SCIENCE AND RELIGION: THE LIFE OF NICOLAUS STENO

The Seashell on the Mountaintop: A Story of Science, Sainthood, and the Humble Genius Who Discovered a New History of the Earth

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ISBN 0-525-94708-6

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Introductory geoscience textbooks sometimes credit the law of constancy of interfacial angles in mineralogy to the Seventeenth Century Danish naturalist Niels Stensen (also known as Nicolaus Steno, the Latinized form of his name). Steno is also commonly credited with developing the most basic stratigraphic principles of relative dating and with one of the first arguments that fossils were truly organic remains. Understandably perhaps, very little other context is provided beyond the fact that he worked in Italy and became a bishop in the Catholic Church: but then relatively little scholarly work is available to draw upon in English on Steno's life. One exception is Kardel's (1994) excellent, concise review of Steno's life and work which focuses particularly on assessing his science.

Alan Cutler's new, popular account of Steno's life allows us to appreciate Steno's greater achievements in science and, ultimately, makes one ponder the meaning of his religious conversion and death in pious poverty. Cutler's slim volume is the first original English biography of Steno and, at a mere 204 pages (plus index etc.), is the longest available in English, even in translation. The book details Steno's life, except for the last two chapters which assess the influence of his ideas in the subsequent history of geology. The only comparable book is perhaps Cioni (1962 translation), but it says relatively little about his science and tends towards hagiography.

Steno enrolled in the University of Copenhagen in 1656 to study medicine and, although he did not graduate (mainly owing to the upheavals of the Thirty Years War), he acquired great skill and a brilliant, almost virtuosic reputation for anatomical dissection in travels that took him to Amsterdam and Paris (he finally earned an MD from Leiden). During this time he discovered the salivary and tear glands, and the former is still today labeled the ductus Stenonianus (but perhaps his greatest anatomical discovery, later in Florence, was that human ovaries produced eggs which therefore implied that the female played an active role in human reproduction). Most important for his later career, his dissections of the brain lead him to refute Descartes' claim that the pineal gland was the means by which the soul animated the body: Steno thought Descartes' conclusion was based on sloppy dissection and an over-reliance on pure deduction. Steno's observations of the heart also lead him to reject Descartes' assertions that this organ acted as a furnace rather than a muscular pump, as Steno's observations suggested. Then, in the mid 1660s, he moved to Florence and obtained a position in the Accademia del Cimento ("Academy of Experiments") of Ferdinando II d'Medici, an institution that well suited his approach to knowledge.

Soon after arriving in Florence, in 1666, the head of a giant shark was delivered to Steno for dissection. Steno used his observations of the shark's teeth to argue that local "tongue stones" were in fact fossil teeth, leading him eventually to a general explanation of all marine fossils in the Mediterranean region and beyond as being the result of marine transgression (1667, Canis carchariae dissectum caput: A shark's head dissected). The view that fossils were organic in origin contradicted the influential Roman Jesuit scholar Athanasius Kircher who, like many others of the time, believed fossils were forms created within the rocks by, among other things, magnetism. One can surmise from Cutler's presentation that in some ways Kircher's opinions on fossils resembled Descartes' views on the role of pineal gland or the nature of the heart, but with a good deal of accumulated folklore thrown in for good measure: clearly, Steno's approach was bound to conflict. However, there was one thing he and Kircher did not disagree on, and that was the Biblical account of the Creation and the Flood. Eventually, by 1668, Steno was able to square his argument on the nature of fossils with his faith in Biblical events and, characteristically, Steno's reconciliation was not based upon speculation, but upon observations of the local geology and stratigraphical reasoning we still use today.

Steno's conversion to Catholicism from his native Lutheranism at this time (1667) is a complex affair. Likely it
had its roots in Steno's earlier disillusionment with Descartes' scientific work and his resultant doubts about Cartesian claims that a religious faith could be based upon reason. The Catholicism of Steno had come to know in Italy provided an intense, emotional faith he welcomed. Here Cutler makes an important point: it was his scientific work that freed Steno to explore different religious beliefs and this opened the door to conversion. Like Gould, one lesson Cutler draws is how compatible religion and science can be.

Despite the chaos of Steno's earliest years in Copenhagen, there was nothing random about the progress of Steno's life: experimental rationalism and religion were interwoven in his thoughts, and religious faith gained increased meaning to him as the years passed.

