

DILUVIAL THEORY

Excerpts from Ships Resource Center at the University of Minnesota
<http://www1.umn.edu/ships/religion/diluvial.htm>

The diluvialists made at least two significant and lasting contributions to geology--raising awareness of two sets of phenomena that might have gone unnoticed without the "bias" introduced by Biblical thinking, and collecting observations with a corresponding motivation.

The first began with William Buckland's (1784-1856) award-winning discovery and research on fossil assemblages. Buckland was appointed to the first chair of geology at Oxford University in 1814. In 1821 he examined the newly found Kirkdale cave in northern England. The cave floor was littered with bones, some half-buried in dried silt. Buckland made the obvious inferences that the cave had formed first, the bones deposited next, and then the mud. The silt, he reasoned further, must have come from a flood, which he equated with the Noachian deluge. The bones included hyenas, rhinos, and elephants--animals not found in England. Reasoning that the large animals could not have entered the cave through its narrow opening, Buckland concluded that he was walking in an antediluvian hyena den. The mixed collection of fossil bones allowed him to reconstruct the world before Noah. Buckland's research earned him the Royal Society's highest honor, the prestigious Copley Medal, in 1822--the first time it was ever awarded for geological work.

Buckland's work inspired similar research, even across the Channel in France. Unfamiliar ancient fauna in each area became evident. It soon became clear that if there had been a flood, there had been many floods, burying bones in caves at different times. Some came to see Noah's flood as the last of many. The Earth may have been much older than once imagined, but the evidence for flooding certainly concurred with Biblical testimony. Buckland himself was later able to divorce his own discovery from the explanation he had originally assigned to it. His discovery and all those he inspired nevertheless remained.

The second major contribution of diluvial geologists involves what we now call glacial erratics--large boulders up to several tons that did not match the underlying bedrock or nearby elevated strata, but which sometimes matched rock far away. In one case, boulders in central England were traced to Norway! Had the rocks really moved? How? Visible scratch marks in the underlying bedrock supplied the first clues to their origin. The deep grooves were likely vestiges of scouring by the huge rocks, which would have been moved in catastrophic movements of water, such as during a worldwide flood. Such immense floods would seem implausible, of course, were it not for independent accounts in Biblical narratives.

Other phenomena confirmed the geologists' conclusions. Piles of rocks lined some hillsides, as though left by water. Charles Darwin (1809-1882), a young emerging geologist, explained one such set as the successive shorelines of a receding ocean. In other places, mixtures of large rocks and fine-grained silt indicated former turbulence. Many of these observations were found in open, rounded valleys, such as might result from the erosive action of powerfully moving rocks.

Diluvialists focused on these phenomena with meaningful vigor. They documented where the enormous boulders occurred and where they had come from. Later, their collected information would be invaluable evidence for another interpretation: that these rocks had been moved by glaciers. The glacier hypothesis at first was far less plausible, however, and was viewed with proper skepticism. After all, how could a sheet of ice move, since it was not fluid like water? Ultimately, the concept of glaciers, championed by Louis Agassiz (1807-1873), was able to explain the particular location of erratics and numerous other small facts. And most diluvialists acknowledged the broader evidence and adopted the once implausible glacial theory.

No well-informed geologist now accepts the diluvialist hypothesis, but it is hard to discount how it contributed to building current knowledge. How could a hypothesis that seems misleading (in retrospect) have been so productive? Trial and error, conceptual change, and theoretical development are all integral parts of science as a process. Should religion alone be singled out for criticism?

Diluvial geology is an occasion for several important lessons about science. First, motivation and guiding ideas are important elements of research. Without these, science does not even begin. Second, science is not just about having confirming evidence. Evidence may support several conflicting hypotheses at the same time. Hence, scientific controversies arise. When students master the basics of the relevance of observations, they are ready to learn, on a more advanced level, how scientists resolve conflicts among competing interpretations of the data. Finally, scientific knowledge changes. New observations do not always fit conveniently as mere additions within the framework of an early theory. Human imagination allows us to perceive different or more complex patterns that wholly reconfigure and

unify the information. The former theories, while not completely "wrong," may still grossly mislead us outside a certain domain. In these three ways, diluvial notions once promoted good science. Valuable lessons lie hidden, here, though they may best be learned elsewhere first, outside a religious context with strong emotional overtones.

