CHARLES LYELL, UNIFORMITARIANISM, AND INTERPRETIVE PRINCIPLES

by Owen Anderson

Abstract. I examine the development of Charles Lyell's principle of uniformity and its influence on the development of modern geology and biology and argue that distinguishing between philosophical starting points and empirical findings is essential for clarity in the discussion between science and religion. First, I explore Lyell's arguments against catastrophism and how these were both empirically and religiously motivated. I then consider how David Hume's empiricism, theory of causation, and rejection of miracles influenced Lyell. Using these insights, Lyell formulated his principle of uniformity, which he believed was based on current empirical findings, and rejected explanatory hypotheses that used the biblical Flood or other catastrophist accounts as violations of uniform causation and introductions of theological concepts into empirical science. I next examine the influence of Lyell's principle on Charles Darwin. Although Lyell opposed Darwinism for most of his life, Darwin relied heavily on Lyell, as is evidenced by references throughout *The Origin of Species*. I contend that the most important aspect of Lyell's principle for Darwin is that it makes natural evil (the struggle for survival) a process that has always been occurring rather than something introduced after the Fall as recorded in Genesis. Finally, I discuss the role that uniformity plays for Lyell, Darwin, and modern science as an interpretive principle rather than as an inference from empirical data, and I conclude by noting that keeping the distinction in mind between interpretive principles and empirical findings will help clarify debates between science and religion.

Keywords: catastrophism; causation; Charles Darwin; empiricism; David Hume; interpretive principles; Charles Lyell; miracles; natural evil; paradigms; principle of uniformity; uniformitarianism

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The principle of uniformity is one of, if not the, most influential interpretive axioms of the nineteenth century and today. Although it is central to Charles Darwin's theory of the origin of species, which dominates the study of nineteenth-century thought, it was articulated and made influential by Sir Charles Lyell in an attempt to better understand geology and to offer an alternative principle to those theories whose explanatory power relied on the Flood. Today this principle is such a deep part of the interpretive framework that it may seem hard to believe that it was ever controversial or debated. Much of the debate has centered on how the principle conflicts with scripture and therefore has been framed as a conflict between science and religion, but I contend that a more basic aspect of the debate is over philosophical starting points, or interpretive principles.[1] When the debate is framed as naturalism against the Bible it often reduces to table pounding. However, if it can be seen as a debate between starting points that play the same role in each respective system, clarity can be brought to the debate with the hope of movement toward agreement. In what follows I explain the principle of uniformity as developed by Lyell, consider its philosophical grounding in Humean empiricism and epistemological naturalism, and argue that, although Lyell himself may have believed in the theistic view of God, this principle raises questions about the role of God and natural evil in the world. By identifying the role that uniformitarianism has played in subsequent science and understanding its role as a nonempirical interpretive principle, I show how fideism can be avoided at the level of first principles.

Lyell developed his principle of uniformitarianism as an alternative to what he saw as overextended supernaturalism. Theories about supernatural forces operating in the world seem to disregard evidence or manipulate it to conform to a preconceived theory. Lyell argued that geological data should be interpreted in light of the forces that can be seen operating today (the principle of uniformity). Although the principle of uniformity appears to be empirical it actually is a principle about how to deal with empirical data which is not itself empirically verifiable.

A characteristic of science at Lyell's time is the placing of physical evidence as more certain than special revelation. This is in part because there was a question as to how we know whether something is special revelation. The wars of religion in Europe testified to the divisions about the content and meaning of special revelation. The continuing divisions between religious groups in Europe all the more emphasized the problem with coming to knowledge about the world through special revelation. In looking for a universal common ground philosophers and scientists increasingly emphasized empirical evidence from the material world. Unlike special revelation, which is not available to all and requires interpretation, it seemed that empirical evidence could be used as a common basis for knowledge claims because it is available to all and was thought to be self-evident.

Lyell worked within this context and sought to overcome what he saw as superstition and theological baggage.

