

History of development of concept of Uniformitarianism, Catastrophism and Neptunism

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Uniformitarianism

“Current geological processes are the same as those at work in the past”

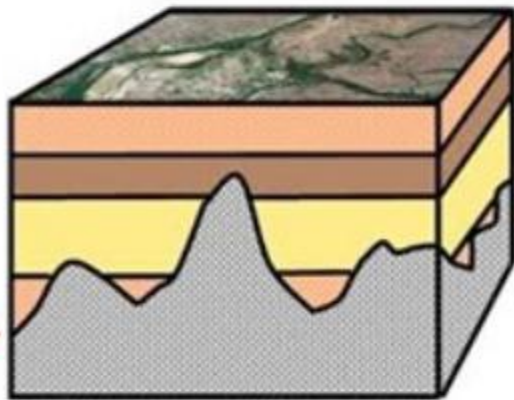
- ✓ Uniformitarianism is a theory based on the work of James Hutton and made popular by Charles Lyell in the 19th century. This theory states that the forces and processes observable at earth's surface are the same that have shaped earth's landscape throughout natural history.
- ✓ The earth sculpting processes alluded to above are the processes of erosion, deposition, compaction and uplift. Although these processes are constant, they occur at extremely slow rates.
- ✓ As a farmer, Hutton realized that the rates of erosion were so slow that it would take an inconceivable amount of time to observe drastic changes in Earth's landscape.

Unconformities

Movements of the earth lift up rock layers.

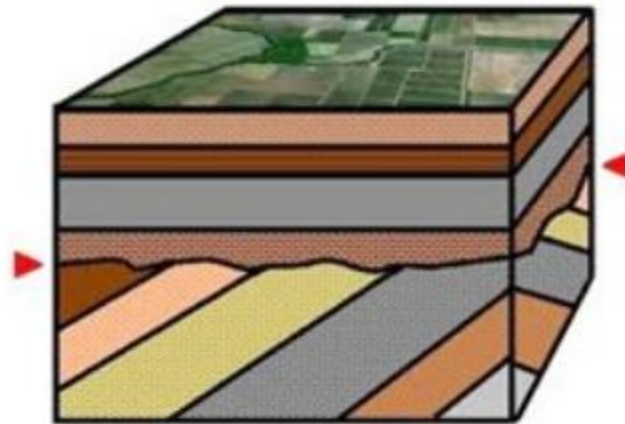
Layers are exposed to erosion.

Sediments are deposited, forming new rock layers



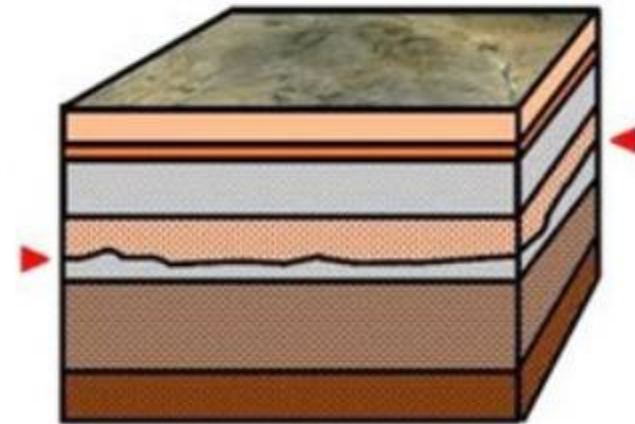
NONCONFORMITY

Stratified rock rests upon unstratified rock



ANGULAR UNCONFORMITY

Stratified rock rests upon tilted stratified rock



DISCONFORMITY

Stratified rock rests upon stratified rock, with a large time gap

- ✓ The theory also states that these processes have occurred at constant rates throughout natural history. James Hutton explains this idea in his book entitled Theory of the Earth, “... we find no vestige of a beginning – no prospect of an end.” Hutton was the first scientist to conclude that the age of the Earth must be so incredibly old that the mind can’t begin to estimate its length.
- ✓ Charles Lyell even went to the Paris Basin to observe the rocks responsible for catastrophism, a theory in direct opposition with uniformitarianism. Based on catastrophism, the forces shaping the earth are not constant. However, when Lyell observed the mass extinction events in the fossil succession of the Paris Basin, he drew a very different conclusion.
- ✓ Lyell recognized that cyclical depositional environments and reoccurring extinctions show that there are controls that cause these processes to be recurrent. However, Lyell saw these processes as taking place over vast amounts of time and only appearing to be abrupt because of the scale of time preserved in the rocks.

