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Untangling Uniformitarianism, Level II: Actualism in Crisis

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Abstract

Uniformitarian geology has opposed biblical history for over two centuries. Most creationist critiques focus on contrary empirical evidence, but this series pursues a logical and axiomatic critique of the "four-definition" formulation of uniformitarianism. Three of these facets—stasis, gradualism, and generic uniformity—fail to support the concept. The remaining "uniformity of process," also called *actualism,* seems on the surface to work well, but can be addressed by seeking justification of its use as an axiom of natural history. Actualism rests on uniformity, and uniformity in turn on causal continuity. These concepts can be evaluated relative to the worldviews of Christianity and Naturalism by the truth test of coherence. Naturalism fails that test, but Christianity passes because causal continuity is coherent with—and only with—Christianity's God. As a theological issue, uniformity and actualism are best understood as physical expressions of divine providence. Since providence is distinct from God's acts of creation, actualism is irrelevant to that part of the rock record and its relevance to the Flood depends on the nature of divine action during that event.

Keywords: actualism, uniformitarianism, catastrophism, neocatastrophism, uniformity, causality

Introduction

Although the term *uniformitarianism* was not introduced until 1832, the concepts that Lyell so cleverly fused together (Gould 1987) had already been operating in the nascent discipline of geology for some decades (Laudan 1987; Rudwick 2005, 2008). Lyell linked Newton's method of "actual causes" to a quasi-static directional gradualism, fusing method and historical narrative. In short order, this new concept became the bedrock of the new geology and continued as its fundamental principle until recently. In fact, many practicing geologists continue to affirm it, unaware of its problems. One of the effects of uniformitarian geology was to destroy confidence in the biblical record of origins and early earth history, and the concept of uniformitarianism still stands as a bulwark against today's Flood geology.

Therefore, it is incumbent upon creationists to address uniformitarianism. This can be done in two ways. The most common is to adduce empirical evidence that contradicts uniformitarianism—an approach dating back to Whitcomb and Morris (1961) and still prominent (Oard and Reed 2009; Snelling 2009). The empirical approach has also proven popular on the secular side, as seen in the rise of neocatastrophism (for example, Ager 1973, 1993; Alvarez et al. 1980). The second approach is a logical analysis of the ideas and concepts behind uniformitarianism.

Since the 1960s, the intellectuals of the earth sciences have recognized problems in the standard Lyellian formulation and have resolved those problems by following Gould's (1965) lead in subdividing the term into four discrete definitions (Albritton 1967; Gould 1965, 1975, 1984; Hooykaas 1963, 1970; Rudwick 1971, 1972; Shea 1982). These definitions (fig. 1) and their inability to save the concept are discussed in Reed (2010), and for convenience are summarized here.

The strategy of this series is to demonstrate that the concept of uniformitarianism, as presently defined and defended in secular geology, is faulty. The first paper argued that three of the four definitions of uniformitarianism were outmoded, invalid, or irrelevant to geology. Semantic confusion was documented, and a proposed solution offered, in the elimination of a number of redundant terms (fig. 2). This paper will address the final facet of uniformitarianism in more depth and attempt to show that it, too, fails to provide a firm foundation for modern secular geology. Thus, with the failure of all four definitions, uniformitarianism as a whole must be considered invalid unless its advocates can reformulate its meaning.

Recap of Part I

From 1832 to the 1960s, uniformitarianism was as undefined as it was important, thanks largely to Lyell's blending ideas about geological method and historical narrative under his principle of actual causes (Gould 1987). Growing concern, perhaps related to the introduction of Flood geology and problems noted by Professor Reijer Hooykaas (1963), stirred leading geologists to address the issue. Consensus solidified around the strategy of Gould, who proposed explicating multiple meanings of uniformitarianism.

	Gould (1975, 1984)	Rudwick (1971)	Austin (1979)
Methodological	*uniformity of law* a priori claim about science; laws same over time, space	*theological status* primary act of God secondary, "naturalistic" manifestation	*methodological uniformitarianism* agreed with Gould that this is an a priori claim about science
Methodological	*uniformity of process* actualism	*methodological status* past geological causes same as present; "actualistic" versus "non-actualistic"	*causal uniformitarianism* argued for both known present causes, unknown present causes, and unique past causes
Substantive	*uniformity of rate* gradualism	*rate* gradualistic or saltatory	*actional uniformitarianism* uniformity of process rates
Substantive	*uniformity of conditions* non-directionalism, dynamic steady state	*"pattern" of past geological cause* steady-state or directional	*configurational uniformitarianism* steady state conditions through time

Fig. 1. The "four definition" solution to uniformitarianism's problems as proposed by Austin (1979), Gould (1984), and Rudwick (1971). Gould's terminology is the most widely known and will be employed here. Modified from Reed (2010).

Four were generally agreed upon. From his "substantive" and "methodological" uniformitarianism in 1965, Gould (1984) finally arrived at:

1. Uniformity of law
2. Uniformity of process (also called actualism)
3. Uniformity of rate (also called gradualism)
4. Uniformity of conditions

The first two were considered "methodological" and the latter two "substantive." Similar strategies by Austin (1979) and Rudwick (1971) are shown in Fig. 1. In the first paper in this series (Reed 2010), significant flaws in three of these definitions were seen as unworkable. The first was deemed irrelevant to geology and errors in the third and fourth had led to their rejection by leading secular thinkers. Logical issues in defining gradualism were also addressed in Reed (1998). A short recap will set the stage for the discussion of actualism below.

The first definition—uniformity of law—is generic to science, preceded geology, and is not directly applicable to geological method except as a principle affirming that physicochemical "laws" remain constant universally. Clearly, that alone cannot resolve debates about the tempo and mode of geologic history, since it does not require anything of geological processes except that they obey the laws of physics and chemistry. More importantly, secular thinkers are inconsistent when using this principle since it was historically derived from Christian theology. If Christianity is rejected, then the uniformity of law becomes nothing more than a naked assumption. Claims of an empirical justification (for example, Simpson 1963) are dashed on the rock of Hume's argument that a limited number of observations cannot prove a universal proposition, a problem exacerbated by deep time.