He articulated the principle in the following manner: Uniformity meant "one uninterrupted succession of physical events, governed by the laws now in operation" (1989, 144). His purpose was to offer an alternative to the catastrophism[2] that was popular in the eighteenth century. His reasons for rejecting this theory were:

> We have seen that, during the progress of geology, there have been great fluctuations of opinion respecting the nature of the cause to which all former changes of the earth's surface are referable. The first observers conceived that the monuments which the geologist endeavours to decipher, relate to a period when the physical constitution of the earth differed entirely from the present, and that, even after the creation of living beings, there have been causes in action distinct in kind or degree from those now forming part of the economy of nature. These views have been gradually modified, and some of them entirely abandoned in proportion as observations have been multiplied, and signs of former mutations more skillfully interpreted. Many appearances, which for a long time were regarded as indicating mysterious and extraordinary agency, are finally recognized as the necessary result of *the laws now governing the material world*; and the discovery of this unlooked for conformity has induced some geologists to infer that there has *never been any interruption to the same uniform order of physical events*. The same assemblage of general cause, they conceive, may have been sufficient to produce, by their various combinations, the endless diversity of effects, of which the shell of the earth has preserved the memorials. (1989, 75)[3]

His thinking has been said to involve principles such as actualism, uniformity, and steady-state:

> First, he was an *actualist*: he wanted to explain past geological phenomena in terms of causes of the kind that are operating at present. Second, he was a *uniformitarian*: he wanted to explain only in terms of causes of the degree operating at present; that is, he wanted to avoid "catastrophes." Third, as a geologist he saw the earth as being in a *steady-state*, in which all periods are essentially similar to one another. (Ruse 1976, 121)

Lyell makes force absolute and is willing to alter the time needed. It is possible to make time absolute and alter the force needed, or to suggest that given features of the world were not formed at all but were created. The uniformitarian appeals to great amounts of time and limited forces now observable. This seems to be more "scientific" because it appeals only to what is now observable. But if the uniformitarian wishes to make force absolute, why can't the catastrophist make time the absolute? "The uniformitarian feels free to call on unlimited *time* to explain phenomena; why then should the catastrophist not call on unlimited *force* to explain the phenomena?" (Ruse 1976, 129) To say that the uniformitarian is correct because his theory is empirical is to misunderstand the role of interpretive principles. The principle of uniformity cannot be empirically verified. This is similar to the mistake made by the logical positivists in claiming that all knowledge must be empirically verifiable—a claim that is itself not

empirically verifiable. Neither approach is discovered empirically but is instead an interpretive principle used to interpret whatever evidence is gathered.

Lyell was saying that the use of observable forces to explain origins is better than the use of catastrophes or what he considered supernaturalism. Some believe that consistency requires using only naturalist thought in all areas of knowledge if it is used to explain present phenomena:

> . . . believing Christians who are working in other scientific fields do not feel that they have to begin with the Bible's description of their subject matter and take those as the foundation of their work. In embryology, astronomy, meteorology, mineralogy, medicine, anatomy, and countless other fields, we applaud the work of those who diligently pursue their research and synthesize their findings into a reasonable model. We do not expect them to derive their conclusions from a reading of the Bible. So why should there be a double standard for fields such as geology, paleontology, and cosmology? (There shouldn't!) (Godfrey and Smith 2005, 192).

The difference, however, is that in these fields present forces can be observed, whereas the past cannot be observed. In projecting present forces into the past in order to explain origins, Lyell and others must leave the observable present and make claims about the unobservable past that are intestable. All that can be done is to ask: Is this how rock formations are currently produced? To project this into the past is to leave the observable.