- ✓ Lyell's theory of uniformitarianism would eventually coincide with plutonism as the foundation of modern geology. Uniformitarianism is also the first theory to predict deep time in western science. Deep time is the idea that Earth history is so deep that a person can't possibly conceive the amount of time that has passed on planet earth. This further proved that the earth could not be a few thousand years old, as believed by theologian scientists.

Catastrophism

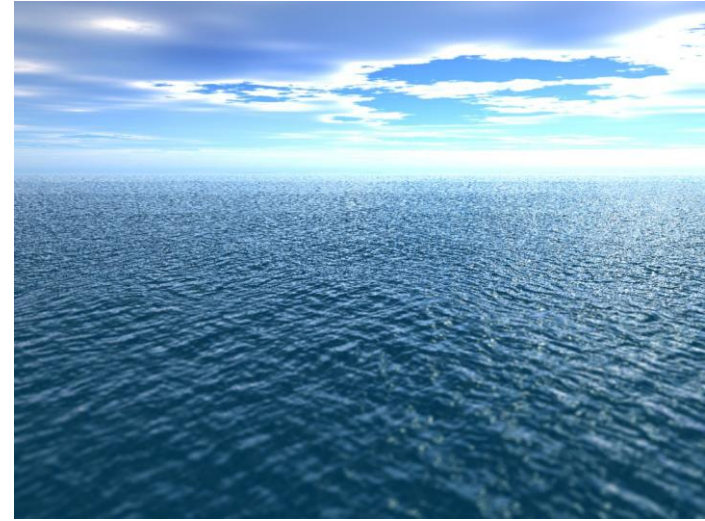
“Catastrophism is the theory that the Earth has largely been shaped by sudden, short-lived, violent events, possibly worldwide in scope”

- ✓ Catastrophism was a theory developed by Georges Cuvier based on paleontological evidence in the Paris Basin. Cuvier was there when he observed something peculiar about the fossil record.
- ✓ Instead of finding a continuous succession of fossils, Cuvier noticed several gaps where all evidence of life would disappear and then abruptly reappear again after a notable amount of time. Cuvier recognized these gaps in the fossil succession as mass extinction events.
- ✓ This led Cuvier to develop a theory called catastrophism. Catastrophism states that natural history has been punctuated by catastrophic events that altered that way life developed and rocks were deposited.

- ✓ Although Cuvier hypothesized that the flooding of lowland areas could have been the cause of mass extinctions, he never really explained any force that could cause the flooding to occur in the first place. Therefore, an implication of Cuvier's theory is that the forces acting on the earth must have changed periodically throughout earth's history. Because Cuvier never identified these forces, many individuals believed these extinctions could have been the result of biblical floods or acts of god.
- ✓ An avid supporter of catastrophism was Abraham Werner, the leading geologist of the 18th century. As we have seen before, Werner was the most influential supporter of neptunism, a theory stating that most of the rocks observable at earth's surface were once precipitated out of a vast ocean. Therefore, Werner used catastrophism as evidence to prove that the earth had experienced mass floods throughout geologic history. However, both catastrophism and neptunism would eventually be discarded during the 19th century.

Neptunism

“Neptunism was a theory stating that the majority of the rocks that comprise earth’s surface were once precipitated out of a vast ocean”



- ✓ Neptunism states that the Earth was once completely covered by an ocean. Then, as this ocean receded, all of the rocks observable at Earth’s surface were precipitated out of the ocean in a definite order to form the current landscape. The rock types were differentiated by the period of time in which they precipitated out of the ocean.
- ✓ According to Werner’s theory the ocean floor was an originally uneven surface on which the oldest rocks precipitated during the primitive period. The primitive period was characterized by very deep, calm water conditions. Werner attributed the formation of crystalline rocks, such as granite, to these conditions.

- ✓ The next period of Werner's geologic timescale was the floetz period. This period was characterized as alternating between a shallow stormy ocean and a deep calm sea. This alteration between depositional environments apparently represented rocks with inconsistent or broken stratification. These rocks as well as volcanic and alluvial rocks are concurrent but are the result of different forces. For example, floetz were precipitated out of a universal ocean while basalts were believed to form by the burning of underground coal deposits.
- ✓ Werner eventually realized that some of his primitive rocks contained fossils, so the transitional period was created to account for this discrepancy. The transitional period marks the slow transition from calm ocean conditions to stormy conditions that caused the extinction of fossils found in the transitional period.

- ✓ It must be noted that Werner never traveled much. His interpretations of the landscape only pertained to the area where he taught. His assumption that the rocks he was observing must be the same everywhere else was his fundamental error. Werner's theory of neptunism is a perfect example that assumptions in science are toxic to a well-developed understanding of the world.