Rashed, Roshdi. **Les mathématiques infinitésimales du IXe au XIe siècle. Vol. 4. Ibn al-Haytham: méthodes géométriques, transformations ponctuelles et philosophie des mathématiques.** *Al-Furqān Islamic Heritage Foundation,* London, 2002. xiv+1064+viii pp. ISBN 1-873992-60-2.

This book contains Arabic editions with French translations and commentaries of the following six texts on plane geometry by the medieval Islamic mathematician Ibn al-Haytham (ca. 965-1041):

(1) (pp. 13-155) *On the properties of the circle.* Rashed has conjecturally restored the text from the unique manuscript which was discovered in the 1970s in Samarra in Russia, and which is now in St. Petersburg. The manuscript is damaged and a few of Rashed's reconstructions are probably incorrect (Propositions 24, 25), but his edition is nevertheless an important contribution. The text as it stands is a potpourri of theorems on the circle. Most of these are trivial, but the end of the text (Propositions 32-43) looks like a well-organized and self-contained treatise on the centers of similitude of two circles. To Rashed's commentary one may add that Proposition 15 is the probable source of a citation in al-Bīrūnī's work *Extraction of chords*, which was completed in the spring of 1027; therefore *On the properties of the circle* was probably written before that date. This little piece of information is interesting because we know almost nothing about the dates of Ibn al-Haytham's works.

(2) (pp. 177-391) *On analysis and synthesis.* The Arabic text and French translation previously appeared (without commentary) in [R. Rashed, La philosophie des mathématiques d'Ibn al-Haytham. I. L'analyse et la synthèse. *Mélanges, Institut Dominicain d'Études Orientales du Caire* 20 (1991), 31-231]. In this long treatise, Ibn al-Haytham explains the use of analysis (in the ancient Greek sense of the word) in geometry, arithmetic, and astronomy, with examples. Rashed had already published the part of the text on perfect numbers in Ibn al-Haytham et les nombres parfaits, [*Historia Mathematica* 16 (1989), no. 4, 343-352]. The treatise concludes with a complicated construction of a circle tangent to three given circles. See also the articles Kh. Jaouiche, L'analyse et la synthèse dans les mathématiques arabo-islamiques. Le livre d'Ibn al-Haytham [in *Histoire des mathématiques arabes* (Algiers, 1986), 37-50, Maison des Livres, Algiers, 1988]; and Kh. Jaouiche, Aperçu sur le problème des cercles tangents chez Ibrāhīm ibn Sinān, ibn al-Haytham et Viète [in *Histoire des mathématiques arabes,* Vol. 2 (Pro-

ceedings of the 3rd Maghrebian Colloquium held in Tipaza, 1990), 179-193, Association Algérienne d'Histoire des Mathématiques, Algiers, 1998].

(3) (pp. 393-583) *On known things.* A detailed French summary of this text by L. A. Sedillot appeared in 1834 but the treatise received little attention afterwards. In this treatise Ibn al-Haytham begins with a lengthy philosophical discussion of the concept "known," which according to him means "invariant." Thus "known" has a wider meaning than "constructible" by Euclidean or other means. Ibn al-Haytham then presents 13 easy theorems to the effect that the locus of points with certain properties is a straight line or a circle. He concludes with around 30 propositions in the style of the *Data* of Euclid. The text and translation already appeared in [R. Rashed, La philosophie des mathématiques d'Ibn al-Haytham. II. Les connus. *Mélanges, Institut Dominicain d'Études Orientales du Caire* 21 (1993), 87-275].

(4) (pp. 585-600, 616-633) *Treatise on a geometrical problem*, namely the construction of a triangle if its base, its circumference and its area are given. The same text was analyzed in [C. Schoy, Behandlung einiger geometrischen Fragepunkten durch muslimische Mathematiker, *Isis* 8 (1926), 254-263].

(5) (pp. 600-615, 634-653) *On the properties of triangles with respect to perpendiculars*, i.e., on the sum of the distance of any point inside a triangle to the three sides. For an analysis of this treatise see also [H. Hermelink, Zur Geschichte des Satzes von der Lotsumme im Dreieck, *Sudhoffs Archiv* 48 (1964), 240-247].

(6) (pp. 655-685) *On place.* In this philosophical treatise, Ibn al-Haytham defines place in a mathematical way as the imagined space filled by a body, and he argues against the Aristotelian definition of place as the surrounding surface [see also E. Wiedemann, "Beiträge zur Geschichte der Naturwissenschaften 17: kleinere Arbeiten von Ibn al-Haytham," in *Sitzungsberichte der physikalisch-medizinischen Sozietät in Erlangen* 41 (1909), 1-25].

Rashed included as appendices editions with French translations of a number of relevant texts and fragments by other medieval Islamic authors. The most important of these are the following:

(7) (pp. 687-690, 735-737, 742-765) The *Letter to Ibn Wahb on the method of deriving a construction of geometrical problems* by Thābit ibn Qurra (836-901). This text was available in an Arabic edition and a Russian translation but had not hitherto been translated into a western language.

(8) (pp. 690-735, 738-739, 766-825) The *Book on making easy the ways of deriving geometrical propositions* by the Iranian geometer al-Sijzī (ca. 960-1000). This text can be compared to G. Polya's *How to Solve It. A New*

Aspect of Mathematical Method, Princeton Univ. Press, Princeton, N. J., 1948]. A valuable Arabic edition was published by A. S. Saidan in [*The works of Ibrāhām ibn Sinān* (Arabic), Edited by A. S. Saidan, Nat. Council Cult. Arts Lett., Kuwait, 1983], and an English translation by the reviewer appeared in [*al-Sijzā's treatise on geometrical problem solving, With a Persian translation of the original text by Mohammad Bagheri, Translated from the Arabic, annotated, and with an introduction by Jan P. Hogendijk, With an Arabic translation of Hogendijk's introduction and annotations,* Fatemi, Tehran, 1996]. On p. 738, Rashed passes a devastating judgement on the reviewer's publication, but the differences between the two translations are on the whole unimportant. Rashed adopted more than 100 of the reviewer's 143 corrections to Saidan's edition, without noting this anywhere.

(9) (pp. 739, 827-831) A letter by the same al-Sijzī to the physician Naẓīf ibn Yumn, *On the construction of an acute-angled triangle from two different straight lines.* For an English translation see [J. P. Hogendijk, Traces of the Lost *Geometrical Elements* of Menelaus in Two Texts of al-Sijzī, *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* 13(1999/00), 129-164, 9 (Arabic paging)].

(10) (pp. 843-899) Various propositions from the *Istikmāl* of the Islamic king of Saragossa, Al-Mu'taman ibn Hūd (died 1085), related to Ibn al-Haytham's texts (2) and (3).

(11) (pp. 900-953) A brief text by the philosopher ^{c}Abdullaṭīf al-Baghdādī (c. 1200) against Ibn al-Haytham's ideas about place in (6).

The mathematically and historically most interesting texts by Ibn al-Haytham in this volume are texts (2), (1) and (3). Texts (3) and (6) are interesting for the relationship between mathematics and Aristotelian philosophy.

Volumes 1-3 of the same series have been reviewed. Volumes 3 and 4 have no relation to infinitesimal calculus but Rashed decided to give these volumes the same title as the first two volumes in the series.