Catastrophism? Yes!

by Ariel A. Roth

A review of how science has gone back and forth on the role of catastrophism in the study of earth's history.

Early on the morning of November 14, 1963, the crew members on the fishing vessel *Isleifur II* noticed a strange sulphur-like smell in the air, but dismissed it as unimportant. About an hour later, the boat, navigating near the coast of Iceland, started to roll in an unusual pattern. In the dim light of dawn, the crew observed dark smoke rising in the south. Thinking that a ship might be on fire, they checked for any S.O.S. radio messages, but none had been heard. Looking through his binoculars, the captain noted black columns erupting out of the sea about a kilometer away. The crew immediately suspected a volcano; after all, they should know as they were from Iceland where volcanic activity is almost a way of life. The fisherman were right over the volcanically active mid-Atlantic ridge. There the floor of the ocean is about 100 meters below sea level, so the activity of a submarine volcano could be easily noticed at the ocean surface.

The disturbance continued all day, with stones, flashes of light, and a column of steam, ash, and smoke, rising 3 kilometers into the air. In five days, where before there had been only open ocean, an island 600 meters long had formed (Figure 1). The island, later named Surtsey after the mythological giant *Surtur*, eventually reached a diameter of nearly 2 kilometers. Amazingly, when scientists visited the island, it looked as though it had been there for a long time. In about five months, a mature-looking beach and cliff had formed (Figure 2). One of the investigators commented: "What elsewhere may take thousands of years . . . may take a few weeks or even a few days here. On Surtsey only a few months sufficed for a landscape to be created which was so varied and mature that it was almost beyond belief."[1]

Normally, on our relatively placid earth, changes don't happen very rapidly, but occasionally events like the formation of Surtsey remind us that rapid catastrophic changes do occur.

Catastrophism and uniformitarianism

Catastrophism and uniformitarianism have played a major role in the interpretation of the history of earth. The first assumes rapid, unusual, major geological events, while the second asserts with the contrary concept of small, slow, and prolonged changes. The long ages required for slow uniformitarian changes demand that the biblical account of a recent Creation be discarded when explaining the formation of huge geological layers and the fossils that appear on the surface of the earth. Uniformitarianism fits better with a prolonged evolutionary history and long geological ages, while catastrophism fits better with the biblical concept of a recent Creation and a subsequent worldwide Flood. The biblical Flood, which could deposit the geological layers rapidly, represents a prime example of catastrophism.

Throughout most of human history, catastrophism was a well-accepted view,[2] occurring in ancient mythology and in Greek and Roman antiquity. Interest waned during medieval times, although the Arabs closely followed Aristotle, who believed in catastrophes. The Renaissance saw a renewed interest. The abundant marine fossils found in the

Alps were often explained as the result of the Flood. The 17th and 18th centuries witnessed attempts at harmonizing science with biblical Creation and Flood accounts. However, there were some notable detractors, such as René Descartes (1596-1650), who suggested the Earth formed by a cooling process. Orthodox ideas began to be modified, such as suggestions that the Deluge might have resulted from natural causes and that it might not have formed all of the sedimentary rock layers. Multiple catastrophes were proposed by Georges Cuvier (1769-1832) in France, and during this period a few other scholars advocated uniformitarianism.

At the same time, in England, there was strong support for the biblical Flood from such leading authorities as William Buckland, Adam Sedgwick, William Conybeare, and Roderick Murchison. In this milieu, a book appeared that would have more influence on geological thought than any other.

Principles of Geology first appeared in 1830.[3] Written by Charles Lyell, it strongly changed the prevailing climate of geological thought from catastrophism to the strict slow changes of uniformitarianism. By the middle of the 19th century, uniformitarianism had become a dominant concept and catastrophism a dwindling view. Various schemes tried to reconcile the biblical account of a recent Creation with the long geological ages proposed by uniformitarianism.