With the increasing popularity of the principle of uniformity it becomes an unquestioned assumption that the universe was formed by forces now operating, which must be traced back as far as can be imagined. This is a trademark approach for the nineteenth-century cosmologists.[4] But it is cosmology and not empirical data collecting. The cosmological approach that says that the origin of the universe must be understood by projecting current forces and phenomena as far into the past as possible is one approach among many and not, as Lyell seemed to think, the pinnacle of Enlightenment and empirical data finding. Just as the Aristotelians gathered huge amounts of data and yet because of false interpretive principles drew false conclusions about the world, so any other "science" is only as good as its interpretive principles.

Lyell's argument in favor of naturalistic principles, specifically his uniformitarianism, is that the alternative is supernaturalism (used pejoratively). He believed that as humans progress they increasingly leave behind their superstition and adopt a view of secondary causes that is naturalistic.

> Whether we coincide or not in this doctrine, we must admit that the gradual progress of opinion concerning the succession of phenomena in remote eras, resembles in a singular manner that which accompanies the growing intelligence of every people, in regard to the economy of nature in modern times. In an early stage of advancement, when a great number of natural appearances are unintelligible, an eclipse, an earthquake, a flood, or the approach of a comet, with many other occurrences afterwards found to belong to the regular course of events, are

regarded as prodigies. The same delusion prevails as to moral phenomena, and many of these are ascribed to the intervention of demons, ghosts, witches, and other immaterial and supernatural agents. By degrees, many of the enigmas of the moral and physical world are explained, and, instead of being due to extrinsic and irregular causes, they are found to depend on fixed and invariable laws. The philosopher at last becomes convinced of the *undeviated uniformity* of secondary causes, and, guided by *his faith* in this principle, he determines the probability of accounts transmitted to him of former occurrences, and often rejects the fabulous tales of former ages, on the ground of their being irreconcilable with the experience of more enlightened ages. (1989, 76; emphases added)

Without discussing Lyell's personal beliefs about God (he seems to have been a theist, and opposed to deism), it can be affirmed that "Lyell had launched a comprehensive programme for the naturalistic explanation of all phenomena in the organic and inorganic worlds" (Bartholomew 1973, 269). He does seem to have objected to evolutionary theory on the grounds that it degraded the uniqueness of humans, and he held the position for some time that humans were uniquely created by God. But did Lyell find a universal principle that can be affirmed by all humans with the aim of obtaining knowledge, or is his project simply the worldview of naturalism claiming to be neutral and unbiased?

Keeping in mind the program of detaching geology from theology and superstition, Lyell also believed that recent discoveries (relative to his time period) demonstrated the truth of a slow, gradual formation of the geological strata.

A close comparison of the recent and fossil species, and the inferences drawn in regard to their habits, accustomed the geologist to contemplate the earth as having been at successive periods the dwelling place of animals and plants of different races, some of which were discovered to have been terrestrial and others aquatic—some fitted to live in seas, others in the waters of lakes and rivers. By the consideration of these topics, the mind was slowly and insensibly withdrawn from imaginary pictures of catastrophes and chaotic confusion, such as haunted the imagination of the early cosmogonists. Numerous proofs were discovered of the tranquil deposition of sedimentary matter and the slow development of organic life. (1989, 72)

What had been only a theory (uniformitarianism) was, Lyell believed, increasingly supported by empirical evidence.

It was necessary for supporters of this doctrine to take for granted incalculable periods of time, in order to explain the formation of sedimentary strata by causes now in diurnal action. The time which they required theoretically, is now granted, as it were, or has become absolutely requisite, to account for another class of phenomena brought to light by more recent investigations. It must always have been evident to unbiased minds, that successive strata, containing, in regular order of superposition, distinct beds of shells and corals, arranged in families as they grow at the bottom of the sea, could only have been formed by slow and insensible degrees in a great lapse of ages; yet, until organic remains were minutely examined and specifically determined, it was rarely possible to prove that the series of deposits met with in one country was not formed simultaneously with

that found in another. But we are now able to determine, in numerous instances, the relative dates of sedimentary rocks in distant regions, and to show, by their organic remains, that they were not of contemporary origin, but formed in succession. (1989, 87)

Lyell's principle requires a radical form of empiricism as developed by David Hume. Hume's invective against anything that appears to be metaphysical or theological has had immeasurable influence on the modern mind. He believed that there were only two sources of knowledge and ruled out the idea of special revelation.

