallic [oxides] and the reduction of the latter to metals: but it did more. Like every scientific theory worthy of the name it soon proved to be applicable to facts with which it first seemed completely unconnected, and by bringing them all to a common denominator it achieved the earliest great synthesis of chemical philosophy" (Holmyard, 1931, pp. 148-149). But Lavoisier launched an experimental attack on the theory and opinion decisively turned against it starting in 1785. Joseph Priestly, considered to have been the discoverer of oxygen, died a believer in phlogiston. "One of the last acts of his life (he died

in 1804) was to issue a *Defence of Phlogiston* …" (Holmyard, 1931, p. 211).

6 In fact the detailed properties of the radiation fail to match Big Bang theory predictions (Henry, 2006b, pp. 56-58).

7 Planetary cores may not exist in the outer planets (Hartmann, 1993, p. 249), and the presumption that they do is based more on expectations from evolutionary models of solar system development than on observation. "[T]he study of planetary interiors is laced with uncertainty and difficulties" (Hartmann, 1993, p. 249) because direct observation is impossible. But the evolutionary presumption is that all the planets began with cores. Then "[b]ecause the inner protoplanets had smaller masses and lesser distances from the sun, the solar heating left the inner planets almost totally lacking in hydrogen and helium. Instead of the great gas spheroids of the outer solar system, the inner planets consist of rock and metal" (Goldsmith, 1985, p. 382). The cores of the outer planets, according to this view, remain shrouded under inscrutably thick atmospheres. But available evidence suggests that Jupiter, for example, has no substantial core (Hubbard, 1984, pp. 264, 270).

8 Hypotheses, theories and laws are scientific *models*. A scientific model is not truth. It is only a way of *thinking* about the physical world, or a way of *visualizing* how it is that phenomena occur (Henry, 2009a, pp. 4-14 – 4-15). The phlogiston theory provided a way of thinking about how things burn, but it was false. Modern atomic theory provides a way of visualizing why the elements and atoms behave the way they do, but this is no guarantee that this visualization is true.

9 Henry (2008, pp 1-7 – 1-9) presents five limits or *weaknesses* of the scientific method (SM), as follows:

1. The SM cannot prevent mistakes in reasoning.
2. Our observations are always incomplete.
3. Even false theories can make true predictions.
4. The distinction between a hypothesis, theory or law is not always certain.
5. The SM cannot ensure that scientists are objective.

Item 2 is presented in the present paper as a *limit* of the SM. The present paper presents items 1 and 5 as a *danger* of the SM. Item 3 is discussed under the *fallacy* of the SM. Item 4 is not discussed here.

10 Henry (2009b, 6-2 – 6-10) presents five ad hoc assumptions employed in geological evolution; and six ad hoc assumptions utilized in astronomical evolution (Henry, 2009c, pp. 12-4 – 12-24).

References. Bolding in quotations is added.

Aaronovitch, D. 2007. In defence of hymn-singing atheists. *Times*. http://www.timesonline.co.uk/tol/comment/columnists/david_aaronovitch/article3075389.ece. December 20. Accessed February 12, 2009.

Anthony, H.D. 1961. *Sir Isaac Newton*. Collier, New York.

Baker, Jeffrey W., and Garland E. Allen. 1967. *The Study of Biology*. Addison-Wesley, Reading, Massachusetts.

Barrow, John D., and Frank J. Tipler. 1986. *The Anthropic Cosmological Principle*. Oxford, New York.

Bernstein, Jeremy. 1973. *Einstein*. Penguin, New York.

Brewer, Gail Sforza, and Tom Brewer. 1977. *What Every pregnant Woman Should Know: The Truth about Diet and Drugs in Pregnancy*. Random House, New York.

Calbreath, Donald E. 1980. The challenge of creationism: another point of view. *American Laboratory*. 12(11):10. November.

Chittick, Donald E. 1984. *The Controversy: Roots of the creation-Evolution Conflict*. Multnomah, Portland, Oregon.

De Camp, L. Sprague. 1970. *Lost Continents: The Atlantis Theme in History, Science, and Literature*. Dover, New York.