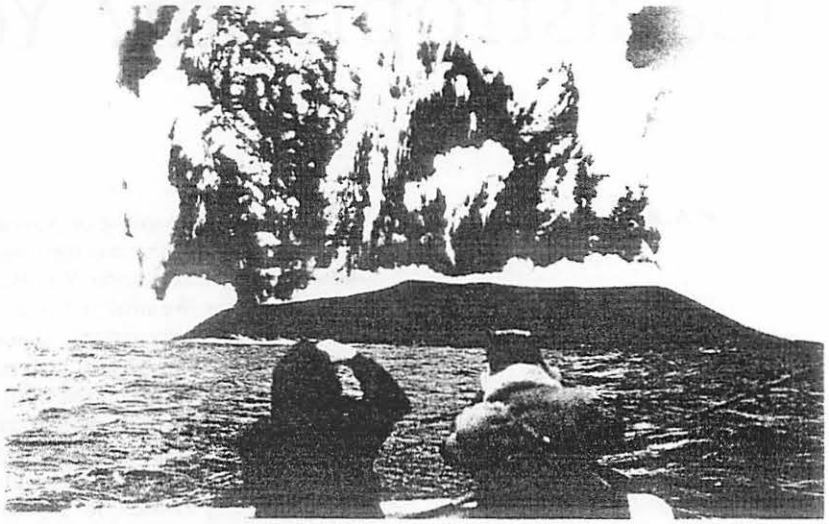

Figure 1. The developing island of Surtsey, south of Iceland. At this stage, it is only four days old.

Figure 2. The new island of Surtsey. Note the beach, the cliff, and men for scale. The small white objects on the beach in the foregound are krill, planktonic crustaceans that constitute food for whales. The rock stacks in the distant horizon are not part of the island. Five months and two days earlier, this area was open ocean.

The Bretz event

In 1923 the independent-minded geologist Harlen Bretz described one of the most unusual landscapes to be found on the surface of our planet. Covering some 40,000 square kilometers in the southeastern region of the State of Washington (U.S.A.), it is characterized by a vast network of huge dry channels, sometimes many kilometers wide, forming a maze of buttes and canyons cut into stark, hard volcanic rock. Unlike ordinary river valleys, which generally have a broad V shape in cross-section, these channels often display steep sides and flat floors. In addition, huge mounds of stream gravel have been found at various elevations. Evidence of hundreds of ancient waterfalls, some as high as 100 meters, with large eroded plunge pools at their base, testify to something very unusual.

How did this odd landscape form? Bretz had an idea, but it was outrageous enough to spark a geological controver-

sy that lasted for 40 years. In his first publication on this topic, Bretz did not express his suspicion about a major catastrophic flood, but only indicated that prodigious amounts of water would be required.[4] However, later in the same year, he published a second paper expressing his view that this landscape had been formed by a truly vast, but short-lived, catastrophic flood. This flood had scoured the area, eroded the channels, and deposited the immense gravel bars.[5]

At that time, geologists opposed any sort of explanation associated with catastrophes, and Bretz knew this. Uniformitarianism was the accepted view; although recognized as having an impact, volcanoes and earthquakes were considered unimportant. Catastrophism was anathema; it was in the same category in which Creation finds itself in many scientific circles now—totally unacceptable. The geologic community had to deal with this young upstart Bretz, who was completely out of line. His heretical ideas were uncomfortably close to the rejected idea of the biblical Flood.[6] To adopt his theories, they thought would mean retreating into "the Dark Ages."[7]

As Bretz, who was professor of geology at the University of Chicago, continued his study and publication, some geologists decided to try to persuade their wayward colleague. In 1927, he was invited to present his views to the Geological Society of Washington, D.C. There was a special purpose behind this invitation: "a veritable phalanx of doubters had been assembled to debate the flood hypothesis."[8] After Bretz's presentation, five members of the prestigious U.S. Geological Survey presented their objections and alternative explanations such as glaciation and other slow changes.[9] Two of these geologists had not even visited the area! In answering them, a weary Bretz commented that "perhaps, however, my attitude of dogmatic finality is proving contagious."[10] One major problem for Bretz's idea remained unanswered: Where did all the water come from so suddenly? Apparently no minds were changed at the meeting; the idea of a catastrophic flood still seemed to most scientists, preposterous.

