



FROM THE
PRESIDENT
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A reasonable argument can be made that Charles Darwin's *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* is the most important scientific work of the last 200 years. The fundamental concepts of evolution derived from his work have application across a wide range of scientific disciplines including biology, ecology, immunology, psychology, and sociology. Interestingly, it is probably earth science that played the most important role in the formulation and ultimate acceptance of this work. This underscores the importance of earth science as a foundational element of all natural sciences. The biggest challenge to the acceptance of Darwin's theory has always been the principle of creationism. Understanding creationism in the context of earth science is really what opened the door for Darwin.

The essence of the scientific problem with creationism was captured in the exchange in which Clarence Darrow examined William Jennings Bryan in the 1925 Scopes Trial. In that exchange Bryan explained how in 1650 Irish bishop James Ussher had determined that the earth was created at midday on October 23, 4004 B.C. Modern science recognizes that the earth is approximately 4.6 billion years old, and Ussher's calculation that the earth is only 6,000 years old is often attributed strictly to religious dogma. However, noted evolutionary biologist Stephen Jay Gould famously came to Ussher's defense in his 1991 essay "*The Fall of the House of Ussher*." Gould contended that Ussher had used "the best of scholarship in his time. He was part of a substantial research tradition, a large community of intellectuals working toward a common goal under an accepted methodology." Ussher's findings

were likely not based solely on religious belief. Gould noted that many cultures have had creation stories that invoke a very similar timeframe. It is likely that the 6,000-year period of creationism is the result of a basic limitation of human beings to perceive the span of geologic time. In much the same way that humans are only capable of seeing a narrow window of the electromagnetic spectrum that we call "visible light," it is likely that we are only inherently capable of conceiving of a narrow span of time equivalent to the 6,000 years that we commonly call "recorded human history." Technology has allowed for us to devise ways to "see" wavelengths in the infrared and ultraviolet portions of the spectrum, and we have similarly developed analogs and metaphors that help us to understand the scope of geologic time, such as the "football field geologic time scale." It appears likely however, that creationism exposes a basic human tendency to limit our perception of the world to the last 6,000 years. That is in fact the principal challenge that creationism poses to science literacy.

The first serious challenge to creationism came during the 18th century Scottish Enlightenment. James Hutton, who is often considered to be the father of geology, studied the rock outcrops around Edinburgh, and determined that the earth would have to be considerably older than 6,000 years to allow for all of the complexities that he was seeing in the rocks. Hutton proposed that the modern landscapes were not the result of a continuous, straight-line set of processes from creation to the present, as creationism held. He saw them as the result of innumerable cycles of building, destruction, and rebuilding. The creationism did not allow for the many repeated cycles of change that were recorded in the rocks. The development of Hutton's work was popularized by Charles Lyell. Lyell was a close friend of Darwin's, and Darwin carried a copy of Lyell's seminal work *Principles of Geology* on the HMS Beagle. There can be no doubt that Hutton's recognition of natural cycles and Lyell's focus on stratigraphy, paleontology and paleoanthropology heavily influenced Darwin in the development of his theory.

It is significant that the biggest challenge to Darwin's theory at the time of its publication also came from the earth science community. William

Thompson (Lord Kelvin) was widely recognized as one of the great scientific minds of the 19th century. It was his work in thermodynamics and heat conductivity that led him to conclude that the earth was not old enough to have allowed time for Darwin's model to have played out. Based on his largely correct calculations of heat flux, Kelvin concluded that the time span over which planet earth could support life could not exceed 400 million years, at which time it would succumb to "heat death." Kelvin was such a highly regarded scientist, his refutation of Darwin's theory shortly after its publication may have had lingering effects that carry through until today. Toward the end of his career Kelvin recognized that there were "two dark clouds" looming over the understanding of the dynamics of heat and light. In this regard he correctly predicted the scientific explosion

of the early 20th century, which brought about the theories of quantum mechanics, relativity and radioactivity. It turned out that radioactive heating was the heat source that Kelvin did not include in his calculations, and which explains how the planet has been able to sustain life for billions of years.

The interaction between earth science and Darwin's theory captures the true essence of science. It is not that Hutton, Lyell and Darwin were correct and Ussher and Kelvin were incorrect. It is that science is always in a continuous state of flux. It is as important to recognize the importance of Ussher's work as it is to recognize Darwin's work. Every aspect of scientific theory must always be subject to review and re-review. As soon as we say "the science is set" it ceases to be science.

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