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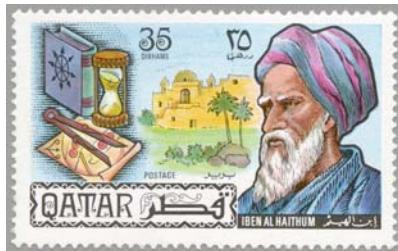
“Universality and Modernity of Ibn al-Haytham’s Thought and Science”

Valérie Gonzalez*

with an introduction by Azim Nanji**

Abstract

Ibn al-Haytham (965-1039), also known as Alhazen, was an Arab philosopher, physicist and mathematician whose legacy in the West is mainly due to his work in the optics. However, Ibn al-Haytham’s contributions go far beyond his famous optical *oeuvre*, *Kitab al-Manazir*. In his lifetime of study, Ibn al-Haytham was able to articulate a relationship between the physical, observable world and the world of intuition, psychology and mental processes. His theories of knowledge and perception, which link the present-day domains of science and religion – resulted in a philosophy of existence based on the direct observation of the ‘real’ as it presents itself to the seeing subject. Much of his thought in this field is still present in the discourse of twentieth-century philosophy and phenomenology.



A Qatari stamp celebrating Ibn al-Haytham.

Keywords

Ibn al-Haytham, Alhazen, optics, ophthalmology, phenomenology, beauty, science, philosophy, metaphysics.

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* Valérie Gonzalez received her doctorate in the Humanities, specialising in the Arab world, from l’Université d’Aix-en-Provence and holds a diploma in painting from l’Ecole des Beaux-Arts de Marseille-Luminy. Formerly a member of the Institute for Advanced Study, Princeton, she is currently a Research Associate at l’Ecole d’Architecture de Marseille-Luminy where she lectures on the history of architecture and Islamic town planning. Dr Gonzalez is the author of *Beauty and Islam: Aesthetics in Islamic Art and Architecture* (I.B Tauris in association with The Institute of Ismaili Studies, 2001), *Le Piège de Salomon*, *La Pensée de l’art dans le Coran* (Albin Michel, 2002) and *Emaux d’al-Andalus et du Maghreb* (Edisud, 1994) as well as numerous articles on art history and Islamic aesthetics.

** Azim Nanji assumed the role of Director of The Institute of Ismaili Studies in 1998. Previously, he was Professor and Chair of the Department of Religion at the University of Florida. He has contributed to numerous journals and encyclopaedias and is the author and editor of several books including *The Nizari Ismaili Tradition* (Caravan, 1976), *The Muslim Almanac* (Gale, 1996) and *Mapping Islamic Studies* (Mouton de Gruyter, 1997).

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Introduction

What accounts for the complexity of our world, our environment and ourselves, and for our great fascination with mapping and understanding the processes underlying this complexity?

These questions continue to guide the intellectual quest for the study and meaning of science as well as religion. Among Muslims, this quest has a long and distinguished history.

The Fatimid era reflected a particularly creative period in the flowering of science, art, culture and architecture. It was also accompanied by a very significant development in all the religious and philosophical sciences. Ibn al-Haytham exemplifies the spirit of the time and his work as a scientist marked him as a figure of influence in his time, as well as beyond, in both the Muslim and Western worlds.

Ibn al Haytham and his colleagues did not see faith and religion as being mutually exclusive subjects of enquiry. They saw the intellectual quest as being a shared experience, encouraging and validating an engagement and exploration of the whole of creation. Alhazen, as Ibn al-Haytham came to be known to the Latin West, was also an engineer and first came to Cairo to apply his skills as a mathematician to regulate the flow of the water in the Nile.

As the boundaries of science and religion continue to expand and be challenged in our time, it may be worth examining the models and inspiration of the medieval Muslim scientists and the enabling environment that encouraged their work. One of the most important lessons they might teach us is to recognise the gift and value of the intellect and to avoid dichotomising human development. The study of scientific processes is also the beginning of the journey for the understanding of the Reality underlying those processes.

