The revolution in geology from the Renaissance to the Enlightenment, edited by Gary D. Rosenberg, 2009. GSA Memoir Series # 203(order through Geological Society of London in Europe), hardcover, 283 pp. Price US$ 80.00, £ 57.50; member price US$ 56.00, £ 40.00. ISBN 9780813712031.

A conference on Niels Stensen (Steno) by the 'History of Geology Division' of the Geological Society of America in Philadelphia (2006) resulted in this memoir on the place and development of geology in the Western world. It addresses emerging concepts and descriptions of three-dimensional landscapes and of the solid Earth, allowing recognition of shaping processes in their proper sequence. This was defined parallel to a "growing understanding of anatomy and against lingering questions whether a designer or deity had to be considered" (Rosenberg).

Anatomist Nicholas Steno established a number of basic principles of geology in his study of the structure of the hills in Tuscany. Gian Battista Vai shows that artists were able to portray in realistic scientific detail three-dimensional characteristics of geological strata. Isaac Newton is not the first person that comes to mind as a founder of geology. However, W.R. Newman shows that his alchemistic model of subterranean metal and mineral formation demonstrates interest in spatial relationships of chemical reactions within the Earth. This is further pursued in J.P.Melero's contribution about mining in Spain and its New World colonies. He introduces Alvaro Alonso Barba's approach on mining techniques and ore generation, summarized as the last alchemical treatise before the transitional work of F.X.de Gamboa to a modern understanding of ore generation and mining practices. In addition to many other curious interests, the Jesuit Anastasias Kircher was also interested in the interior of the Earth. W. Parcell shows him capable to separate observation from religious interpretations although Kircher also confusingly mixes iconic divine symbols with opinions that variously call upon natural and supernatural causes.

Ten papers discuss various aspects of the life and work of Nicholas Steno. Vai emphasizes that his life is punctuated by two conversions, from anatomist to geologist and from Lutheran to Roman Catholic. Neither made Steno abandon previously held values. Catholicism may even have facilitated a pragmatic and liberal approach to science. According to E. Thomsen, Steno shows himself one of the first modern taxonomist in his publications as a skillful anatomist. He was deeply influenced by 'Wunderkammer' or 'Curiosity cabinets in Denmark, Holland, France and Italy, which made him a collector and a classifier.

Kuang-Tai Hsu demonstrates Steno's capacity for comparative medical jurisprudence based on the presentation of evidence of structure and form to contradict opposing theories. Steno used this to argue that Glossopterae are sharks teeth rather than productions from 'plastic forces in sediments as shaping agents'. Toshihiro Yamada discusses Steno's vs. Robert Hooke's priority for recognizing a biological origin of the Glossopterae and formulating a number of principles of geology, a matter of dispute since Steno's and Hooke's time. Steno derived the sequence of formation of two adjacent objects from their spatial and structural relationships. T. Kardel argues that he applied this when sequencing biological and geological events. Jesuit scholar A. Ziggelaar argues that Steno was a Diluvianist but not a Creationist, which he bases on his translation of Steno's note book 'Chaos', in which Steno even presented a chronology of the Earth before the Biblical Flood. Both Ziggelaar and A. Cutler note that nothing in Tuscany's history, as analyzed by Steno, allows measuring the duration of natural history.

According to S. Olden-Jørgensen, Steno was deeply influenced by Descartes, although he later rejected Descartes' deductive reasoning and his 'certainty'. J.M. Hansen identifies 'uncertainty' as the crux of Steno's philosophy. This is best shown in his aphorism: "what is most beautiful is that which we do not understand". He also contrasts Newton's 'infinite predictability' with Steno's

empiristic belief that science does not proceed to divine understanding. According to F. Sobiech, Steno left science because he felt that he was drifting away from "intimate relations with God". But the publication of his seminal 'Prodromus' and of some anatomical studies shows that he did not abandon science.

N. Heringman discusses why the British were slow in embracing evolutionary science. In line with Vai's conclusion, he points to British religious conservatism. But also, early evolutionary science was born in France while the (Napoleonic) war was waged with Great Britain with a large, poor population ruled by a small privileged upper class which distanced itself from social disruptions across the Channel. Moreover, the Geological Society of London formed of dedicated amateur naturalists rigidly pursued Baconian empiricism. All this is suggested in the contemporaneous poem 'Beachy Head' by Charlotte Smith.

In the new United States, Benjamin Franklin and Thomas Jefferson each contributed to the development of geology as detailed by D. Dean and S. Rowland. The relevance of this is the context, within the Enlightenment, not necessarily the content of their contributions. Franklin recognized that deterioration of the climate resulted in the demise of the mammoths of which fossil bones were found in Kentucky. Jefferson, however, rejected extinction of animals. Not because this was against his religious beliefs, but because he was against the allegations of French naturalist Buffon that New World life was degenerate.

A 'hot topic' was whether the newly discovered geometric order of nature pointed to God's design. V. Baker reviews Renaissance thinkers with various opinions on this. He introduces 19th century polymath S. Peirce, who showed how sedimentary strata, fossils and landscapes convey meaning about the history of the Earth. According to Peirce, hypothesizing was useful. It led to the understanding that the cosmos is a manifestation of divine action and is made for Man. However, W. Vanderburgh, in line with Rosenberg's conclusions, argues that scientists fit observations into prior conceptions and cites the work of Charles Lyell as an example. Finally, M. Ghiselin rejects a divine lawgiver and argues that random events play an influential role in Earth and life history. This idea Steno began to understand.

The exploration of the history of geology in this volume leads the reader through the ideas of landscape and the metaphysics of geology, raising contemporary issues with long antecedents. It shows that scientific discoveries are best understood in the context of the cultures that produced them. This volume attempts to do just that. Nicholaus Steno with his many sided activities is the guide. And in this process, Steno formulated fundamental geological laws. This book is a fascinating work, worthy of thorough study.

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