The third definition is the one most commonly associated with Lyell and is often called gradualism. Many geologists today try to maintain it by re-defining gradualism to allow some catastrophism, but of course that position is antithetical to Lyell's, given his vigorous opposition to the similar position of secular catastrophists like Cuvier. Lyell advocated a uniformity of the rate. Gould (1984) labeled this a testable empirical proposition, although Reed (2010) pointed out weaknesses in that claim. Ager (1973) claimed that most of the geologic record is that of rare high-energy events rather than a gradual accumulation

Old Term	New or Redefined Term
~~1. Uniformity of law~~	replaced by prior term *uniformity*
~~2. Uniformity of process~~	replaced by prior term *actualism*
~~3. Uniformity of rate~~	replaced with synonym *gradualism* for the late Lyell
~~4. Uniformity of conditions~~	replaced with *Huttonism* for historical models of Hutton and early Lyell
5. Actualism	rock record explained by observed processes
6. Uniformity	natural laws do not vary with time or location
~~7. Uniformity of Nature~~	replaced by prior term *uniformity*
~~8. Methodological Uniformitarianism~~	unnecessary and discarded
~~9. Substantive Uniformitarianism~~	unnecessary and discarded

Fig. 2. Reed (2010) proposed a revision in terminology that would focus on the two primary concepts of actualism and uniformity and eliminate or change confusing terms.

from normal geologic processes. Also, empirical findings of geologists in recent decades have undermined gradualism. Examples abound; the most famous being the Lake Missoula Flood argued by Bretz during the mid-20th century. Another example is found in the rock eroded by this flood, the Columbia River Basalt (fig. 3). Its large individual flows apparently happened in a few days (Tolan et al. 1989), with, of course, no record of the millions of years between them. And these basalt flows are among the smaller of the identified Large Igneous Provinces (LIPs), which typically show rates far in excess of those observed today. Also, regardless of the specific model, creationists agree that Grand Canyon (fig. 4) was eroded in a remarkably short period of time (Austin 1994; Brown 2008; Oard 2011). On the secular side, neocatastrophism has advanced so far that Young and Stearley (2008) berated creationists for equating uniformitarianism with gradualism, claiming that most geologists no longer accept Lyell's formulation. However, they are strangely silent on why that incorrect idea prevailed in geology for more than 150 years.

The fourth definition has long been rejected. A static history has been most closely associated with Hutton's cycling "earth machine" (Rudwick 2005). Gould (1987) provides an interesting discussion of Hutton in the context of the conceptual tension between cycles and linear time. Rudwick (2005) also provides an in-depth analysis of Hutton's ideas, agreeing with Gould that they were unique to Hutton, were strongly influenced by his deistic theology, and were corrupted, not clarified, by Playfair. Lyell toyed with the idea (Rudwick 2005), to the extent that he was lampooned by Sir Henry de la Beche in an 1830 cartoon showing a class of Ichthyosauri discussing human fossils! Lyell quickly retreated to the directional gradualism for which he is best known, and the directional, rather than static, view of earth history was sealed by evolution. Thus, most of the terms available to discuss uniformitarianism are obsolete or redundant (fig. 2). Many should be discarded or replaced, including *uniformitarianism* itself, except for historical reference.

Clarity in terminology will help move the debate forward, but it is not the only problem. Although many geologists today call themselves "uniformitarian" and default to gradualistic interpretations when the evidence for catastrophism is not overwhelming, Shea's (1982) critique probably still applies. He noted that most geologists cannot even define the term, much less explain it. Slow changes in the geological perception of uniformitarianism can be seen in the evolution of its definition in the *Glossary of Geology* between 1987 and 2005. Reed (2010) analyzes the transition from a loose Lyellianism in 1987 to a hesitant neocatastrophism in 2005.

Fig. 3. Large basalt flows of the Columbia River Basalts, shown here as stacked layers at Palouse Falls, Washington, could have been emplaced in a matter of days. Photo: Michael Oard.

If the first, third, and fourth definitions of uniformitarianism cannot support the concept as geology's fundamental principle, then attention must be directed at the second; Gould's (1984) "uniformity of process." This view is also called *actualism,* resurrecting the term that Prevost introduced in 1825. Only it can save uniformitarianism. If so, it must be a powerful concept and deserves careful analysis.

What is Actualism?

Actualism, like uniformity, is an axiomatic universal principle of method. As such, empirical arguments cannot prove it true because actualism is assumed in the argument. We cannot know that actualism was valid in the past because non-actualistic explanations of the rocks record are logically possible. This indicates how it must be

Fig. 4. The Grand Canyon was likely eroded in a matter of hours or days, whether from post-Flood lakes or receding floodwaters. Photo: Michael Oard.

evaluated—by logical truth tests, not observations. Like uniformity, modern geologists have never really validated actualism; they assume it was done long ago. But early naturalists did not rigorously examine their presuppositions; actualism was "validated" by nothing more than a passing analogy to physics (Baker 1998; Laudan 1987). This link between Newtonian physics and Lyellian geology rested on broader errors, including the materialism and positivism of the Enlightenment (Reed 2001; Stark 2003). These errors de-emphasized the philosophical tools by which these basic principles could have been examined. Instead, empirical inconsistencies such as the Spokane Flood controversy (Baker 2008) garnered attention, but could not resolve the debate over method. That debate was further confused because it was too closely tied to arguments over catastrophism vs. gradualism.

Secular geologists sway from gradualism to catastrophism, but seldom raise deeper questions about the method by which they might affirm either narrative. In that sense, such debates are red herrings. Yet it is surprising that something as momentous as the recent rejection of uniformitarianism by many thinkers (Ager 1973; Alvarez et al. 1980; Gould 1984; Young and Stearley 2008) has not spurred more philosophers of science to consider the underlying actualistic method. Even Hooykaas' (1963, 1970) rigorous analysis did not scale the barrier of positivism.