Azim Nanji

Ibn al-Haytham and his Optics

Abu'l-Hasan ibn al-Hasan ibn al-Haytham al-Basri al-Misri (965-1039 CE), also known in Europe by the Latin names Alhacen, Alhazen, Avenatan or Avennathan, was an Arab mathematician, physicist and philosopher born in Basra, Iraq. He spent many years of his life in Fatimid Cairo, working under the auspices of the Ismaili Imam-Caliph al-Hakim bi-Amr Allah (985-1021). He conducted important research in geometry, astronomy, mathematics and optics, based on an in-depth knowledge of the Greek scholars and philosophers, resulting in one of his most important works, the *Kitab al-Manazir* (partly translated into English as *The Optics*).¹

¹ Ibn Haytham, *The Optics*, ed. and tr. A.I. Sabra (Kuwait, 1983; London, 1989).



From a scientific point of view, the *Kitab al-Manazir* presents a radically new approach to the studies of optics in the Middle Ages, starting from the basic physiological principle according to which, “Sight (*al-basar*) is composed of various layers, coats and bodies, its principle and origin lying in the frontal part of the brain.”² Thus, Ibn al-Haytham provided an important analysis on the physical process of sight, based on his observation of the functioning of light and colour:

Sight perceives (*yuhiss*) the light and the colour existing on the surface of the contemplated object (*mubsar*), thanks to the shape that expands from the light and the colour existing on the surface of this object through an intermediary diaphanous body (*al-jism al-mushiff al-mutawassit*) between vision and its object. Vision perceives necessarily all the objects through supposed straight lines [i.e. lines of perspective] that spread themselves between the object and the central point of the sight (*markaz al-basar*).³

Significantly, this theory explains, for the first time in the Middle Ages, the two principles of light and perspective that will have such a profound impact upon European culture of the medieval and modern eras. In fact, Ibn al-Haytham’s treatise belongs to a wider Muslim scientific trend of works on optics (especially after Euclid)⁴ that was to exert a profound influence upon the whole of medieval civilisation, both Muslim and Christian. From the end of the 12th century and throughout the 13th century, Christian scholars confirmed the importance of physics, mathematics and geometry to explain the structure of the universe, deriving their theories from the threefold influence of the Arabic sciences, Saint Augustine and Neo-Platonism.⁵ Robert Grosseteste (1168-1253), Abbot of Lincoln (1175-1253), who was particularly aware of these Arabic sciences, claimed:

It is impossible to know nature without geometry: its principles hold true within the entire universe and within every part of it: it is through its lines, angles and figures that we have to represent all the causes of natural phenomena: it is impossible without this means to reach the ‘proper quid’ in nature.⁶



Diagram of the eye as illustrated in Risner's edition of *Kitab al-Manazir*

² Ibn Haytham, *Kitāb al-Manāzir*, vol. I, Chapter 5, quoted in note no. 7 by José Miguel Puerta Vilchez, *Historia del pensamiento estético árabe, al-Andalus y la estética árabe* (Madrid, 1997), p. 689. In the first book of the treatise, the Muslim scholar explains in detail the physiological structure of the eye and the physical process by which vision receives images of external objects. See also A.I. Sabra, ‘Sensation and Inference in Alhazen’s Theory of Perceptual Vision’, in *Studies in Perception: Interrelations in the History of Philosophy and Science*, (Colombus, Ohio, 1978), pp. 160-185.

³ Text quoted by Puerta Vilchez, *Historia del pensamiento estético árabe*, pp. 689-90.

⁴ See a very interesting recent book by Elahéh Kheirandish, *The Arabic Version of Euclid’s Optics* (*Kitāb Uqlīs fī ikhtilāf al-manāzir*), 2 vols. (Cambridge, 1999).

⁵ See Edgar de Bruyne, *Etudes d'esthétique médiévale*, 2 vols. (Paris, 1997).



