

Hutton's Uniformitarianism

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Uniformitarianism, or cause and effect, is a very important and basic concept in geology. The heart of the concept is that there is order and regularity in the operation or functioning of natural laws. This consistency is what gives significance to cause-and-effect patterns. What we see happening today helps us to identify the results of natural processes which were active millions of years ago. We observe ripple marks being formed by wave action on beaches today; when we see similar ripple marks in ancient sandstone, we use cause and effect or uniformitarianism to suggest that the ripple-marked sandstones were once part of an ancient beach.

The geologist, as he studies natural processes at work and sees how long it takes to produce soil from solid rock or for a glacier to carve a U-shaped valley, is convinced that most of the changes which take place on the earth's surface must develop gradually and thus over a long period of time.

Violent events such as volcanic eruptions, which are convincing evidence that not all change occurs slowly, are still part of uniformitarian change so long as there is a pattern of cause and effect that reflects the orderly function of natural laws. By studying such processes, and by assuming that these processes follow constant and consistent laws, geologists have even been able to predict certain violent events, including the eruption of Mount St. Helens.¹

Although the term *uniformitarianism* has been abused and misused and severely criticized,² the form in which it is accepted and related to the practical application of geology today is essentially the

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¹Information from the United States Geological Survey Hazard Evaluation Report published in 1978—two years before the eruption—enabled authorities to respond quickly to the volcano's preliminary activity and undoubtedly saved many lives (see Dwight R. Crandell and Donal R. Mullneaux, *Potential Hazards from Future Eruptions of Mount St. Helens Volcano*, U.S. Geological Survey Bulletin no. 1383-c [Washington, D.C.: U.S. Government Printing Office, 1978]).

²For a recent discussion of the errors in the definition and use of *uniformitarianism*, see James H. Shea, "Twelve Fallacies of Uniformitarianism," *Geology* 10 (September 1982): 455-60. The major value of this paper is the very extensive bibliography on the problems and criticism of uniformitarianism. See also my comments in *Geology*, forthcoming, on Shea's article.

same as that proposed by Scottish geologist James Hutton nearly 200 years ago. Though Hutton (1726–97) did not use the term *uniformitarianism*, he was the one who developed the concept. He referred to *cause-and-effect* relationships as the means by which he gained understanding and was able to make geological interpretations.³

Hutton was opposed by geologists of his day because they supported catastrophic events as the cause for most geologic change. Hutton, who was convinced of the great age of the earth, emphasized that these changes could be more effectively accounted for by having slower processes act over longer periods of time to produce the results. The catastrophic point of view gradually lost ground to uniformitarianism as convincing evidence from field studies gave more and more support to uniformitarianism.

Let me use a well-known example to show how this change in viewpoint has taken place. The catastrophists identified anomalous deposits of coarse heterogeneous sediments and large erratic boulders as having been deposited by the biblical Flood. These deposits were scattered throughout Europe. Careful field studies of glaciers and the effects of glaciation by such men as Venetz (1829) and Agassiz (1840)⁴ proved that this type of deposit was associated with modern glaciers. A restudy of the “Flood” deposits showed that striations and polished surfaces, such as are produced by moving ice, were also present. An additional convincing piece of evidence against catastrophism was that the “Flood” deposits were not universal in their distribution but were limited to areas known to have been covered by continental glaciers. The catastrophic explanation of the “Flood” deposits was finally considered to be erroneous and was abandoned. The use of this example is not intended to prove that the biblical Flood did not occur but only to suggest that the use of the Flood to account for the distribution of these peculiar deposits was not supported by factual evidence. The glacial interpretation, on the other hand, was convincing because it was supported by substantial field evidence.

Catastrophists support the idea that the earth is just a few thousand years old, and they are determined to discredit the evidence of slow gradual change. They insist that rates of erosion, for example, were much more rapid or violent in the past than they are today.