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DRIFT THEORY

Excerpts from Ships Resource Center at the University of Minnesota
<http://www1.umn.edu/ships/glaciers/Lyell.htm>

Drift theory as an alternative to diluvial theory had two main supporters, Charles Lyell (1797---1875) and Roderick Murchison (1792---1871). Lyell thought that violent currents alone from a global flood were not sufficient enough to explain the movement of huge erratics and boulders sometime hundreds of mile from their origin. In the 1833 edition of Lyell's *Principals of Geology* he suggested a different version of flood theory. He proposed that these boulders might have simply been frozen in large icebergs and drifted from their origins during the Noachian flood. Over time the icebergs melted thereby depositing their geologic passengers in a new location, possibly hundreds of miles from where they started.

Lyell reported on observations of sea ice breaking off from coasts in the Denmark---Sweden Sound (see de Brongniart's comments on this) and in the Gulf of St Lawrence: this sea---ice contained large blocks of rock and this he suggested might be a mode of transportation for erratics in the Baltic and around the coasts of Britain. Ice floes were also reported to contain masses of gravel and mud. New "reefs of rock" had been apparently caused by floes piling up and melting in certain locations, he had been told by correspondents. Given the latitude at which these processes had been observed, "It is therefore by no means necessary to speculate on the former existence of a climate more severe than that now prevailing in the Western Hemisphere in order to explain how the travelled masses in Northern Europe may have been borne along by ice. We know from independent evidence that large parts of the lands bordering the Baltic, and now strewn over with erratics, have constituted the bed of the sea at a comparatively modern period."

Regarding Alpine erratics, Lyell ventured a different, and familiar, explanation: "a combination of local causes might have contributed to their transfer; for repeated shocks of earthquakes may have thrown down rocky fragments upon glaciers, causing at the same time avalanches of snow and ice, by which narrow gorges would be choked up and deep Alpine valleys, such as Chamouni, converted into lakes. In these lakes, portions of the fissured glaciers, with huge incumbent or included rocks might float off, and on the escape of the lake, after the melting of the temporary barrier of snow, they might be swept down into the lower country."

Lyell studied the "mud-cliffs" of coastal Norfolk in 1829 and again in 1839. Lyell referred to a component of the "mud-cliffs" as "stratified and unstratified drift" -- "called by some diluvium." This drift is similar, he says, to the "boulder formation" (till) he has seen in Denmark and Sweden and which is common "in all countries surrounding the Baltic as well as in northern Russia." It contains erratics of various sizes. "It may be said to extend uninterruptedly from Sweden through the Danish islands . . . to the borders of Holland, and then to appear again with the same characters in Norfolk and Suffolk."

But, having made this connection, Lyell favored of a different conjecture he had discussed in 1836:

"There can be no doubt that similar accumulations must take place in those parts of every sea, where drift ice, into which mud, sand, and blocks have been frozen, melts in still water, and allows the denser matter to fall tranquilly to the bottom. The occasional intercalation of a layer of stratified matter in the till, or the superposition or juxtaposition of the same, may be explained by the existence or non--existence of currents, during the melting of the ice, whether successively in the same place or simultaneously in different places."

However, perhaps the strongest case for the "drift" origin of erratics and drift itself was at this time made by Roderick Impey Murchison (1792--1871) as part of his masterly work on "The Silurian System." His synthesis of the geologic evidence and of the processes involved made the drift theory a difficult theory for others to overcome, and Murchison, along with Lyell and Darwin, never abandoned it. Murchison used the term drift, as Lyell did: to denote the "superficial detritus" that was the product of regional submergence of the land. He avoided the older term "diluvium" because of what he viewed as its original association with "the [universal] Deluge of Holy Writ" (p.509). Murchison noted that the drift commonly contained marine shells and so must have been deposited under marine waters. Shells were reportedly found even at altitudes of up to 1750 feet, on Moel Tryfan in Wales (for example, by Joshua Trimmer, in 1834 -- something that Murchison went to great pains to substantiate). The fact that these were existing species indicated that the submergence was comparatively recent, according to Murchison. However, some of the shells were reported to be of higher latitude species. Murchison argued that the existence of shells, making the drift "submarine," precluded a glacial origin, such as was proposed by Esmark (p. 538). "Northern drift" (as opposed to local drift) also contained erratic "granite boulders," indicating that it was "foreign or transported from a distance." Murchison, like de Charpentier, reasoned that both the drift and the boulders could not be deposited by a diluvial current because a current, should one be shown strong enough to actually transport the boulders, would have carried off the gravelly and finer drift.

Instead, Murchison argued that the boulders were deposited from melting ice floes (ice bergs) “upon a submarine surface of gravel, sand, and shells” (p.539).

Could ice floes be a viable hypothesis?

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