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Review: D. C. Lindberg, *Theories of Vision from Alkindi to Kepler*, (Chicago, 1976), *Annals of Science*, London, Vol. 34, No. 4, (July 1977), pp. 439-441.

David C. Lindberg, *Theories of Vision from Alkindi to Kepler*, Chicago and London: The University of Chicago Press, 1976. xii +324 pp., 38 figs. £13.60.

Professor Lindberg provides the reader with an excellent introduction to a number of leading figures in a 2000 year long series of debates from Aristotle to Kepler concerning vision. For its painstaking survey of the secondary literature, its references, its bibliography (and indeed because of its careful index) the work will become a standard reference for scholars.

Lindberg identifies two problems as central to optics prior to 1600 (p. x) - the nature and propagation of light and the process of visual perception- and he devotes his work to the latter of these. By way of introduction he distinguishes three ancient approaches to visual theory: medical (Galen), physical-philosophical (Aristotle, Plato, Epicurus, etc.) and mathematical (Euclid, Hero, Ptolemy). He then turns to Alkindi and begins an impressive survey of the extramission/intromission debate in mediaeval Arabic and Latin writings. In this story Alhazen's importance is emphasized for drawing together the hitherto separate strands of the medical, physical and mathematical traditions. The thirteenth-century synthesis of Bacon, Pecham and Witelo is presented as the next important step in a story that culminates in Kepler's theory of retinal image formation.

Notwithstanding the impressive scope of the survey, a few omissions should be noted. Lindberg makes no mention of Simplicius, and although he refers in passing to Alexander of Aphrodisias, John Philoponus and Themistius, it is regrettable that he makes no attempt to analyse the significance of these four early commentators for later interpretations of the Aristotelian texts. Nor does he mention either Gregor Reisch's *Margarita philosophica* or Giorgio Valla's *De expetendis et fugiendis rebus*. Given their great popularity throughout the sixteenth century, the role, misleading or otherwise, of these encyclopaedic texts deserves attention.

Lindberg is excellent in citing key passages and recording various interpretations concerning them; and yet one might have hoped that a mature scholar would devote more energy to reconsidering some basic assumptions about the history of optics. For example, in the notes (1, 72) to Chapter I, Lindberg presents the reader with a curious passage, attributed by Proclus to Geminus, which claims that optics 'accounts for illusions in the perception of objects at a distance.' The passage, if taken seriously, suggests that the scope of optics in Antiquity remained within the confined to what would now be termed 'psychological optics'. Surprisingly, this possibility is not even considered by Lindberg, who limits himself to repeating Lejeune's opinion that Euclid's *Optica* systematically ignores every physical and psychological aspect of the problem of vision' (p. 12).

Indeed, one suspects that Lindberg's zeal for reporting various opinions from the secondary literature has distracted him from tackling some of the deeper puzzles about the history of optics. What, for example, is the significance of Vitruvius's cryptic allusion (*On architecture*, I, I) to intimate links between music and 'geometricians in the science of vision'? And how are we to account for that perplexing passage in Hero's *Definitions* that states:

Optics does not deal with physical questions and does not study whether given rays flowing out from the eyes go forth to the boundaries of objects or whether images that are detached go forth from corporeal objects [and] enter the eye along a rectilinear path or whether the intervening air is stretched or contracted by the my-like pneuma from the eye. It is only concerned whether, at each reception (of all: image) the right direction of movement or tension is maintained as well as the requirement that the convergence to a point occurs at an angle when objects are seen that are larger or smaller than the eye.¹

If Hero's claim that extramission/intromission theories are *not* the concern of optics be taken seriously, we are faced with the dramatic possibility that the plethora of secondary literature over the past century debating whether or not Greek optics favoured extramission theories has missed the point. And if so, complaint is in vain about ambiguity when no clear opinion was even intended.

Lindberg identifies the medical, physical and mathematical strands as independent sources for discussion of vision in Antiquity. Yet he offers no explanation why the definition of optics was for so long a time confined to the mathematical strand, nor what conditions brought about its wider meaning.

In his first chapter Lindberg states: "It is perhaps significant that Kepler employed the term *pictura* in discussing the inverted retinal images, for this is the first genuine instance in the history of visual theory of a real optical image 'within the eye'" (p. 202). He is amazingly hesitant in emphasizing the significance of Kepler's fundamental distinction between the *pictura* -which is a real optical image-and the *imagines rerum* -which are perpetual phantoms. This hesitation leads us to consider a further problem with Lindberg's approach: he makes no attempt to trace or account for the shift that transformed traditional theories in terms of mental images to the later concern with the nature of actual physical images.