In the following years, the geological community concentrated on developing alternatives to Bretz's model. In Bretz's words, the "heresy must be gently but firmly stamped out."[11] Nevertheless, field studies continued to produce data favorable to a catastrophic interpretation, and the conflict began to moderate. Bretz and others found a source for the flood waters. Ancient Lake Missoula to the east had once harbored 2,100 cubic kilometers of water. Some evidence indicated that ice had dammed the lake. A sudden break in the ice would release the water needed to produce the evidence for the rapid erosion seen to the west. The best support for this explanation came later when scientists found giant ripples in both Lake Missoula and the channel region to the west. You are probably familiar with the parallel ripple lines frequently seen on sandy stream beds. These are usually just a few centimeters from crest to crest. The ripples on the floor of Lake Missoula and to the west were gigantic—up to 15 meters high, with a span of 150 meters from crest to crest.[12] Only vast quantities of rapidly moving water could produce such an effect. More recent studies have concentrated on details. Some suggest there may have been as many as eight or more flood episodes.[13] One of the studies proposed that water flowed at 108 kilometers per hour, eroding the deep channels in the hard volcanic rock in a few hours or days.[14]

Eventually Bretz's masterful interpretations, based on careful study of the rocks, were accepted by most of the geological community. In 1965 the International Association for Quaternary Research organized a field trip to the region. At the conclusion of the conference, Bretz, who was unable to attend, received a telegram from the participants sending him their greetings and closing with the sentence: "We are now all catastrophists."[15] In 1979 Bretz was awarded the Penrose Medal, the United States' most prestigious geological award. Bretz had won; so had catastrophism. This modern-day "Noah" and his likewise unwanted flood had been vindicated.

Turbidity currents

By the middle of the 20th century, some geologists had noticed that strict uniformitarianism contradicted the data from the rocks themselves. Bretz had found evidence of very rapid action. Other scientists were finding sedimentary layers with both shallow- and deep-water components.[16] How could these ever get mixed together under quiet conditions? The resolution: catastrophic underwater mud flows, starting from shallow water and flowing down to deep water. These fast mud flows, called *turbidity currents*, produce special deposits called *turbidites*. Turbidites have turned out to be surprisingly common all over the world. A few other daring thinkers have suggested other catastrophic activities such as mass extinctions caused by influxes of high-energy cosmic radiation[17] and the sudden spread of fresh arctic water over the world oceans.[18] All of these theories indicate a growing departure from strict uniformitarianism.

The coup de grace for the dominance of uniformitarian explanations did not, however, come from the study of the rocks themselves, but from the fossils they contained. Why did the dinosaurs disappear near the end of the Cretaceous, and why were other mass extinctions evident at other levels of the fossil record? Some reasonable cause must be found. Various explanations had been proposed for the extinction of dinosaurs, ranging from starvation to poisonous mushrooms or even hay fever. Nevertheless, their disappearance had

been generally considered a mystery. Then in 1980 Nobel Prize Laureate Luis Alvarez, from the University of California at Berkeley, and others[19] suggested that the unusual abundance of the element iridium found at a number of places throughout the world at the top of the Cretaceous layers might have come from an asteroid hitting the earth and killing off the dinosaurs. The idea engendered a mixed reaction. Some questioned it because the dinosaurs and other organisms did not seem to disappear that suddenly in the fossil layers. Others proposed widespread volcanic activity and global fires, or an impact from a comet instead of an asteroid.

The debate about details continues, but the door to catastrophic interpretations is wide open. The scientific literature now reports a wide range of sudden major changes.

Newer catastrophic ideas

Some of the newer catastrophic ideas propose that comets or asteroids could send ocean waves up to heights of eight kilometers[20] and plumes of volatiles hundreds of kilometers above Earth's surface.[21] Other proposed effects include 500° C blasts of air at 2,500 kilometers per hour that would kill half of the life on earth, and global earthquakes accompanied by ground waves reaching heights of 10 meters. The opening of cracks that span 10 to 100 kilometers and rapid mountain building have also been proposed.[22] There is even a suggestion that these impacts could have initiated the break up of Earth's ancient supercontinent called Gondwanaland.[23]

Catastrophism has made a rapid return, but it is not exactly the classical catastrophism of two centuries ago that incorporated the biblical Flood as a major geologic event. Interestingly, some geologists recently suggested that an extraterrestrial impact could be related to the Genesis flood account.[24] At present, major rapid catastrophes are readily accepted, but in contrast to the biblical flood, which took only one year, an abundance of time is introduced between many major catastrophes. The term *neocatastrophism* seems to be gaining acceptance, as attempts are made to distinguish the newer concept from the older catastrophism. The return to catastrophic interpretations has been identified as "a great philosophical breakthrough,"[25] and it is acknowledged that "the profound role of major storms throughout geologic history is becoming increasingly recognized."[26] This latter view fits well with the biblical model of the Deluge as an extended series of storms during the year of the Flood.