When we run over libraries, persuaded of these principles, what havoc must we make? If we take in our hand any volume; of divinity or school metaphysics, for instance; let us ask, *Does it contain any abstract reasoning concerning quantity or number?* No. *Does it contain any experimental reasoning concerning matter of fact and existence?* No. Commit it then to the flames: for it can contain nothing but sophistry and illusion. (Hume 1902, 132)

Lyell's principle of uniformity is an application of this second source of knowledge—matter of fact or existence. Humans interact with the world, gaining empirical data, and then extend this to formulate laws about cause and effect.

Every idea is copied from some preceding impression or sentiment; and where we cannot find any impression, we may be certain that there is no idea. In all single instances of the operation of bodies or mind, there is nothing that produces any impression, nor consequently can suggest any idea of power or necessary connexion. But when many uniform instances appear, and the same object is always followed by the same event; we then begin to entertain the notion of cause and connexion. (Hume 1902, 61)

Through this process of empirical induction we arrive at the principle of uniformity. Any other explanation that relies on supernatural explanation is "sophistry and illusion."

The Flood, as an act of God, was a miracle rather than a natural or secondary cause. Hume's attack on miracles is well known. It was common in his day to use the existence of miracles to prove the truth of scripture and its claims about Christ or the existence of God. Often miracles were used by adherents of religious views that conflicted with other religious views also appealing to miracles, thus raising the question of how to arrive at universal agreement. Rather than pointing out that there is no necessary connection between the existence of a miracle and these conclusions, Hume undermines the possibility of knowing if there even was a miracle. His argument lays the groundwork for rejecting the Flood and instead projecting observable laws into the distant past to account for the origins of geological strata, life, planets, solar systems, stars, galaxies, and the universe itself.

Hume's argument against miracles foreshadows Lyell's argument in favor of uniformity. "A miracle is a violation of the laws of nature; and as a

firm and unalterable experience has established these laws, the proof against a miracle, from the very nature of the fact, is as entire as any argument from experience can possibly be imaged" (Hume 1902, 90). Belief in miracles as recorded in the Bible belongs to an age of superstition that people grow out of as they increasingly rely on naturalistic explanations.

> Our most holy religion is founded on *Faith*, not on reason; and it is a sure method of exposing it to put it to such a trial as it is, by no means, fitted to endure. To make this more evident, let us examine those miracles, related in scripture; and not to lose ourselves in too wide a field, let us confine ourselves to such as we find in the *Pentateuch*, which we shall examine, according to the principles of these pretended Christians, not as the word or testimony of God himself, but as the production of a mere human writer and historian. Here then we are first to consider a book, presented to us by a barbarous and ignorant people, written in an age when they were still more barbarous, and in all probability long after the facts which it relates, corroborated by no concurring testimony, and resembling those fabulous accounts, which every nation gives of its origin . . . we may conclude, that the *Christian Religion* not only was at first attended with miracles, but even at this day cannot be believed by any reasonable person without one. (Hume 1902, 100)

Hume allows for "faith," but we should not submit the articles of faith to the test of reason, which is a test such beliefs cannot survive. Here Hume has set religious belief and reason at odds. Because reason is universal, the Enlightenment project of overcoming divisions means that it must move beyond religious belief, which is subjective, divisive, and not verifiable. Lyell portrays a similar attitude in formulating his principle, which appeals only to observable phenomena that are, in theory, accessible by everyone.