Related to this is another problem that Lindberg's approach ignores; namely, how were arguments concerning the illusory nature of sight overcome? Ronchi's claim that everyone prior to 1610 rejected outright the evidence of vision was an obvious exaggeration that Lindberg rightly challenged elsewhere albeit, sadly in an argument that was primarily *etd hominem*. How sight changed from being considered a deceptive sense to being recognized as man's key to science still needs to be told. Related to this story is an entire tradition of prerequisites for proper, undeceived vision to which Lindberg only alludes in passing. For example, in discussing Alhazen he mentions, out of context, but a small part of a long description of how impressions are certified.

That Lindberg attributes so little importance to the shift from mental to physical images may result from his conviction that an understanding of the ongoing progress of visual theory “requires attention to the academic tradition in medicine and mathematics” (p. 168). We can be more certain that his preoccupation with a purely intellectual tradition helps explain why he concludes that the fourteenth century commentators Blasius of Parma and Henry of Langenstein (p. 132), probably “represent a decline of the perspectivist tradition.”

This conclusion overlooks entirely the practical side of Blasius's contribution, such as the exciting evidence that he was using his surveying experience actually to call into question a traditional assumption in visual theory, or the evidence that writes on optics were not only studying Ptolemy's *Planisphere* but actually exploring with the use of candles in dark rooms the nature of planisphere projection onto walls. Does not this provide us with some vital clues how interest shifted from purely abstract images to the physical "picture" that inspired Kepler's distinction?

Lindberg's bias towards purely academic questions also helps explain his negative conclusions concerning Leonardo: “the problem of sight was not to be solved through a fresh start by an ingenious empiricist working in an intellectual vacuum” (p. 168). To be sure he is perfectly right in reminding us that Leonardo did not arrive at a correct model of the eye. But to dwell on this point—which, incidentally, arises precisely because Leonardo paid too much attention to earlier examples such as Mondino and *not* because “he was working in an intellectual vacuum.” Again over 1000 images of camera obscuras point to the significant role played by Leonardo in shifting attention to actual physical images. Particularly interesting in this regard is Leonardo's systematic study of linear perspective whereby he demonstrates experimentally how one can trace on a vertical glass plane the diminution of real objects. But this Lindberg does not mention.

In the several pages devoted to linear perspective Lindberg concentrates on a single negative point: writings on the subject do not discuss at length theories of vision. This is a good point, but again one is sad that Lindberg is content to explode an old cliché—about artists and Renaissance science and then stop short. The discovery of linear perspective introduced objective means of relating to the measured world which, as Panofsky showed half a century ago, ran directly counter to the theories of Euclidean *Optics*. One might assume that their discovery should therefore have led them to amend their visual angles theories in optics. But the astounding truth is that they did not, and one thus finds throughout the sixteenth and seventeenth centuries a striking disjunction between a practice of linear perspective that assumed an inverse size/distance law—and a theory of vision—that expressly denied such a law. Or, to put it simply, there were two different senses of vision in the Renaissance: one a practical method of observation, the other a theoretical explanation of how the eye sees. Why these conflicting visions continued side by side, and what implications this disjunction has for our methods in dealing with Renaissance intellectual history, are questions one wishes Lindberg might have dealt with had he perceived the initial problem.

We must return briefly to consider a final implication of Lindberg's bias in favour of the purely academic tradition. In dealing with Kepler it leads him to feel he must strenuously object to Crombie's and Straker's attempt to view him as a revolutionary figure who transformed visual theory by "mechanizing" it ' (p. 207). To stress Kepler's dependence on the 'perspectivist tradition' is an excellent point if we need reminding that even revolutionaries cannot react without a context. That Lindberg has denied this with great learning and detail is something for which we must be grateful. Nonetheless there remains much to be done.

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Notes

¹ The translation is my own and is based upon J. L. Heiberg, *Heronis Alexandrini opera quae supersunt omnia*, vol. IV, *Heronis definitiones cum varii collectionibus* (Lipsiae, 1912), 102-105. Cf. D. C. Lindberg and N. H. Steneck, "The sense of vision and the origins of modern science" in: *Science, medicine and society in the Renaissance: Essays to honor Walter Pagel* (2 vols., ed, A. G. Debus,; New York, 1992, vol. 1, 29-45.