³Hutton's theories were first presented in 1785 and published as an essay in 1788, and then later as a two-volume work in 1795 entitled *Theory of the Earth with Proofs and Illustrations* (Edinburgh: Printed for Messers Cadell, Junior, and Davis, London; and William Creech, Edinburgh, 1795). He also wrote a third volume, part of which was lost. The remaining portion was published in 1899, more than a century after Hutton's death.

⁴For a brief summary of the work of Ignatz Venetz (1788–1859) and Jean Louis Agassiz (1807–73), see William Lee Stokes, *Essentials of Earth History*, 4th ed. (Englewood Cliffs, N.J.: Prentice-Hall, 1982), pp. 400–4.

Catastrophists ignore the cause-and-effect relationship which indicates that if you change the rate you also change the result. For example, if the rate or energy of stream erosion is increased to that which occurs with a destructive flood, it produces thicker and coarser deposits with numerous erosion channels within the deposits. On the other hand, very fine grained evenly laminated sedimentary deposits indicate that deposition occurred in low-energy quiet water. The rock record contains evidence of not just the type of process but also the rate at which it occurred.

Sir Charles Lyell (1797–1875) was an ardent supporter of Hutton's uniformitarianism and did much to convince the scientific world of its validity.⁵ Unfortunately, Lyell perverted the concept by suggesting that the rates at which natural processes operate have not varied through time and that only those processes seen operating today can be used to explain geologic features found in the rock record.

“Lyellism” has caused considerable controversy and misorientation in the use of the term *uniformitarianism*. Modern-day catastrophists have seized upon this error of Lyell's as a means to discredit uniformitarianism. Most geologists today, however, do not follow Lyell and consider his error just an aberration of the past. Uniformitarianism as it is followed today is basically what was first proposed by Hutton.

HUTTON'S EMPHASIS ON UNIFORMITARIANISM

It is important that we carefully consider what Hutton said, so that we can get a clear picture of uniformitarianism. Hutton, as is evident from the few quotations included in this paper, had an amazing sense of what the earth was like and what his limitations were in defining and interpreting what had happened.

Hutton accepted God as the Creator and saw a master design in what he had studied as a geologist.

When we trace the parts of which this terrestrial system is composed, and when we view the general connection of those several parts, the whole presents a machine of peculiar construction by which it is adapted to a certain end. We perceive a fabric, erected in wisdom, to obtain a purpose worthy of the power that is apparent in the production of it.⁶

It is not only by seeing those general operations of the globe which depend upon its peculiar construction as a machine, but also by

⁵Lyell's chief contributions were his monumental work *Principles of Geology*, 3 vols. (London: John Murray, 1830–33), and his later addresses to the Geological Society of London.

⁶Hutton, *Theory of the Earth*, 1:3.

perceiving how far the particulars, in the construction of that machine, depend upon the general operations of the globe, that we are enabled to understand the constitution of this earth as a thing formed by design. We shall thus also be led to acknowledge an order, not unworthy of Divine wisdom, in a subject which, in another view, has appeared as the work of chance, or as absolute disorder and confusion.⁷

The term *uniformitarianism* was not used by Hutton but the concept follows from what Hutton wrote on the orderly function of natural laws and the evidence of cause-and-effect patterns.

Lastly, There [*sic*] are operations proper to the *surface* of this globe, by which the form of the habitable earth may be affected; operations of which we understand both the causes and the effects, and, therefore, of which we may form principles for judging of the past, as well as of the future. Such are the operations of the sun and atmosphere, of the wind and water, of the rivers and the tides.⁸

Hutton felt that by studying the processes of nature today we can see cause-and-effect patterns which enable us to interpret the past.

In examining things present, we have data from which to reason with regard to what has been; and, from what has actually been, we have data for concluding with regard to that which is to happen hereafter.⁹

Hutton recognized that most change is brought about a step at a time. Some steps may be very violent but most are very gradual. Altogether the steps required to erode away a mountain or to raise a mountain from the bottom of the sea give evidence of extremely long intervals of time.