Once the principle of uniformity has been adopted it cannot be limited to one area of science without becoming arbitrary. Darwin (among others) sought for a naturalistic explanation of the origin of the species. Throughout *The Origin of Species* he shows his indebtedness to Lyell and uniformitarianism:

> New species have appeared very slowly, one after another, both on the land and in the waters. Lyell has shown that it is hardly possible to resist the evidence in the case of the several tertiary stages; and every year tends to fill up the blanks between the stages, and to make the proportion between the lost and existing forms more gradual. (Darwin 1952, 167)

Darwin, like Lyell, relied on empirical discoveries in geology to support his view of the development of species.

> If we look to long enough intervals of time, geology plainly declares that species have all changed; and they have changed in the manner required by the theory, for they have changed slowly and in a gradual manner. We clearly see this in the fossil remains from consecutive formations invariably being much more closely related to each other, than are the fossils from widely separated formations. (1952, 233)

Darwin believed that an important obstacle to accepting the evolutionary origin of species was in the failure to see that long periods of time were involved in the formation of the world.

> The belief that species were immutable productions was almost unavoidable as long as the history of the world was thought to be of short duration; and now that we have acquired some idea of the lapse of time, we are too apt to assume, without proof, that the geological record is so perfect that it would have afforded us plain evidence of the mutation of species, if they had undergone mutation. (1952, 240)

One reason that Darwin gave for the difficulty in accepting changes over long periods of time is that it is hard to understand the steps involved in these changes.

> But the chief cause of our unwillingness to admit that one species has given birth to clear and distinct species, is that we are always slow in admitting great changes of which we do not see the steps. The difficulty is the same as that felt by so many geologists, when Lyell first insisted that long lines of inland cliffs had been formed, and great valleys excavated, by the agencies which we see still at work. The mind cannot possibly grasp the full meaning of the term of even a million years; it cannot add up and perceive the full effects of many slight variations, accumulated during an almost infinite number of generations. (1952, 240)

Darwinism appears to be so intertwined with uniformitarianism that it would be impossible divorce them.

Whereas Lyell sought to give an interpretive principle for use in geology that would avoid theological or superstitious baggage, Darwin sometimes appealed to the divine, or the "noble," as justification for his system. He believed that his theory gave a kind of nobility to life and was in accord with how God would work.

> To my mind it accords better with what we know of the laws impressed on matter by the Creator that the production and extinction of the past and present inhabitants of the world should have been due to secondary causes like those determining the birth and death of the individual. When I view all beings not as special creation, but as the lineal descendants of some few beings which lived long before the first bed of the Cambrian system was deposited, they seem to me to become ennobled. (1952, 242)[5]

Darwin used the principle of uniformity to reject the idea of a world-wide flood and also projected it into the future:

> As all the living forms of life are lineal descendents of those which lived long before the Cambrian epoch, we may feel certain that the ordinary succession by generation has never once been broken, and that no cataclysm has desolated the whole world. Hence we may look with some confidence to a secure future of great length. And as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection. (1952, 243)

This use of the principle of uniformity by Darwin—and which has become common sense in thought since Darwin—brings us to the way in which this principle views natural evil. Although Lyell analyzed catastrophist

theories from the perspective of superstition or theological baggage and instead sought to rely only on empirical evidence now observable, the extension of the principle of uniformity into the past to account for origins raises questions about the problem of natural evil. Darwin clearly extends uniformity to apply to natural evil as well as other observable phenomena:

> Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved. (1952, 243)

Uniformity claims that natural evil has always been part of the world and in the same degree as it is now.

Part of viewing evidence as common ground is the assumption that evidence does not need to be interpreted and that scientists are simply following the evidence while theologians and metaphysicians are imposing artificial restraints on the scientist's exploration and discovery. This concern applies to rationalists of all kinds, not merely to those engaged in theology. Some worldviews have minimized the material world to the extent of seeing it as a hindrance to knowing the eternal forms, or even as an illusion due to ignorance. Mathematicians can fall into this temptation, and it is even reported of such a renowned scientist as Einstein:

> Einstein, it seems, was only mildly interested in the eclipse that dazzled the rest of the world and provided such spectacular support for his theory. A few years earlier, he had written a personal letter saying he was "fully satisfied" with his theory of relativity on purely mathematical grounds—so much so, he wrote, that "I do not doubt any more the correctness of the whole system, *may the observation of the eclipse succeed or not*.". . . [A student asked] Einstein what he would have done had the results *not* confirmed his prediction. "Then I would have been sorry for the dear Lord," he replied. "The theory *is* correct." (Pearcey and Thaxton 1994, 184)

This concern about the dangers of rationalism proves the point being made that evidence must be interpreted. If one begins with the worldview that the material world is a shadow of the eternal forms, or an illusion due to ignorance, the physical sciences will not develop. What is necessary for the development of the physical sciences is the belief that the material world is real and that it follows laws that are knowable by the human mind. But this does not settle the matter of interpretation because both naturalists and theists (as well as deists) have maintained these presuppositions. The evidence is further interpreted in respect to the nature of the past and God's work in history. The naturalist maintains that presently observed forces must be projected indefinitely into the past to explain origins. The theist maintains that God can act in history in ways that have catastrophic impact on the formation of the earth. For the naturalist to

maintain that he or she is simply working with the evidence while the theist is importing theology is for the naturalist to ignore his or her own interpretive assumptions. The theist will maintain that the material world and its past cannot be entirely explained through secondary causes and that, although God has created these causes and endowed the human mind with the ability to know them, they do not exhaust what humans should know about the formation of the world (there is also the redemptive work of God in history). Neither of these interpretive principles can claim to be neutral or "just following the evidence where it leads."

Another aspect of using empirical evidence for common ground is that it is said to avoid theories based on the God-of-the-gaps approach. Practitioners of the empirical sciences wished to be free of theological interference and allowed to investigate all areas of the world and overcome gaps in knowledge that were being filled with appeals to the divine. While in itself this is an important step in gaining knowledge, it can encounter problems if it fails to note the difference between empirical gaps and logical gaps as well as the boundaries of the empirical. An empirical gap is an area where greater data and application of natural laws can render new knowledge. A logical gap is a question about the existence and origin of the data or the laws themselves. These cannot be invoked to explain their own existence without circular reasoning. Similarly, while scientists wished to be freed from theological baggage they then quickly began constructing theories that were not empirical. Allowing free empirical investigation is important, but so is the realization that theories that project currently observable forces into the past are intestable and not empirical.

How does the principle of uniformity apply to natural evil? Has natural evil always existed? Hume denied that natural evil was logically necessary, leaving open the possibility of a world without natural evil.

> Is the world, considered in general and as it appears to us in this life, different from what a man or such a limited being would, *beforehand*, expect from a very powerful, wise, and benevolent Deity? . . . None of them [natural evils] appear to human reason in the least degree necessary or unavoidable, nor can we suppose them such, without the utmost license of imagination. (Hume 1955, Part XI, 73)

Yet, as we saw earlier, Darwin considered the "war of nature" to be an indispensable part in his explanation of origins. As stated by Lyell the principle of uniformity means that natural evil must be projected back as having existed from the beginning. But theism asserts that God made the world very good, without evil (Genesis 1). This is a claim of special revelation but also a conclusion of natural theology. If God is perfect in power and goodness, God could and would make the world without evil.

This is why the problem of evil is such an important problem for theism. If evil is a necessary part of the world, it poses no problem. But if the world could have been made without evil, and God as perfect in goodness would want to make such a world, why wasn't the world made that way?

Theism has asserted that it was. In the beginning there was no evil. Again, this is both a claim found in special revelation and a conclusion of natural theology. Natural evil enters the world after moral evil. However, the principle of uniformity denies this and consequently must reject any view of God that requires that the original creation was very good.