The problem with the argument over catastrophism and gradualism is that the positions are not qualitative contraries. Instead, they are only quantitatively distinct, being two points on a continuum of rate and scale, as recognized decades ago by Hooykaas (1963, p. 16):

> Thus, one of the early exponents of uniformitarianism is already an example confirming our thesis that there is no hard and fast rule to distinguish it from catastrophism.

Lyell set the precedent for conflating gradualism with geologic method and geology as a whole has not yet rid itself of that error. The development of the "four-definition" solution allowed method and mode to be distinguished, but more importantly, it provided secular geologists room to dance around challenges. For example, if a creationist pointed to a formation formed by catastrophic processes, a secular opponent could still stand foursquare on uniformitarianism by affirming the methodological definition. Defenses of gradualism typically revert to generic uniformity.

But the "four-definition" solution fails—first in the semantic realm because there is a significant difference between defining the problem and solving it. Reed (2010) offered a wholesale revision of terminology (fig. 2) that left two clear and relevant terms: *uniformity* and *actualism*. *Uniformity* reverts to its primary meaning—the regular and universal operation of natural processes in relationships defined by cause and effect. It is most commonly understood as an axiom of science in general—not just geology—referring to the constancy of "natural laws." As such, it does not really demonstrate actualism.

Assessing actualism is complex. Several problems impede clear analysis. First, the term itself is much misunderstood and misapplied in modern geology:

> De Luc's actual causes [causes actuelles] were "actual" not in the modern Anglophone sense of real and not imaginary, but in the older sense still retained in other European languages, meaning current or of the present day . . . . Hence the analytical term actualism, applied to the earth sciences, denotes the methodological strategy of using a comparison with observable present features, processes, or phenomena as the basis for inferences about the unobservable deep past: in epigrammatic form, "the present is the key to the past." . . . the heuristic value of this strategy was taken for granted by all the geologists . . . it was not—as modern historical myth would have it—first proposed by Charles Lyell in 1830. The arguments were about its adequacy for causal explanation, not about its validity or its value (Rudwick 2008, p. 15, n4).

Thus, when philosopher of science William Whewell introduced in 1832 the dichotomy between catastrophists and uniformitarians, he was not accusing catastrophists of questioning the validity of actual causes (as later uniformitarians would). The argument was instead about the adequacy of observed rates of these causes to explain the rock record (Rudwick 2005, 2008). Whewell's insights into the method of geological investigation were rejected and lost for many decades (Baker 1998), but time has demonstrated that his concept of approaching the rock record without an a priori template (such as Lyell's gradualism) was a valid insight into forensic investigation (Baker 2008), and one congenial to creationist studies. However, the nature and validity of actualism as a method remains a topic that needs to be addressed.

Another problem in understanding actualism is the tendency of some geologists to confuse it with uniformity. There are significant differences between geologic processes and physicochemical causes. Although theoretical works (for example, Julien 1998) predict some geological processes based on principles of physics or chemistry, the rock record is too complex to allow comprehensive explanation in this fashion. Geologic processes can seldom be reduced in their totality to simple "laws," being prone

to greater complexity arising from variations in scale, rate, and process. For example, all eruptions obey physical principles regarding interactions between heat, pressure, density, viscosity, and flow dynamics, but the application of these principles to individual eruptions can be very difficult. Eruptions range from small Kilauea basalt flows to giant explosive events like Tambora, and the resulting rock record of each is quite different. Likewise, sedimentary particles in water, air, or ice follow principles of flow dynamics, but the many rapidly-changing variables (grain size, shape, flow depth, velocity, bottom effects, etc.) preclude any simplistic "law" of sedimentation that can accurately predict the exact bedforms or particle distribution of an entire deposit. Groundwater flow models can work well in controlled conditions, but no modeler would claim to be able to predict the motion of each particle of water in a real aquifer (Bredehoeft 2005). So although there is a clear relationship between uniformity and actualism, as between physicochemical processes and geological processes, the relationship is not univocal.

This lack of evidence is exacerbated by the partial preservation of the rock record. Because secular geologists affirm that most of all the rocks ever deposited are absent, usually by erosion, it would not be possible to reconstruct a comprehensive geologic history even if geologists possessed the ability to accurately explain every rock body available to observation. And, of course, only a small percentage of the rock record has been directly observed. The persistence of Lyell's uniformitarianism over decades that saw dramatic increases in empirical knowledge illustrates how his principle acted as an a priori template, not an interactive model. The confidence of Lyell and his followers was predicated on their mistaken idea that geology was as definitive as Newtonian physics. Laudan (1987, pp. 202, 203, brackets added) noted:

> He [Lyell] did *not* try to apply one version or another of Newton's substantive theories to geology. Instead, he argued that geologists should adopt the scientific methods advocated by Newton, for only in this way could geology achieve the status of sciences like astronomy and mechanics.... Lyell also wanted to develop a geological theory with impeccable methodological credentials. In Lyell's mind there was no better way to accomplish this than to adopt the method favored by Newton himself—the so-called *vera causa* method, or method of true causes—and adapt it to geology.

But is Newton's method appropriate for forensic earth history? Baker (1998) disagreed, arguing that Lyell's primary error was his misguided idea that physics could serve as a methodological template for the new geology. So not only must actualism be distinguished from gradualism, but it must be shown not to be an outmoded or arbitrary assumption of method. The essential question then becomes: how do we justify actualism as a fundamental doctrine of modern geology? Secular geologists interpret the rock record by analogy with observed geological processes. But how do they know? If no justification can be offered, then the entire edifice of uniformitarianism will lie in shambles, with all of its four facets discredited.

Secular thinkers have typically taken one of two paths to justify actualism: (1) an appeal to an underlying uniformity of nature (for example, Gould 1965, 1984) or (2) an appeal to experience (for example, Simpson 1970). The first path has several flaws. First, uniformity and actualism are not univocal. Second, the question of how uniformity is justified must then be raised. Thus, an appeal to uniformity only changes the question; it does not answer it. The second path is clearly fallacious. The limited and uncertain observations of a few years cannot be validly extrapolated across billions. Neocatastrophism presents another barrier to the empirical appeal. A static world is amenable to extrapolation from an observed present, but a dynamic earth increases unpredictability as preserved strata are less representative of the past as a whole.