From the top of those decaying pyramids to the sea, we have a chain of facts which clearly demonstrate this proposition, That [*sic*] the materials of the wasted mountains have traveled through the rivers; for, in every step of this progress, we may see the effect, and thus acknowledge the proper cause. We may often even be witness to the action; but it is only a small part of the whole progress that we may thus perceive, nevertheless it is equally satisfactory as if we saw the whole; for, throughout the whole of this long course, we may see some part of the mountain moving some part of the way. What more can we require? Nothing but time.¹⁰

The raising up of a continent of land from the bottom of the sea, is an idea that is too great to be conceived easily in all the parts of its operations, many of which are perhaps unknown to us; and, without

⁷Ibid., 1:5-6.

⁸Ibid., 2:4-5.

⁹Ibid., 1:19.

¹⁰Ibid., 2:329.

being properly understood, so great an idea may appear like a thing that is imaginary. In like manner, the co-relative, or corresponding operation, the destruction of the land, is an idea that does not easily enter into the mind of man in its totality, although he is daily witness to part of the operation. We never see a river in a flood, but we must acknowledge the carrying away of part of our land, to be sunk at the bottom of the sea; we never see a storm upon the coast, but we are informed of a hostile attack of the sea upon our country; attacks which must, in time, wear away the bulwarks of our soil, and sap the foundations of our dwellings. Thus, great things are not understood without the analysing of many operations, and the combination of time with many events happening in succession.¹¹

Hutton differed sharply with catastrophists in the area of preternaturalism, or the practice of appealing to supernatural, unique, or extraordinary processes to explain past events.

Not only are no powers to be employed that are not natural to the globe, no action to be admitted of except those of which we know the principle, and no extraordinary events to be alledged in order to explain a common appearance, the powers of nature are not to be employed in order to destroy the very object of those powers; we are not to make nature act in violation to that order which we actually observe, and in subversion of that end which is to be perceived in the system of created things. In whatever manner, therefore, we are to employ the great agents, fire and water, for producing those things which appear, it ought to be in such a way as is consistent with the propagation of plants and life of animals upon the surface of the earth. Chaos and confusion are not to be introduced into the order of nature, because certain things appear to our partial views as being in some disorder. Nor are we to proceed in feigning causes, when those seem insufficient which occur in our experience.¹²

It is in the philosophy of nature that the natural history of this earth is to be studied; and we must not allow ourselves ever to reason without proper data, or to fabricate a system of apparent wisdom in the folly of a hypothetical delusion.¹³

Hutton indicated that things could have happened in the past for which we have nothing to compare with today. He accepted the fact that rates could have been different in the past. He did not discredit catastrophic changes but insisted that changes must follow patterns that are consistent with the laws of nature.

So many must have been those alterations upon the surface of the earth which we inhabit, and so short the period of history by which, from the experience of man, we have to judge, that we must be

¹¹Ibid., 1:184–85.

¹²Ibid., 2:547.

¹³Ibid., 2:564.

persuaded we see but little of those operations which make any sensible change upon the earth; and we should be cautious not to form a history of nature from our narrow views of things; views which comprehend so little of the effects of time, that they may be considered as nothing in the scale by which we are to calculate what has passed in the works of nature.¹⁴

If we knew all the powers of nature, and all the different conditions in which those powers may have their action varied, that is to say, if we were acquainted with every physical cause, then every natural effect, or all appearances upon the surface of this earth, might be explained in a theory that were just. But, seeing that this is far from being the case, and that there may be many causes of which we are as yet ignorant, as well as certain conditions in which the known action of powers may be varied, it must be evident, that a theory of the earth is not to be confuted by this argument alone, That [*sic*] there are, among natural bodies, certain appearances which are not explained by the theory. We must admit, that, not having all the data which natural philosophy requires, we cannot pretend to explain everything which appears; and that our theories, which necessarily are imperfect, are not to be considered as erroneous when not explaining every thing which is in nature, but only when they are found contrary to or inconsistent with the laws of nature, which are known, and with which the case in question may be properly compared.¹⁵