The Influence of the *Kitab al-Manazir*

The *Kitab al-Manazir* had a strong impact upon European thought through a Latin translation entitled *Opticae Thesaurus*, that introduced many scholastics of the 13th century, like Grosseteste quoted above or Witelo, to a new conception of the universe and a new aesthetics. These new concepts were to influence the gothic style of the great cathedral building programme of medieval Europe and the principle of visual perspective that was to revolutionise pictorial representation.⁷ The specialist of Christian medieval philosophy, Edgar de Bruyne remarks accurately:

Around 1200, translations of the *De Perspectiva* or *De Aspectibus* by Alhacen are copied: he affirms the spherical diffusion of light, he develops as a mathematician the theory of reflection and the refraction of luminous rays, and as a positivist the psycho-physiological doctrine of visual sensation. Alhacen exerts a big influence on Grosseteste and Bacon and the perspectivists, for example, Witelo and Jean Peckham. The *De Perspectiva* treatise of Witelo, dedicated to Guillaume de Moerbeke (around 1270), will be commented on by Kepler, the second one by Peckham inspires deeply the *Trattato della pittura* (*The Treatise of Painting*) by Leonardo da Vinci, from whom aesthetic-scientific trends are well known.⁸

Observable Beauty

During the early Renaissance in the 15th century, philosophical theories were developed concerning the aesthetics of human proportion. These were based on symmetry as a fundamental concept of perfection, and were first notably employed in the work of the famous Italian artist Ghiberti (1378-1455).⁹ One of the main sources for these theories, if not the main one, is Ibn al-Haytham's concept of observable beauty that he defined originally in terms of objective visual concepts (*al-ma'ani al-mubsara*). Among these concepts, the Muslim thinker revived the central notions of order (*tartib*) and symmetry in Aristotle and Plato's aesthetics, and dealt with derived notions such as regularity (*muntazim*) and proportional correspondence (*mutanasib*) as factors producing beauty;¹⁰ notions that became so important for the definition of the arts in particular and knowledge in general, during this important period of European civilisation. Ibn al-Haytham analyzes the character of a beautiful face in the following terms:

⁶ Grosseteste is quoted by de Bruyne, *Etudes d'esthétique médiévale*, vol. 2, p. 121.

⁷ See *Opticae Thesaurus, Alhazen Arabis libri septem nuncprimum editi. Eiusdem Liber de Crepusculis et Nubium ascensionibus. Item Vitellionis Thuringopoli Libri X*, ed. F. Risner (Basilea, 1572); facsimile ed., D.C. Lindberg (New York, 1972); D.C. Lindberg, 'Alhazen's Theory of Vision and its Reception in the West', in *Isis*, 58 (1967), pp. 321-41, and *Theories of Vision from al-Kindi to Kepler* (Chicago, 1976); de Bruyne, *Etudes d'esthétique médiévale*, vol. 2.

⁸ De Bruyne, *Etudes d'esthétique médiévale*, vol. 2, p. 123. About Witelo, see also an interesting passage from the *Opticae Thesaurus*, vol. 4, p. 148, quoted in note n. 35 by Puerta Vilchez, *Historia del pensamiento estético árabe*, p. 698.

⁹ See Erwin Panofsky, *Meaning in the Visual Arts*, pp. 89-90.

¹⁰ See Puerta Vilchez, *Historia del pensamiento estético árabe*, p. 698-710.



The proportion (*tanasub*) only produces beauty if each one of the members taken separately is not ugly even though they do not reach a high degree of beauty. If we join in the same form the beauty of the figure of each part of it and the beauty of its measures, like the beauty of its composition and the proportion of the members as well as their respective shapes, sizes and dispositions as all what must be proportioned, and moreover, the members are proportioned according to the figure and the measure of the face as a whole, this will raise the top of beauty.