Actualism permeates geohistorical theory. Core disciplines such as stratigraphy, paleontology, tectonics, and geochronology all rely on actualism. As far back as the 17th century, Steno proposed that his principle of superposition could apply to the entire rock record based on his single observation in the Bay of Naples. That thinking was actualistic. Today, the assumption that crustal plate motions have occurred throughout earth history relies on actualism, as does the idea that modern sedimentary environments are represented in ancient rocks. If actualism cannot be justified, large parts of the earth sciences would be open to question.

Logically, there are three possible answers to the question of whether actualism can be justified: (1) actualism cannot be justified, (2) actualism can be justified within the current framework of earth history, or (3) actualism can be justified, but only by modifying that framework. The first or third options will have a profound effect on contemporary geohistory and biohistory. Since actualism cannot be justified empirically, it must be justified by logical truth tests. This process entails three steps:

1. Dig down to the fundamental propositions supporting actualism.
2. Determine whether and how actualism and those related concepts can be justified.
3. Assess the implications of the answer.

Finding the Basis for Actualism in Uniformity and Causality

Actualism can be self-evidently true or it can be true by reference to another proven principle. Because actualism is an axiom of method for materialist earth history, it must be universal in the physical world. So what is actualism? At root, it is a statement about cause and effect. It links a set of causes—observed geologic processes—to consequent effects, defined as features of the rock record. How can the validity of that link be affirmed, especially since our knowledge of the effects (the rock record) is poor, due to problems in observing the entire entity, to incomplete preservation, and to diagenetic or metamorphic changes?

Is actualism self-evident? The answer is "no." We can conceive of non-actualistic approaches to the rock record (for example, Hooykaas 1970). Furthermore, I am unaware of any author claiming this status for actualism. Most scholarly efforts to justify it do so by reference to the principle of uniformity (for example, see Gould 1965, 1984). This logical relationship—actualism as a subset of uniformity—makes sense because the two ideas are similar, but it does not completely answer the question because the two principles are not the same. But that relationship can be explored as a means by which to better understand how to justify actualism. If uniformity is a precondition of actualism, then actualism is contingent on uniformity and before actualism can be justified, uniformity must first be shown to be true.

This is as far as secular thinkers go because everyone "knows" uniformity is true. But how do we know? Uniformity is not absolute. It too is contingent, and rests on the proposition that there exists an unbreakable chain of cause and effect in the physical world across time. Fig. 5 shows the progression from actualism to uniformity to causal continuity. Actualism demands uniformity and uniformity demands the validity of the underlying principle of the continuity of cause and effect. Is it enough to simply affirm cause and effect and consider uniformity and actualism justified too? If we know that cause and effect is universal, then the uniformity of physical and chemical processes may be a valid corollary. If uniformity is universal, then perhaps actualism can be justified by reference to it.

But since causal continuity and uniformity are thus both necessary preconditions of actualism, then if neither is valid, then actualism cannot be justified. Only a few secular thinkers have attempted a logical

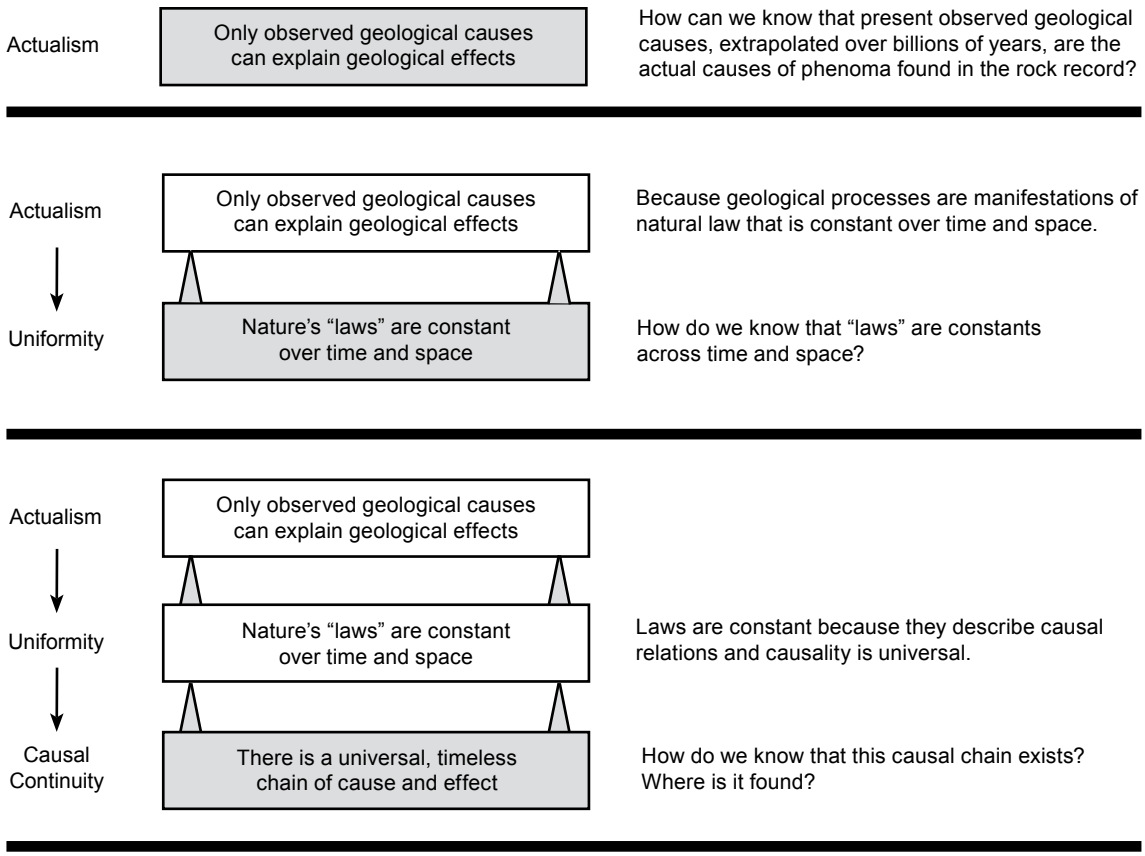

Fig. 5. Drilling down through concepts to get to the root of the issue moves us to causal continuity. Starting at the top, we ask how to justify actualism. That takes us to uniformity (middle) and finally to causal continuity (bottom), which is the foundational principle.

analysis (for example, Hooykaas 1963; 1970), but his positivist view of knowledge prevented them from moving to the metaphysical level. Hooykaas never discussed the links between uniformity and causal continuity; he assumed them valid a priori.

