

# Seeing optics in a new light

## Johannes Kepler and the transition to modern optical theories

By Christopher Dainty

Until the 17th century, the science of optics focused mainly on explaining why and how we see things. Our understanding of light and vision was, effectively, that they were one and the same thing. The transition from “ancient” to “modern” theories of light occurred, in part, as a result of the publication of Johannes Kepler’s theory of retinal image formation in 1604, which demonstrated that images are projected by the eye’s lens onto the retina.

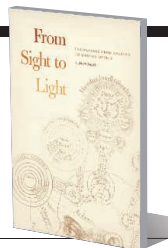
*From Sight to Light* is a scholarly text written by an eminent historian who argues that Kepler’s theory was a radical break from the perspectivist tradition. This hypothesis contrasts with previous histories, which frame Kepler’s theory as an incremental advance in a long-evolving field.

Since most readers of *Science*, and of this book, are likely to be scientists, it is important to note that the author is a historian and that the style of this book is therefore different from a scientific text. For a start, it is absolutely delightful to read, with an elegance far exceeding that of the overwhelming majority of scientific papers. The book holds one’s attention and is difficult to put down. Some scientists, however, may find the pervasive

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### From Sight to Light The Passage from Ancient to Modern Optics

A. Mark Smith  
University of Chicago Press,  
2015. 469 pp.



presence of personal opinion and the subjective framework of the book’s narrative problematic. The author, A. Mark Smith, clearly states that he is “telling a particular story, not necessarily the whole story, nor the ‘true’ story, nor the only story, nor even the best story.”

Smith begins in the Greco-Roman period with a discussion of *Euclid’s Optics*, the first known text to describe the geometry of vision. In this, and indeed in his descriptions of all subsequent theories, he provides detailed explanations and diagrams of the visual ray fields described by the early optical theorists. This is where having an expert in the history of science is so important: Few contemporary scientists would likely have the impartiality or patience to explain the ideas of these early thinkers so clearly.

No book on this topic can ignore the contributions of Ibn al-Haytham (965–1040), more familiarly known by the Latin name Alhacen, whose seven-volume treatise on optics is considered to have been a major contribution to the field. Smith has previously published definitive texts

on Alhacen’s contributions to optics, including his understanding of refraction (1, 2). Yet, as he reveals in this book, Alhacen apparently showed no hint that it might be the cornea and lens of the eye that actually focused an image onto the retina.

It was Kepler who discovered that a real, inverted image was formed on the back of the eye on the light-sensitive retina. The properties of focusing and diverging lenses were known at that time, but his recognition of the eye as an optical system made his work a radical break from previous studies. Smith makes a persuasive case that this was indeed a breakthrough that marked the start of “modern” optics.

This book should be read together with the classic text *Theories of Vision from al-Kindi to Kepler* (reviewed in *Science* in 1976) (3, 4). Both books are based on the same facts, but Lindberg and Smith ultimately disagree as to whether Kepler’s discovery was incremental or radical.

I would recommend this book very highly for two reasons. First, because it provides an authoritative account of how the study of “sight” became that of “light” and highlights the contributions of scholars over many centuries. Second, and less obvious perhaps, is that it serves as an important reminder that “research” does not come in only one flavor and that we, as scientists, have a lot to learn from history.

#### REFERENCES

1. A. Smith, *Alhacen’s Theory of Visual Perception* (American Philosophical Society, Philadelphia, 2001).
2. A. Smith, *Alhacen on the Principles of Reflection* (American Philosophical Society, Philadelphia, 2006).
3. D. Lindberg, *Theories of Vision from al-Kindi to Kepler* (Univ. Chicago Press, Chicago, 1976).
4. A. G. Molland, *Science* **194**, 1047 (1976).

10.1126/science.aab2222



### Wild Ideas Let Nature Inspire Your Thinking

By Elin Kelsey  
Artist: Soyeon Kim  
Owlkids Books, 2015. 32 pp.



What can hyenas teach us about cooperation? Who do baboons turn to for help? Drawing on observations gleaned from recent animal behavior research, *Wild Ideas* encourages young readers to look to the animal kingdom for inspiration the next time they encounter a seemingly unsolvable problem. Delightful dioramas bring the book’s accessible prose to life.

10.1126/science.aab3116

Children’s Book Week, the longest-running literacy initiative in the United States, will be held 4 to 10 May 2015.