Neocatastrophism has stimulated reinterpretation of many geologic features. For instance, many sedimentary deposits thought to have accumulated slowly are now interpreted as the result of rapid turbidity currents, and a number of fossil coral reefs, previously thought to have formed slowly, are reinterpreted as rapid debris flows.

Examples of rapid action

Under normal, quiet conditions, changes in Earth's surface proceed very slowly. However, there are many examples of catastrophic activity that suggest major changes in a short time.

Erosion can occur very rapidly. In 1976 the newly built Teton Dam in Idaho (U.S.A.) sprang a leak that could not be stopped, and the rushing water cut through sediment to a depth of 100 meters in less than one hour. The dam was made of soft sediment, which is easily eroded. However, it has been proposed that Bretz's channels, mentioned earlier, which are in hard basalt rock, were cut to equivalent depth in a few days. The carrying capacity of moving water has been determined to increase as the third to fourth power of the velocity.[27] This means that if the speed of flow is increased 10 times, the water can carry 1,000 to 10,000 times as much sediment.

Non-creationists sometimes point out that the geologic column is far too thick to have been deposited in the single year of the Deluge.[28] This may not be a significant argument. While most creationists would exclude the lowest (Precambrian) and highest portions of the geologic column from the Flood, some present rates of deposition are so rapid that there would be little problem in depositing the whole column in a few weeks. Turbidity currents can deposit their sediment in a single locality in a few minutes or less, and over thousands of square kilometers in a few hours. Large turbidites, called *megaturbidites*, found in Spain have thicknesses up to 200 meters, along with an immense volume of 200 cubic kilometers.[29] There are also several methods other than turbidity currents that cause the rapid deposition of sediments. An intense Deluge lasting a year could deposit a lot of sediment.

The accumulation of thick layers of tiny microscopic organisms such as the White Cliffs of Dover in England is often presumed to require lengthy periods

of time. But such accumulation can occur rapidly. Along the coast of Oregon (U.S.A.), a three-day storm of high winds and rain deposited 10 to 15 centimeters of microscopic diatoms for a distance of 32 kilometers. I have seen a well-preserved fossil bird and many fish in thick deposits of microscopic diatoms near Lompoc, California. A whale was also found in this deposit. Such preservation would require rapid burial before disarticulation of the organism takes place.[30] It has been found that disarticulation in birds normally occurs in a few days. Evidently some layers of microscopic organisms have been deposited rapidly.

Some implications

We can learn from the history of the catastrophic-uniformitarianism interpretations. For millennia, catastrophes were accepted, then for well over a century they were virtually eradicated from all scientific thought; now they are well accepted again. This illustrates how science often changes its views, and sometimes even accepts rejected concepts. The Bible, on the other hand, does not change. It is of interest that the reacceptance of catastrophes came mainly from the study of the rocks themselves. We should be cautious about accepting broad views, such as uniformitarianism, that are based on opinion or a restricted amount of information. Furthermore, the newer catastrophic interpretations, now reaccepted by science, show that major events can occur rapidly. This makes the biblical account of beginnings, including Creation and the Flood, all the more plausible.