But was that a valid assumption? For the sake of argument, let us assume that none of the ideas are valid a priori. Instead, let us attempt to justify the most basic level of causal continuity, recognizing that the validity of both uniformity and actualism would be called into question if this more fundamental principle could not be confidently affirmed. If we cannot validate causality and uniformity, then no amount of empirical evidence can save actualism. Having climbed down the steps to the foundation, we must then move back up, carrying validation back up through the sequence.

Using Coherence as a Means of Validation

Having defined the questions (fig. 5), how can these principles be validated? As with other metaphysical or epistemological axioms, "proof" cannot be found in empirical tests of truth, but in those of logic. In this case, the test of coherence is appropriate. That is because the assertion of actualism is not made in a vacuum, but in the context of a worldview. Thus, it is legitimate to evaluate its coherence with that worldview's tenets of reality and knowledge. Inconsistencies would indicate a failure of the test of coherence. This test provides two logical checks. The first is the validation of the fundamental principle of causal continuity. The second checks the basis for deriving uniformity. Though coherence is not "scientific," it is a valid truth test. Rational people understand that the principle of causality, like that of contradiction, is a prerequisite of truth. Since science is the pursuit of truth in the natural realm, then causality is also crucial to science. If an effect can occur spontaneously without cause, empirical predictability is not absolute.

There are two possible ways to justify causal continuity (fig. 6). Both return a positive result, but one way is less rigorous and satisfying. The first method is to treat causality as a pure axiom. But saying that causal continuity is necessary (Answer 1 in fig. 6) is not a justification of the assumption, except on utilitarian grounds. In other words, we accept causal continuity because rational knowledge and practical living are not possible without it. For example, we rest our life on the causal continuity between stepping on the brake and the car stopping. In a negative sense, this perhaps justifies causality; we cannot imagine it not being true. But is there a better answer? The second option provides one by going one step further and providing a positive coherence with metaphysical reality. That method may seem strange to our positivist culture, but it is certainly better than the first option.

Statements about ultimate being and reality are found in worldviews. The two worldviews relevant to this discussion are orthodox Christianity and Enlightenment secularism (that is, Naturalism). Each makes distinct metaphysical assertions that can be used to evaluate the legitimacy of the axiom of causal continuity. Christianity (answer 2 in fig. 6) presents a metaphysical justification for causality by virtue of its coherence with the nature of God and with His acts of creation and providence. God is rational, unified,

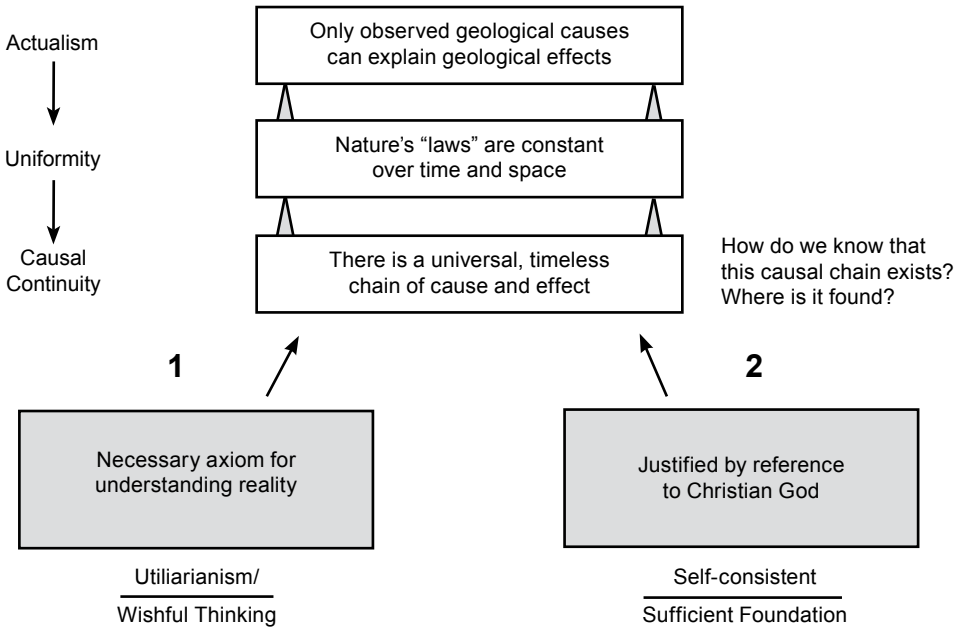

Fig. 6. Of the two possible answers justifying the doctrines of causal continuity, uniformity, and actualism, only Christianity provides the consistent tenets to do so.

and unchanging, thus continuity of cause and effect is assured. God is eternal, and so causal continuity is operative everywhere in time. God is infinite, so cause and effect applies everywhere. Causal continuity exists in the material realm because the cosmos is the contingent creation of God, and His creation manifests His attributes. That view is confirmed by the doctrine of providence; God's causation behind every ongoing function of His work of creation guarantees the validity of causal continuity. But there is one important distinction in the Christian position—absolute causal continuity exists in the person of God, not in the physical creation.