The famous work on minerals, fossils, and stratigraphy that Steno published in 1669 (De Solido Intra Solidum Naturaliter Contento Dissertationis Prodromus: Precursor of a dissertation of a solid naturally contained within a solid) was merely a forerunner to a fuller dissertation on geology Steno planned to write. With the Accademia by this time broken up through deaths and dissensions, Steno wandered Western Europe collecting more geological information. Eventually Steno returned to Italy intent upon completing this work, but he found his time taken up increasingly with theological study and writing. He briefly resumed his anatomical career in Denmark in 1673 at the request of the king, but again he found his work being infused ever more with religious meaning; he returned to Italy and was ordained a priest in 1675, whereupon he took a vow of poverty.

In 1677 he was invested as the titular Bishop of Titiopolis (as explained by Cutler) and the next year he was sent to northern Germany to minister to the remnants of the Catholic population living there. Interestingly, in Hannover, he was attached to the same noble household as Leibniz, and Cutler relates Leibniz's attempts to locate Steno's "lost" dissertation after his death, as well as Leibniz's own geological theorizing. Leibniz naturally sought Steno in scientific discourse, but Steno would have none of it: his science was behind him.

Steno died a painful death, which he dutifully anatomically described, in great poverty in Schwerin in 1686, aged 48. In Germany he had been a faithful servant of the church, but had been at times hounded by parishioners who did not understand his self-abnegation. Frustrated in his last years in his desire to return to the Florence he loved, his body was returned there for burial in 1687. Steno was beatified in 1988, on October 23, coincidentally Bishop Usher's day of creation.

Cutler assesses Steno's influence in geology. Some scholars, such as Drake and Komar (1981) and Thomson (2003), argue that Robert Hooke has not received full credit for his work on fossils. Hooke's Micrographia (1665) predated Steno's Prodromus by four years and Eyles (1958) provides evidence that Steno must surely have read it. Yet Eyles (1958, p.179) concludes that "one can largely discount the possibility that Hooke's ideas had any marked influence on the development of Steno's geological ideas," mainly because "Steno's writings show that he did not reach his conclusions by second hand."

In the other direction, Cutler reviews how Steno's ideas on fossils were received in England with the publication of the Prodromus in English in 1671. He gives Hooke full credit for his work, but notes how Hooke squandered some of his scientific capital through personal feuds within the Royal Society (the fact that his only portrait was destroyed by Newton after death is symptomatic of this).

It is difficult to say why Steno's Prodromus is often thought more influential in geology than Hooke's various publications, which covered much the same ground in these plus other geological matters. Certainly, Geikie and more recent scholars, such as Davis, Laudan, and Oldroyd, have worked hard to restore Hooke's contributions.

Lyell (1830), in his "Principles of Geology" reviewed the contributions of both, and said of Steno (p.28-29): "His generalizations were for the most part comprehensive and just; but such was his awe of popular prejudice [on the age of the Earth and its evolution] that he ventured to throw them out as mere conjectures, and the timid reserve of his expressions must have raised doubts as to his own confidence in his opinions, and deprived them of some of the authority due to them." On the other hand, Lyell's review of Hooke's work (p.31-35) is extremely positive: "an important step in the progress of modern science" (p.34). Lyell also notes that Hooke's stated goal was to "explain the former changes of the earth in a more natural manner than others had done" (p.35, Lyell's emphasis). Nevertheless, like others, Hooke fell into speculative theorizing about Earth history and invoked great catastrophes to accomplish the work. Hence, in Lyell's opinion, his more focused work on earthquakes and volcanoes has perhaps met with "undeserved neglect" (p.35). In the end, perhaps it is as simple as saying that we can visualize Steno from his portraits, but not Hooke!

Cutler discusses Steno's wider influence in a discussion of Eighteenth Century theories on the history and age of the Earth, and he outlines a notorious case of plagiarism of Steno's work.

In the late Eighteenth Century, Steno's stratigraphical principles came into their own, not as a means of determining age, but as a means of fixing the number of steps that must be accounted for in the evolution of the landscape (something Hooke had not done in any detail). James Hutton, oddly, did not mention Steno in his discussion of much the same steps, although he must have known Steno's work. However, the clarity of Steno's formulation of these stratigraphic principles is ageless, and the combination of Hutton's Siccar Point and Steno's "original horizontality" is irresistible to those wishing to cut through the complexity of science history; here might lie another key to the relative neglect of Hooke, whose influence was perhaps more subtle and less visible.
Literature Cited

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