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Notes and references

1. S. Thorarinsson, *Surtsey: The New Island in the North Atlantic*, S. Eysteinsson, tr. (New York: The Viking Press, 1964), p. 39.
2. For general reviews, see: D. Ager, *The New Catastrophism: the Importance of the Rare Event in Geological History* (Cambridge and New York: Cambridge University Press, 1993); A. Hallam, *Great Geological Controversies*, 2d. ed. (Oxford and New York: Oxford University Press, 1989), pp.30-64, 184-215; R. Huggett, *Cataclysms and Earth History: the Development of Diluvialism* (Oxford: Clarendon Press, 1989).
3. C. Lyell, *Principles of Geology; or The Modern Changes of the Earth and Its Inhabitants Considered as Illustrative of Geology*, rev. ed. (New York: D. Appleton & Co., 1857).
4. J. H. Bretz, "Glacial Drainage on the Columbia Plateau," *Geological Society of America Bulletin* 34 (1923): 573-608.
5. Bretz, "The Channeled Scablands of the Columbia Plateau," *Journal of Geology* 31 (1923): 617-649.
6. J. E. Allen, M. Burns, and S. C. Sargent, *Cataclysms on the Columbia: Scenic Trips to the Northwest's Geologic Past, No. 2* (Portland, Ore.: Timber Press, 1986), p. 44.
7. J. H. Bretz, "The Channeled Scabland: Introduction," in V. R. Baker, ed., *Catastrophic Flooding: the Origin of the Channeled Scabland: Benchmark Papers in Geology 55* (Stroudsburg, Penna.: Dowden, Hutchinson & Ross, 1981), pp. 18, 19.
8. Baker, p. 60 (note 7).
9. For a report of the presentations and discussions, see J. H. Bretz, "Channeled Scabland and the Spokane Flood" in Baker, pp. 65-76.
10. Ibid., p. 74.
11. J. H. Bretz, H. T. U. Smith, and G. E. Neff, "Channeled Scabland of Washington: New Data and Interpretations," *Geological Society of America Bulletin* 67 (1956): 957-1049.
12. Ibid., J. T. Pardee, "Unusual Currents in Glacial Lake Missoula, Montana," *Geological Society of America Bulletin* 53 (1942): 1569-1600.
13. J. H. Bretz, "The Lake Missoula Floods and the Channeled Scabland," *Journal of Geology* 77 (1969): 505-543; M. Parfit, "The Floods That Carved the West," *Smithsonian* 26 (1995) 1:48-59.
14. V. R. Baker, "Paleohydraulics and Hydrodynamics of Scabland Floods" in: Baker, pp. 255-275 (note 7).
15. Bretz 1969 (note 13).
16. M. L. Natland, P. H. Kuenen, "Sedimentary History of the Ventura Basin, California, and the Action of Turbidity Currents," *Society of Economic Paleontologists and Mineralogists Special Publication* 2 (1951): 76-107; F. B. Phleger, "Displaced Foraminifera Faunas," *Society of Economic Paleontologists and Mineralogists Special Publication* 2 (1951): 66-75.
17. O. H. Schindewolf, "Neocatastrophism?" V.A. Firsoff, tr. *Catastrophist Geology* 2 (1977): 19-21.
18. S. Gartner and J. P. McGuirk, "Terminal Cretaceous Extinction Scenario for a Catastrophe," *Science* 206 (1979): 1272-1276.
19. L. W. Alvarez, W. Alvarez, F. Asaro, H. V. Michel, "Extraterrestrial Cause for the Cretaceous-Tertiary Extinction," *Science* 208 (1980): 1095-1108.
20. W. M. Napier, S. V. M. Clube, "A Theory of Terrestrial Catastrophism," *Nature* 282 (1979): 455-459.
21. H. J. Melosh, "The Mechanics of Large Meteoroid Impacts in the Earth's Oceans," *Geological Society of America Special Paper* 190 (1982): 121-127.
22. V. Clube, B. Napier, "Close Encounters with a Million Comets," *New Scientist* 95 (1982): 148-151.
23. V. R. Oberbeck, J. R. Marshall, and H. Aggarwal, "Impacts, Tillites, and the Breakup of Gondwanaland," *Journal of Geology* 101 (1993): 1-19.
24. E. Kristan-Tollmann, and A. Tollmann, "The Youngest Big Impact on Earth Deduced From Geological and Historical Evidence," *Terra Nova* 6 (1994):209-217.
25. E. Kauffman, quoted in R. Lewin, "Extinctions and the History of Life," *Science* 221 (1983): 935-937.
26. D. Nummedal, "Clastics," *Geotimes* 27 (1982)2: 22-23.
27. A. Holmes, *Principles of Physical Geology*, rev. ed. (New York: The Ronald Press Co., 1965), p. 512.
28. E.g., R. L. Ecker, *Dictionary of Science and Creationism* (Buffalo, N.Y.: Prometheus Books, 1990), p. 102.
29. M. Séguret, P. Labaume, and R. Madariaga, "Eocene Seismicity in the Pyrenees From Megaturbidites of the South Pyrenean Basin (Spain)," *Marine Geology* 55 (1984): 117-131.
30. P. G. Davis, D. E. G. Briggs, "The impact of decay and disarticulation on the preservation of fossil birds," *Palaios* 13 (1998): 3-13.