In contrast, the worldview of Naturalism fails at this point because its metaphysical materialism demands that absolute causal continuity be found in matter or energy. That proposition is contradicted by any beginning for the universe (Reed and Williams, in press). It does not matter what kind of origin or how long ago it occurred; any origin represents a discontinuity in material cause and effect which in turn disallows a materialist rationale for causal continuity, and thus for uniformity and actualism. Another conflict is found in the epistemological realm. Reed (1998) noted that uniformitarianism and positivism—the epistemology of Naturalism—are also incompatible because uniformitarianism cannot be validated by empirical data. Neither uniformity nor causal continuity can be justified empirically, therefore Naturalism fails the test again with its restrictive epistemology.

Although widely unrecognized as such, this axiomatic failure of the truth test of coherence is the fundamental crisis of modern natural history because it precludes uniformity and its derivative actualism. How did this come about and why is it so widely unrecognized? That is a question for professional philosophers of science, but one possible explanation is that geology (like other aspects of Enlightenment knowledge) was built on a secular foundation, but one that unconsciously embedded various Christian concepts already accepted as presuppositions of science (Lisle 2009; Reed 2001). It is ironic that the same geologists who were accepting these axioms, such as linear, progressive time, were at the same time vociferously attacking historical tenets of Christianity. Even those who were Christians (for example, Buckland and Sedgwick) dismissed the Genesis account, not recognizing the stunning inconsistency in their position. If Naturalism cannot justify causal continuity or uniformity, then it cannot possibly justify actualism. Yet geohistory rests on the mistaken assumption that it has already done so.

The positivism of the secular worldview elevates science above theology and first-order philosophy, blinding thinkers to first-order problems of the nature of reality and the necessity of knowing it through theology and philosophy, not science. Even Christians in the modern age have been influenced by culture; theological truth seems out of place in the scientific realm. By failing to ask the appropriate questions about the nature of their own axioms, natural historians cannot possibly provide the correct answers. This is illustrated by the long-time emphasis on the tempo of the past instead of the basis for the method of deriving it. They avoid the logical inconsistencies, focusing instead on "uniformitarianism vs. catastrophism." But the ultimate problem in Lyell's thought (and that of many other early geologists)—his inconsistent method—escapes scrutiny.

Thus, actualism can be justified, but only within the framework of Christianity. But that creates another problem of consistency. Because Christianity also speaks to ancient history and to the beginnings of the cosmos, consistency demands that the framework of natural history be aligned with the biblical narrative.

The results of this truth test raise several related questions:

1. Why did Lyellian gradualism rule geology for so long?
2. Why do geologists who reject gradualism think that actualism and neocatastrophism are valid fallback positions?
3. To what extent must geology be reevaluated and transformed in the wake of the Lyellian failure?
4. If Christianity alone justifies actualism, then what changes are necessary in geology and natural history to ensure consistency?

Implications of the Answer: Christian Actualism?

The last question will be answered first. If actualism is derived from uniformity, and if uniformity is derived from causal continuity, and if causal continuity is validated by the nature of God, then all three concepts are only justified by Christianity. Absolute causal continuity can only exist in a being who is also absolute. Christianity's God, who is eternal, infinite, and unchanging, meets these criteria. Based on information God has revealed about how He created and governs the cosmos, we can expect continuity of cause and effect, uniformity, and even actualism to be valid tools in examining the natural world. But it would be illogical to accept these principles while rejecting other relevant parts of the Christian worldview, including the divine prerogative to act directly (what we call "miraculously") in His creation. Since the metaphysical and historical frameworks that underlie natural history must be those of Christianity, then propositions contrary to Christianity must be abandoned. This entails sweeping changes in the way

both uniformity and actualism are understood.

The Nature of Uniformity

As noted earlier, most secular thinkers predicate actualism on the prior principle of uniformity. But if all three principles are validated only by Christianity, then none of them are absolute. That creates another problem, because secular thinkers treat uniformity as absolute. What are the consequences of having to change that view? If uniformity is the facet of causal continuity that applies to the normal operation of matter and energy in the created cosmos—the predictable "laws" of the natural world—then those laws are not absolute, but are contingent on God's will and subject to modification at His whim. That is the argument for scientific naturalism and has been for several centuries. It is claimed that science is impossible in a world governed by divine caprice.

But that raises the question of how science originated in the Christian worldview. The answer to the problem is that secularists make a logical error: they conflate the need for science to be absolute with the need for it to be true. The latter does not demand the former. Christians have long affirmed uniformity's contingency in both theory and practice. In theory, since causal continuity is justified by Christianity, then there is a God who created and governs the cosmos. His ability to work apart from uniform "natural laws" is inherent to His being; after all, He made the universe using non-uniform methods. Thus, He could conceivably create, change, or destroy anything apart from these "laws." In practice, that principle is illustrated by each historical account of a miracle. Everything from Joshua's long day to the healing of the lame beggar at the Temple by the Apostles demonstrates that God can and does act in non-uniform ways.

Secularists see this as a problem. They claim that God's potential to violate "natural laws" makes science impossible and superstition inevitable. However, their unspoken assumption is materialism. For them, "natural laws" are inherent to matter and energy; God is then able to be falsely portrayed as the enemy of the natural order. But how can God not act upon what He has made? The issue is not one of science, but of theology. Furthermore, science does not demand materialism; in fact, science is only possible within the framework of Christianity because only God can guarantee its necessary conditions (D'Souza 2008; Glover 1984; Hooykaas 1972; Keller 2008; Reed 2001; Reed et al. 2004; Stark 2003). Thus, both logically and historically, science and a theology of divine providence are not at odds.

Christians have been confused by secular attacks because they have ignored their legacy of theology and allowed the secular scientific view—which is materialistic or deistic—to direct their thinking. Plantinga (1997, p. 143) called this view "provisional atheism." A clear understanding of the doctrine of divine providence corrects these misunderstandings. Natural "laws" are simply the physical description of divine providence as it governs the material world. Providence is God's mediate work; in other words, it describes the regular, everyday manner in which God keeps the universe operating. Secularists fail to see the issue theologically, and, in doing so, they fail to see that God can and does also work immediately. In this context, the term does not mean that God does something right away; it means that He acts directly in a given situation, without regard for the "normal" causal chain that marks His mediate actions. We often call His immediate acts miracles, set apart from actions of providence involving secondary causes (fig. 7).