Dingle, Herbert. 1972. *Science at the Crossroads*. Martin Brian and O'Keeffe, London.

Euler, Leonard. 1802. *Letters of Euler on Different Subjects in Physics and Philosophy Addressed to a German Princess*. Vol. 1. Henry Hunter, translator. Murray and Highly, London.

Ferris, Timothy. 1981. The spectral messenger. *Science 81*. 2(8):66-72. October.

Giancolli, Douglas C. 1980. *Physics*. Prentice-Hall, Englewood Cliffs, New Jersey.

Goldsmith, Donald. 1985. *The Evolving Universe*. Benjamin-Cummings, San Francisco.

Hammond, Allen, and Lyn Margulis. 1981. Farewell to Newton, Einstein, Darwin ... *Science 81*. 2(10):55-57. December.

Hartmann, William K. 1993. *Moons and Planets*. Wadsworth, Belmont, California.

Harwit, Martin. 1982. *Astrophysical Concepts*. Concepts, Ithaca, New York.

Hein, Morris, and Susan Arena. 2004. *Foundations of College Chemistry*. Wiley, New York.

Henry, J. 2006a. Did death occur before the Fall?:a further critique of the progressive creationism of Hugh Ross. *Creation Research Society Quarterly*. 43:160-167. December.

Henry, J. 2006b. The elements of the universe point to creation: introduction to a critique of nucleosynthesis theory. *Journal of Creation*. 20(2):53-60. http://creation.com/images/pdfs/tj/j20_2/j20_2_53-60.pdf. Accessed November 5, 2009.

Henry, J. 2007. The deadly influence of evolutionary beliefs. http://creationconcepts.org/resources/DEADLY.pdf. Accessed November 5, 2009.

Henry, J. 2008. Chapter 1 - introduction to physical science. In *Physical Science*. Clearwater Christian College, Clearwater, Florida, pp. 1-1 – 1-15.

Henry, J. 2009a. Chapter 4 - flood geology, part 1. In *Earth Science*. Clearwater Christian College, Clearwater, Florida, pp. 4-1 – 4-15.

Henry, J. 2009b. Chapter 6 - flood geology, part 3. In *Earth Science*. Clearwater Christian College, Clearwater, Florida, pp. 6-1 – 6-15.

Henry, J. 2009c. Chapter 12 – astronomy, part 2. In *Earth Science*. Clearwater Christian College, Clearwater, Florida, pp. 12-1 – 12-30.

Himmelfarb, Gertrude. 1994. *The De-Moralization of Society*. Vintage/Random House, New York.

Holmyard, E.J. 1931. *Makers of Chemistry*. Oxford University.

Hubbard, William B. 1984. *Planetary Interiors*. Van Nostrand Reinhold, New York.

Koestler, Arthur. 1960. *The Watershed: A Biography of Johannes Kepler*. Anchor, Garden City, New York.

Medawar, P.B. 1979. *Advice to a Young Scientist*. Harper, New York.

Newton, Isaac. 1979. *Opticks*. Dover, New York. Reprint of 1730 edition.

Pais, Abraham. 1982. *'Subtle Is the Lord ...': The Science and the Life of Albert Einstein*. Oxford, New York.

Pasachoff, Jay M. 1985. *Contemporary Astronomy*. Saunders, Philadelphia.

Slusher, Harold S., and Francisco Ramirez. 1984. *The Motion of Mercury's perihelion: A Reevaluation of the Problem and Its Implications for Cosmology and Cosmogony*. Institute for Creation Research, El Cajon, California.

Thomsen, Dietrick E. 1984. A knowing universe seeking to be known. *Science News*. 123:124. February 19.

Trefil, James S. 1983. *The Moment of Creation: Big bang Physics from Before the First Millisecond to the Present Universe*. Scribner's, New York.

Weisburd, Stefi. 1986. Brushing up on dinosaurs. *Science News*. 130:216-218. October 4.

Young, Hugh D., and Roger A. Freedman. 2004. *Sears and Zemansky's University Physics*. Pearson/Addison-Wesley, San Francisco.