Then, dealing with the principle of proportion in objects in general, Ibn al-Haytham continues:

If the beautiful forms of all kinds of visible objects are investigated, one will verify that proportion produces in them a beauty that none of the other visual concepts taken separately produces ... If the beautiful concepts produced by the conjunction of particular concepts are observed, one will see the beauty that manifests itself, starting from the so called conjunction, is due to the proportion existing between these concepts and its harmonisation (*i'tilaf*).¹¹

Ibn al-Haytham's 'Phenomenology'

Thus, it is as a phenomenologist using the equation of sight and insight that Ibn al-Haytham contributed indirectly but decisively to the progressive rationalisation of the self that occurred in scholastic Christian culture, preceding the emergence of the new theory of humanism (the idea that humanity is at the centre of the universe) during the European Renaissance.

From a contemporary epistemological point of view, Ibn Haytham's study on optics provides one of the earliest examples of theories that were to be developed centuries later, in the book *Phenomenology of Perception* by the influential French philosopher Maurice Merleau-Ponty.¹² Indeed, the Muslim scholar did not cease to amaze scholars of the Islamic sciences because of the modernity of his approach, which posited vision as the primary cognitive process in the relationship of being with the world. During the Middle Ages, physics, ontology and theology were inextricably mixed. However, Ibn al-Haytham was the first thinker of this period to isolate the phenomenon of vision from metaphysics,¹³ thus inscribing it clearly within the positive and objective field of physics as well as the intuitive and subjective field of living bodily experience. This individual experience of the material life was also described as 'being-in-the-world' by Martin Heidegger and some other phenomenologists of the 20th century.¹⁴

¹¹ Ibn Haytham, *Kitāb al-Manāzir*, vol. 2, pp. 313–315, quoted in Puerta Vilchez, *Historia del pensamiento estético árabe*, p. 708–709.

¹² Maurice Merleau-Ponty, *Phénoménologie de la perception*. (Paris, 1945).

¹³ Unlike the other great medieval philosophers such as al-Farabī, Ibn Sīnā and even the positivist Ibn Rushd.

¹⁴ See the definition of 'Phenomenology' in *The Cambridge Dictionary of Philosophy* (Cambridge, 1995), pp. 578–79. See also Martin Heidegger *Qu'est-ce qu'une chose?* (Paris, 1971) and *Chemins qui ne mènent nulle part* (Paris, 1962).



Combining a scientific theory of optical vision with a positive psychology of the sensations, Ibn al-Haytham puts at the centre of his study the living body, with both physical and mental perceptions, that is to say, the five senses combined with an intuitive, pre-cognitive response similar to that of a child. In a famous passage, Ibn al-Haytham describes the experience of choice by a child to whom things of varying levels of beauty are presented. As with the explanation of the origin of consciousness, this evaluation proceeds from a phenomenological analysis:

The perception of beauty in the beautiful (*husn al-hasnan*) and the ugliness of the ugly (*qubh al-qabih*) that he (the child) operates, in that he prefers beauty to ugliness and chooses the most beautiful rather than the less beautiful, all this comes from the fact that he chooses only by comparing one thing with the other and consequently that he perceives the form of each one by capturing the superior quantity of beauty that there is in the most beautiful relative to the less beautiful, then he chooses this greater beauty (*al-za'id al-husn*). The preference of the most beautiful occurs because of the universal proposition according to which the most beautiful is the best (*akhyar*) and one chooses first of all the best. The child uses this proposition without being aware of it.¹⁵

Phenomenology and Perception

In other respects, as a true phenomenologist, Ibn al-Haytham searched for the essence of the function of seeing that consists, for example, in grasping the variable beauty of things by understanding intuitively their objective and perceptual properties:

When sight perceives an object that possesses a composed beauty (*husn murakkab*) by joining concepts (*ma'ani*) or by relating them proportionally, it observes the object in question and distinguishes the concepts that it contains perceiving those that produce beauty by joining themselves and those that produce it through a proportional correspondence between themselves. This perception occurs in the sensorial organ and the distinctive faculty compares them (the concepts) and grasps the beauty of the contemplated object composed by the conjunction of concepts. The sight perceives the beauty existing in contemplated objects by comparing each concept with the others, as we have explained in detail.¹⁶

One of the most novel aspects of Ibn al-Haytham's approach lies in the analysis of immediacy in the act of seeing itself, as a pre-rational cognitive phenomenon. This process corresponds exactly to the 'phenomenological duality of resonances and resounding' by the modern

¹⁵ Ibn Haytham, *Kitāb al-Manāzir*, vol. 2, p. 227, quoted in Puerta Vilchez, *Historia del pensamiento estético árabe*, p. 696.