It must not be imagined that this undertaking is a thing unreasonable in its nature; or that it is a work necessarily beset with any unsurmountable difficulty; for, however imperfectly we may fulfill this end proposed, yet, so far as it is to natural causes that are to be ascribed the operations of former time, and so far as, from the present state of things, or knowledge of natural history, we have it in our power to reason from effect to cause, there are, in the constitution of the world, which we now examine, certain means to read the annals of a former earth.¹⁶

It is quite possible that events about which we have no present knowledge could have happened in the past and might happen in the future, and perhaps we even lack the scientific capability at this time to interpret them correctly.

PARALLELS TO LDS THEOLOGY

Uniformitarianism is a philosophy which asserts that there is order and consistency in the functioning of natural laws. This same idea emerges in Mormon theology. Like James Hutton, the Mormon theologian Apostle John A. Widtsoe rejected preternatural explanations of the universe in favor of a uniformitarian view:

¹⁴Ibid., 2:149.

¹⁵Ibid., 1:298-99.

¹⁶Ibid., 1:169.

Every process of nature is orderly. Chance, disorder, chaos are ruled out of the physical universe. If every condition involved in a system is precisely the same, the result, anywhere, everywhere, today or at any other time, will be the same. The sun does not rise in the east today and in the west tomorrow. . . . the phenomena of nature are the products of law. The infinitely large or the infinitely small move in obedience to law.¹⁷

Elder Bruce R. McConkie has commented on the lawful nature of not only the physical but also the spiritual universe:

All things are governed by *law*; nothing is exempt. In the eternal perspective there is no such thing as chance; in the divine economy the same unvarying result always flows from the same cause. These principles are immutable, eternal, everlasting: they apply to all things, both temporal and spiritual.¹⁸

The naturalistic view of a universe operating by cause and effect was also espoused by President Brigham Young, who said:

The providences of God are all a miracle to the human family until they understand them. There are no miracles only to those who are ignorant. A miracle is supposed to be a result without a cause, but there is no such thing. There is a cause for every result we see; and if we see a result without understanding the cause we call it a miracle.¹⁹

The constancy in the functioning of God's laws is indicated in Doctrine and Covenants 130:20–21: "There is a law, irrevocably decreed in heaven before the foundations of the world, upon which all blessings are predicated. And when we obtain any blessing from God, it is by obedience to that law upon which it is predicated."

CONCLUSION

Because of its great geological significance, the concept of uniformitarianism has been widely used, and, like many other important concepts, it has been subjected to improper definition and application.

This paper has attempted to clarify the meaning of uniformitarianism and to refocus our attention on the original presentation by James Hutton. Very little needs to be changed in the meaning and emphasis given by him.

¹⁷John A. Widtsoe, *Evidences and Reconciliations: Vols. 1–2–3*, ed. G. Homer Durham (Salt Lake City: Bookcraft, 1960), p. 19.

¹⁸Bruce R. McConkie, *Mormon Doctrine* (Salt Lake City: Bookcraft, 1966), p. 433.

¹⁹Discourse by Brigham Young, 9 April 1871, *Journal of Discourses*, 26 vols. (London: Latter-day Saints' Book Depot, 1854–86; reprint ed. 1967), 14:79. See also discourse by Brigham Young, 11 July 1869, *Journal of Discourses*, 13:140–41.

Uniformitarianism, as used in geology, is part of a much broader use of cause-and-effect relationships indicated in Mormon theology. It is evident that there is a unity in the design of the Creator, a unity which is all inclusive. The constancy in the operation of both temporal and spiritual laws gives us a view of the universe that reflects this unity, one in which we can reasonably expect that effects follow causes and that there are important consequences for our actions.