



Ibn al-Haytham's Geometrical Methods and the Philosophy of Mathematics

A History of Arabic Sciences and Mathematics Volume 5

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This fifth volume of *A History of Arabic Sciences and Mathematics* is complemented by four preceding volumes which focused on the main chapters of classical mathematics: infinitesimal geometry, theory of conics and its applications, spherical geometry, mathematical astronomy, etc.

This book includes seven main works of Ibn al-Haytham (Alhazen) and of two of his predecessors, Thābit ibn Qurra and al-Sijzī:

- The circle, its transformations and its properties;
- Analysis and synthesis: the founding of analytical art;
- A new mathematical discipline: *the Knowns*;
- The geometrisation of place;
- Analysis and synthesis: examples of the geometry of triangles;
- Axiomatic method and invention: Thābit ibn Qurra;
- The idea of an *Ars Inveniendi*: al-Sijzī.

Including extensive commentary from one of the world's foremost authorities on the subject, this fundamental text is essential reading for historians and mathematicians at the most advanced levels of research.

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Précédents volumes de la collection :

- R. Rashed, [*Founding Figures and Commentators in Arabic Mathematics. A History of Arabic Sciences and Mathematics*](#), vol. 1, Culture and Civilization in the Middle East, London, Centre for Arab Unity Studies, Routledge, 2011.
- R. Rashed, [*Ibn al-Haytham and Analytical Mathematics. A History of Arabic Sciences and Mathematics*](#), vol. 2, Culture and Civilization in the Middle East, London, Centre for Arab Unity Studies, Routledge, 2012.
- R. Rashed, [*Ibn al-Haytham's Theory of Conics, Geometrical Constructions and Practical Geometry. A History of Arabic Sciences and Mathematics*](#), vol. 3, Culture and Civilization in the Middle East, London, Centre for Arab Unity Studies, Routledge, 2013.
- R. Rashed, [*Ibn al-Haytham. New Spherical Geometry and Astronomy. A History of Arabic Sciences and Mathematics*](#), vol. 4, Culture and Civilization in the Middle East, London, Centre for Arab Unity Studies, Routledge, 2014.

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