¹⁶ Ibn Haytham, *Kitāb al-Manāzir*, vol. 2, pp. 315–316, quoted in Puerta Vilchez, *Historia del pensamiento estético árabe*, p. 710.



French philosopher Gaston Bachelard, observing the specific experience of ‘the poetic image’.¹⁷ Bachelard says “in the resonance we hear the poem, in resounding we speak it, it is ours.” This corresponds to Ibn Haytham’s thought, “in the resonance we *see the thing*, in resounding we *look at it*, it is ours.” It is in these terms that the relationship of the human being with the material world establishes itself, that his existence begins.

In this outlook, we also find the same basic argument on which Merleau-Ponty based his philosophy, demonstrating that “the body is itself the original knowing subject from which all other forms of knowledge derive” and “that all the higher functions of consciousness are rooted in and depend upon the subject’s prereflexive, bodily existence (*le corps propre*), i.e. perception.”¹⁸

An examination of the influence of Ibn al-Haytham’s works yields some surprising facts. Generally speaking, in the Muslim world, as in other monotheistic conceptions of reality, humanity occupied a subordinate position in relation to the divinity, and realistic artistic representation was avoided. It was Ibn al-Haytham who provided the impetus for Christian Europe to further develop the notion of human primacy in the conception of the universe, and to express this in the visual arts through the human figure and its realistic representation. In other respects, Ibn al-Haytham developed a genuine philosophy of existence based on the direct observation of the ‘real’ as it presents itself to the seeing subject. These observations were made centuries before the modern questioning of the experience of the world by Merleau-Ponty and other phenomenologists, who proposed ‘a return to phenomena’ after centuries of absolutist thought built by modern western philosophy. This recognition raises, it seems to me, a fascinating philosophical question upon which we can meditate.



A Pakistani stamp commemorating Ibn al-Haytham’s contributions to the field of optics.

¹⁷ To understand notions of the phenomenological method and approach, see the introduction of Gaston Bachelard, *La Poétique de l'espace* (Paris, 1978); the expression ‘le doublet phénoménologique des résonances et du retentissement’ appears on p. 6.

¹⁸ See ‘Merleau-Ponty, Maurice’, in *The Cambridge Dictionary of Philosophy*, pp. 484–486.



Facts About Ibn al-Haytham

Ibn al-Haytham was a prolific writer who composed no less than 44 treatises on physics, philosophy, astronomy, mathematics, medicine and other subjects. Many of these works were produced from a modest room in the college-mosque of al-Azhar provided to him by the Fatimid state. One of Ibn al-Haytham's remarkable achievements was a detailed description of the human eye and the functions of its various parts. He also wrote on the propagation of light and colours, optical illusions and reflections, spherical and parabolic mirrors, shadows and eclipses, the rainbow and the halo. He was one of the earliest scholars to recognise gravity as a force and knew correctly the relations between the motion, space and time of falling bodies. Most of his scientific writings are of a highly mathematical character and based on his own experiments and calculations.

Ibn al-Haytham was a genuine scientist who made new discoveries in the physical universe. His greatest contribution was in the field of optics, for which he is called the “father of optics”. All the current ideas about light, optics and ophthalmology are founded upon his observations and findings. According to the historian of science, George Sarton, Ibn al-Haytham is the greatest Muslim physicist and one of the great opticians of all time. By his emphasis on precise observation and experimentation, he anticipated the empirical approach of European scientists in the modern era.