It seems that the principle of uniformity is based on a misunderstanding of natural evil. By viewing instances of natural evil as divine interferences (the Flood) or "just part of life" (everyday instances of natural evil: toil, strife, old age, sickness, death), the principle minimizes the latter and rejects the former. The Flood as a divine interference is seen as an unnecessary act on the part of God that would override secondary causes set in place by God. Further, Hume, as quoted earlier, notes that miracles are impossible if we argue from empirical data to uniform laws. The Flood becomes a superstitious story told by "barbarous" people to explain natural phenomena they could not understand. Naturalism is viewed as the choice of the enlightened; but naturalism or superstition are not the only choices.

Lyell may have wished to follow Hume's advice and jettison any semblance of theology, but theology can be understood either as referring only to the study of special revelation or as also including natural theology. Can natural evil be incorporated in one's understanding of secondary causes, uniformity, and presently observable phenomena? The uniformity of natural evil is an important part of Darwinism. That gradual changes brought about by the struggle to survive produced all species presupposes that there has always been a struggle to survive. This cannot be true and it be the case that the original creation was without evil and that natural evil entered the world after moral evil. Darwinism requires that natural evil existed long before human beings were present to commit moral evil. Is the alternative a kind of overextended supernaturalism? It need not be. Instead, it could be maintained that natural evil, as one of the observable phenomena now operating, is a universal that is accessible to all and therefore can form the basis of common ground. The question is: What is the purpose of natural evil? One view says that it has always been a part of the world and accounts for variation of species. The other says that it was not original but instead was imposed by God for redemptive purposes.

Notice that what is at stake are two interpretive principles. Neither is empirical, but instead each is used to interpret the empirical evidence. The role of interpretive principles has led to hermeneutic skepticism among postmodern philosophers. Others who wish to reject this form of skepticism move to a fideistic affirmation of one principle or another. Lyell wanted to provide an interpretive principle and admitted that there was need for careful interpretation of the evidence. But the problem with interpretive principles is that they cannot be derived from evidence without circular reasoning. A careful examination of the fossil record, interpreted

as having been formed by forces now observable, gives one conclusion, while this same record interpreted as having been formed by forces not now observable provides a different conclusion. Both appeal to evidence, so to settle the matter it must be decided which interpretive method is to be used. Much discussion on this reduces to arguments over matters of taste. Some prefer one, some prefer the other. Preferences do not determine truth or reality, however. If there is to be movement toward agreement it must be done by first identifying the different principles and then examining them for consistency.

Noting that the principle of uniformity is not empirical and that it is only one among many interpretations of the empirical data does not prove that it is false. We must instead ask whether it can be applied consistently. Two problems with uniformitarianism as an interpretive principle raise questions about its consistency. First, if applied consistently to present observations there are evidences in favor of a catastrophism and its implications as well as uniformity. Second, the principle rejects any nonmaterial causation and yet if applied consistently requires something nonmaterial.

The first problem deals with whether or not the principle is being applied consistently. While some formations would require large amounts of time to form under the present forces (or the universe itself if it had started from an initial point and expanded/formed only under present forces), other indicators may suggest that time is shorter and the forces involved greater. The erosion levels of physical features, the kinds of gases in the atmosphere, the kinds and levels of chemicals in the ocean, the surface of the moon, and many other things are clocks that indicate short periods of time and catastrophic events that occurred to produce what is now observed. The principle of uniformity is applied when the question is how a rock formation developed, but it is not applied to ask why physical features that should be worn in various ways are not so aged. This is an inconsistency, and as such anomalies build up the desire for consistency will require thinkers to reexamine their interpretive principles.

The second problem is that if the principle of uniformity is applied consistently not only to the past but to the future, can it be maintained, as the naturalist does, that the universe is all that can be appealed to for explanation? As hot and cold interact they should eventually end in sameness (the heat death of the universe). If the universe has always existed it should already have ended in this state. The implication of its not being in this state is that the universe has not always existed. Oscillating-universe theories do not overcome the problem of eventual sameness. The only options remaining are that it began to exist from nonbeing as an uncaused event or that it was created. The naturalist rigorously insists that only presently observed phenomena be used to account for the past, but this insistence must also be applied to origins. The implication of the principle of uniformity is that if it is consistently applied it requires a belief that

there is more than what is empirically verifiable—either uncaused events or a creator.

