



Time Matters: Geology's Legacy to Scientific Thought, by Michael Leddra, 2010, Wiley-Blackwell, John Wiley & Sons Ltd, Chichester, 288 p., paperback, USD 64.96, ISBN 978-1-4051-9909-4

Michael Leddra presents an interesting account of the history of geologic time in his book *Time Matters: Geology's Legacy to Scientific Thought*. Leddra makes a compelling case for the importance of understanding the history of all sciences, not just geologic time, as he outlines the humanity and contemporary constraints that influence the practice of the scientific method. The author writes cogently about the social influences of religion (George Louis Leclerc, Comte de Buffon, publishing age estimates of the Earth at 3,000 years while his unpublished work indicates estimates of 3 million years), industry (Abraham Gottlob Werner developed rock classifications to aid in the prediction of industrial mineral and or rock location), as well as politics, egos, popular opinion, and more recently, popular media. Discussions about how such debates as Plutonism versus Neptunism (chapter 4), uniformitarianism versus catastrophism (chapter 5), evolution versus creationism (chapter 7), and continental drift and plate tectonics (chapter 8) have been resolved through time, however, demonstrates the eventual balance of the scientific method.

Leddra emphasized evaluating research relative to its contemporary standards. *Time Matters* provides the historical context in which to make such assessments. The author presents the development of the Geologic Time Scale, providing the science (Mary Anning's reconstruction of the Plesiosaurs) and the social influences (deceitful geologists using Anning's fossils without giving her credit). The reader also learns about the scientists themselves and how they fit into history (the famous tongue twister "she sells sea shells, by the seashore" is based on Anning's life). The casual historian of geology will not be surprised that there is conflict between religious and scientific theories of time and the history of the Earth. The book, at times, feels like a debate between evolution and creationism. This is unfortunate because it distracts from the science as well as overlooking other possible influences on understanding geologic time.

As a student of geology and a cognitive scientist, I have worked to identify psychological factors that may influence the perception of geologic time. For example, creationist time scales may be psychologically appealing because the creationist stories reduce all of Earth's history into a much more familiar and cognitively manageable range. Geologic time may be so far

removed from familiar human event scales that it is difficult to reason about and understand. Prior knowledge, experiences, and beliefs also influence learning and retention of new information, with preconceived notions being especially resistant to change.

Time Matters is aimed at university geology and geography students and would be a great way to address student misconceptions and difficulties in understanding geologic time. *Time Matters* explicitly addresses such common misconceptions throughout history as creationist stories that the reader may also possess. The reader is also given additional time and practice dealing with unfamiliar concepts, magnitudes, and the logic of geologic time. As a result, students may be better prepared to integrate new ideas about geologic time with existing ones.

Students often struggle with understanding geologic time. Difficulties may arise in part from a disconnect between how humans perceive, remember, and reason about things that happen over time and science's conception of time as a single metric dimension. People think in terms of events, not the interval scale of linear time. Student difficulties may be explained by a sparsely populated framework of geologic events and boundaries. In reporting on the historical account of the development of geologic time, *Time Matters* provides rich descriptions of hierarchical information and important event boundaries. This will help students populate their timelines with event information, thus creating a better sense of geologic time.

In sum, *Time Matters* would serve as an excellent supplementary text in an introductory-level geology classroom. The inclusion of *Time Matters* into course curriculum would be an effective way to highlight a foundational concept that is all too often absent. The engaging style and interesting content of *Time Matters* also make this book appropriate for anyone with an interest in geology or the history of science.

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