Secularists and many Christians make a crucial error by ignoring God's mediate acts of providence and emphasizing His immediate acts, or miracles, as God's only interaction with nature. This assumes a deistic view which grants the power of continuing existence to matter and energy, making uniformity a material property rather than a divine act. However, since uniformity can only be justified by God, then it is wrong to set it in opposition to God's works, since God's efforts include both His works of creation and providence. A proper theological appreciation of these doctrines corrects this error and removes the tension between God and creation vis a vis causality.

Thus, while terms like uniformity and natural law are the currency of contemporary vocabulary, the

Discipline	Term	Definition
Philosophy	Primary Causality	God's act of creation God's ongoing sustaining of universe
Theology	Immediate Works	God's direct action to accomplish His will
Philosophy	Secondary Causality	Ordinary manner by which God rules His creation—"laws of nature" natural causes = ordinary providence
Theology	Mediate Works	God's intermediate use of created things to accomplish His will

Fig. 7. Both philosophy and theology have special terms to refer to causality and providence. Different terms can refer to different aspects of the same thing. Of key importance in understanding God's use of cause and effect are the differences between His mediate and immediate works.

Christian understanding of causality and uniformity rests in the theology of providence. God governs the universe. His power upholds it. In that sense, everything is a wonder, pointing to God's exercise of His divine power. Centuries of a scientific emphasis on the physical world have robbed us of that legacy. But neither science nor materialism can justify uniformity. For that reason, Christians who are also scientists need to understand the theological basis for their work and not be hesitant to affirm its logical superiority to the secular worldview. Uniformity is affirmed, but it is not absolute for it rests ultimately on the will of God expressed in his providential governance of the cosmos.

Since uniformity is validated by Christian theology, and since even secular thinkers relate the justification of geological actualism to the principle of uniformity, we must re-examine our view of actualism too. It must also be rooted in Christian theology and subject to consistency tests with the rest of the Christian worldview, including Genesis. This leaves us with something that sounds quite curious in our present culture—Christian actualism.

The Nature of Actualism

If uniformity is a sub-principle of causality with regard to the "laws" of nature, then actualism describes the subset of geological processes. However it is still fundamentally an axiom of cause and effect. Laudan (1987, p. 206) thought that:

> In short, Lyell's requirement of kind uniformitarianism can be seen as a straightforward extension of the *vera causa* principle to a situation in which the cause and effect are widely separated in time.

This statement reveals a bias toward deep time inherent in the views of secular geologists. It is not the cause (geological process) and effect (feature of the rock record) that are necessarily separated by large amounts of time, but it is our observation of the effect. That in itself might be seen as an effect, but there is a vast difference between the physical cause and effect and our observation of the latter. One is physical; the other is informational. The degradation of information results from several factors, including our incomplete understanding of natural processes, our incomplete knowledge of the rock record, the failure of the rocks to preserve sufficient effects to show the original physical causes, and the partial preservation and erosion of what was originally deposited. All are barriers to a complete understanding of the geological processes that produced the rocks.

Actualism, like uniformitarianism, does not inherently demand deep time (Shea 1982). Instead, secularists have long assumed such a relationship because an extended prehistory is a core assumption of secular history. It is an axiom, not an inductive conclusion. That is why the Christian justification of actualism and its prior principles of uniformity and causal continuity present such a crisis for secular natural history. Actualism can be justified, but only within a framework completely different from the one that informs the secular narrative of the past—including deep time.

What modifications must be made in changing this framework to accommodate the logical consistency demanded by the outcome of the coherence test? The most important change is epistemological; if these principles are justified by Christianity, then the foundation of ultimate truth in science and natural history is transferred from human empirical investigation to divine revelation. God has revealed His works of creation and providence to people who can comprehend them because they are created in His image. Science is contingent upon Scripture; it is not the template against which Scripture is judged. Some rightly argue that God also reveals himself in nature, and then equate natural revelation with modern secular science. However, they miss one key point; that special revelation takes precedence over general revelation when an apparent conflict exists. While Scripture does not reveal everything about earth's natural past, those things that it does reveal must form the framework for empirical pursuit of this knowledge. For example, we do not know all of the geological mechanisms of the Flood, but we do know that such a Flood occurred, and can thus investigate in that context.

This view brings a new framework of history. Its high points include: (1) ex nihilo creation by an eternally self-existing God, (2) creation of man in God's image, providing the basis for comprehending revelational knowledge, (3) a providential understanding of God's ongoing interactions with what He has made, (4) the concomitant rejection of the deistic view that inheres matter and energy with their autonomous existence and inherent properties that cause the uniform action of natural processes, (5) the reality of miracles as God's immediate acts, (6) the ultimate unity of mediate and immediate causality in the mind of God, and (7) the reality of biblical history, including the Genesis Flood. Without all of these facets, actualism cannot be applied as a principle of geological interpretation other than as a subjective and inconsistent imposition.

Irony of "Flood Actualism"

There is no denying the irony in this situation. Actualism was seen by early geologists as a means of ridding themselves of the constraints of biblical history. It was a symbol of freedom from theology; Cuvier in 1812 had waxed eloquent:

"Would it not be glorious," Cuvier had asked

> rhetorically, for geologists to "burst the limits of time", just as astronomers had "burst the limits of space?" (Rudwick 2008, p.1).

Cuvier's wish was granted in the development of secular natural history, culminating in Lyell's *Principles of Geology* (1830–1833). Along with time, geologists had burst biblical history, creating a secular mythology built around the geological time scale. Further "freedoms" from Christianity followed: Lyell's earth history, Darwin's evolution, and social derivatives of the two, including modern political and social pathologies, marking the descent of Western culture.