The influence of the principle of uniformity cannot be overestimated. But such influence means that the theories based on this principle are only as good as the principle itself. If it turns out that the principle is impossible to hold consistently (it is impossible to hold that only the empirical can be appealed to as an explanation), the scientific theories that use it as their foundation are in trouble. Given the centuries of work based on Aristotelian interpretive principles that are so easily dismissed now, it should not be out of the question that the past two hundred years have been based on an equally incorrect interpretive principle and in need of correction.

A final consideration is necessary. Why not meld uniformitarianism with theism? Lyell seems to have believed it possible. The question is whether this can be done without compromising essential features of theism and uniformitarianism. It seems that in both cases one must be consistent with one's worldview. If naturalism is used as the interpretive principle, one cannot appeal to supernatural forces. If theism, one cannot assert both that God is perfect in goodness and power and that the original creation contained evil. The compromise position appears to be more like "open deism" in which God is finite and limited and does not interfere with the creation after the beginning. Any guidance of the evolutionary process by God would compromise the principle of uniformity.

If a given thinker wishes to maintain that God can and does operate in the world (as the Creator of secondary causes), it is no longer out of the question that catastrophic events imposed by God formed the geological world as now seen in a very short period of time. The theist can maintain both that secondary causes are orderly and can be studied to explain physical events now observed, and that God as their Creator is not bound by them in his interactions with the creation. The first such activity is God's imposing natural evil on the creation after the Fall. Such an act changes secondary causes and has a redemptive purpose. This change implies that presently observable phenomena cannot be projected into the past indefinitely and without modification. Similarly, the account of the Flood is a change in secondary causes with a redemptive purpose that interrupts a uniform projection from the present into the past. This does not involve theism in the overextended supernaturalism that Lyell rightly argues against because it involves (a) the originating of secondary causes in their governance of the world, including natural evil as a secondary cause with redemptive purposes, and (b) another aspect of secondary causes regarding God's redemptive work in history.

Lyell's principle of uniformity is arguably one of the most influential scientific theories of the nineteenth century. While discussion of Darwin dominates thinking about the nineteenth century (and the present),

Darwin's reliance on Lyell indicates the centrality of uniformity. By projecting currently observed phenomena—the struggle for survival—into the past, Darwin accounted for species. Other fields of natural science did the same for their respective subjects. I have argued here that while Lyell sought to overcome supernaturalism and any artificial boundaries set up by theology on empirical enquiry, the principle of uniformity is itself not empirical but instead seems to rely on a Humean epistemology. As an interpretive principle uniformity was shown to have problems of consistency in application to empirical data, which raises questions about its use. The alternative for theists (including Lyell) need not be a return to overextended supernaturalism and artificial boundaries on empirical investigation but an affirmation of secondary causes operating in the world, including secondary causes related to natural evil and the redemptive work of God.

Notes

1. Thomas Kuhn calls these "paradigms" in his *The Structure of Scientific Revolutions* (1996).
2. Catastrophists believe that the features of the earth's surface were formed through catastrophic events in the past. Note that not all forms of catastrophism rely solely or even partly on the Flood, and not all believe in a young earth.
3. The emphasis is mine. Notice that the italicized claim is not an empirical claim, although it is about how to understand empirical evidence.
4. Kelvin, assuming that the world began as a molten ball, tested the cooling rates of such objects in his laboratory and projected the age of the earth. Others refined this experiment and were more successful by uniformitarian standards. The obvious assumption is that the earth began as a molten ball and that its cooling was subject to the same forces as were present in Kelvin's laboratory.
5. Darwin did not consider that God's redemptive work in history might also follow the course of secondary causes; natural evil is imposed as a call back from moral evil; miracles as the increase or removal of natural evil are related to this redemptive work.

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