But we have now seen that actualism cannot be divorced from the biblical narrative of creation and the Flood. It follows that the same is true of the rock record. But how do we deal with the discontinuities associated with creation and the Flood? The secular worldview provides a physical uniformity, but cannot justify it because matter is not absolute. Therefore, we must refocus from science to theology, and see the contingency of actualism. Only God is absolute; thus actualism is simply the contingent manifestation of God's mediate work of providence in the natural realm with regard to geological processes. That means that actualism is not applicable to all of God's works.

Scripture's description of these past discontinuities in no way invalidates actualism as a methodological assumption for much of the chronology of earth's past; it represents the continuing, regular function of earth's geological and geophysical processes. In other words, actualism is an appropriate template for the vast majority of earth's time—every minute in which God did not act in an immediate fashion. We may not know every instance of God's immediate work from revelation, but we must honor those that we do know. But based on revelation, we are faced with a conundrum; the vast majority of the rock record represents relatively insignificant amounts of time. Thus while actualism applies to most of history chronologically, it does not apply to much of the rock record.

The biblical record strongly implies that the Flood is the cause of most of the rock record. Secular assumptions of deep time, and the linking actualism to the rock record are therefore invalid, not because actualism is invalid, but because its absolute link to the rock record is. "Christian actualism" then is of limited application; it applies only to those parts of the rock record deposited after the Flood or between creation and the Flood. Therefore, a sound interpretation of the rock record demands a non-uniformity of geologic process, requiring that interpretation be built from observation of the rocks per se, and not from an a priori actualism.

This points us away from traditional secular geology. We must recognize that geohistory is an investigation of unique past events. Because our concern is with natural processes, then the investigation is natural history. Science is applicable, but as a forensic tool, not as the determinative driver. Adler (1965) called natural history a "mixed question," an adequate definition described in more depth by Reed (2001) and Reed, Klevberg, and Froede (2006). Understanding that the secular approach is invalid, and that the biblical approach includes non-actualistic interpretation, we must elevate empirical investigation over the imposition of theoretical templates. Austin (1979, p. 39) described this approach, recognizing that interpretation was complicated by:

> …unusual ancient processes, undiscovered processes, and inversions of actualistic reasoning as important problems for causal uniformitarianism. The geologist's technique in deciphering ancient processes, they affirm, relies not only on analogies with products of modern geological processes, but on analogies with products of similar ancient processes, on analogies with products from experimental replicas and other non-geological systems, and on logical deductions from theories or scientific laws. Proper interpretations of ancient processes should, they say, involve complex techniques of inference, not just simple one-to-one association of products of modern and ancient processes. By using complex inference techniques, the geologist retains the maximum flexibility when confronted with anomalous facts, the proper perception of which is probably the crucial step in the act of scientific discovery.

In a similar fashion, Baker (2008, p. 47) noted:

> William Whewell, one of the few philosophers of science to have had any familiarity with geology, suggested from his historical studies of science that the validity of hypotheses…was demonstrated by their ability to bring together disparate observations under an overarching explanation and to produce explanatory surprises, such that previously unknown phenomena are also found to fit under that explanation…a procedure that he called "consilience of inductions"…. Hypotheses are not mere propositions to be tested. They are "working" elements of inquiry, intimately connected to the phenomena that they explain, and are subject to modification.

As Reed, Klevberg, and Froede (2006) noted, stratigraphy became progressively less empirical, as theoretical templates, or "geotheories" (Reed and Klevberg 2011) drove interpretation. Interpretation driven by field evidence is preferred, whether it

reflects actualistic processes or not.

Summary

Although many practicing geologists would describe themselves as "uniformitarians," the intellectual leaders of the discipline have shown that Lyell's construct was unworkable. They have divided the concept into four facets; rejecting gradualism and stasis, but affirming uniformity and actualism. Reed (2010) showed that the former is not directly relevant to geological interpretation, and we have seen here that actualism fails in their worldview because it fails the truth test of coherence. Thus, "uniformitarianism," as defined by its secular proponents, fails in all four of its definitions. Therefore, the concept is empty, despite its continued use in secular geology.

Some have abandoned Lyellian uniformitarianism and replaced it with the method of actualism conjoined with the narrative of neocatastrophism. But instead of saving geology, this new combination still affirms a method that it cannot justify. Freed from the blinkers of 19th century positivism, we now see that actualism cannot be justified by simple analogy to Newtonian physics, nor can it be justified by reference to uniformity. Both concepts are congenial to the Christian worldview, but incompatible with that of Naturalism.

As Fig. 8 demonstrates, Christianity can answer the hard questions about earth history that secularism cannot. Thus, secularists are faced with a difficult choice; they must either abandon their assumptions about interpreting the rock record or their animosity towards orthodox Christianity. A few have begun to understand the problems created by actualism and its implications. Baker (1998, p. 180) noted:

> Geology is a realistic science, not an actualistic one. A science that would limit itself to using the present as the arbitrator of what counts as natural evidence condemns itself to being actualistically unrealistic. The realism in geology derives not so much through inductive experimental contiguity as through coherence and consistency of observation with hypothesis.

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Concept	Secular Answer	Christian Answer
actualism	Method of geology consistent with Newton's *vera causa* method; since nature is absolute, actualism is too	Method of those parts of history governed by mediate providence; not absolute since God also uses immediate actions by His will
uniformity	Inherent laws of nature are constant across space and time; also absolute since matter/energy are absolute	Describes work of God's mediate providence; contingent and subject to interruption by immediate actions
causality	Every effect has a cause	Every effect has a cause; note that God is not an effect
justification of continuity	If causality is not: (1) absolute and (2) material, then reality cannot possibly be understood = incoherent	Causality is unlimited by time and space because God is infinite, unchanging and eternal = coherent
location of continuity	In nature; materialism allows no other option	In God; natural discontinuities at physico-chemical or geological levels do not compromise causality

Fig. 8. Actualism and its associated concepts are viewed much differently by secularists and by Christians. However, the secular formulation of any of these cannot be justified. Thus Christian tenets touching natural history, including creation and the Flood, are mandatory, if actualism is true.

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