

## Review

### **Abu-Ali Mohammad Ibn-Al-Haytham [Alhazen] 965-1039**

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#### **I- TESTIMONIALS**

In the words of George Sarton, "*He is the Ultimate best Muslim scholar in physics, and one of the all time scientists in optics. The founder of photosynthesis and a researcher whose works paved the way to empiricism.*"[1].

Described by Ibn-Abi-Ausaibia', "*Ibn-Al-Haytham was a truthful character, exceedingly intelligent, and creative scientist. An unmatched scholar of mathematics among his contemporaries... Wrote extensive summaries of Aristotle's works, and reviews of Galen's medical heritage ...So experienced in fundamentals of medical applications , their rules , and their wide-ranging matters though he did not practice medicine fully.*"[2]

Rose Paul , the author of ' The Concise History of Mathematics, [3] stated, "*Ibn-Al-Haytham is the one who validated several theories of physics such as the theory of light deflection " –" His works in optics are more appropriate and greater than Euclid's and Ptolemy's."*

Singer, the author of 'The short History of Science' [3] points, "*Ibn-Al-Haytham's book on optics is unsurpassed work .Neither the Greeks, nor any other preceding scientific culture has produced something alike."*

Pernal, the author of 'Science in History' emphasized that the adequate description of the eye structure presented by Ibn-Al-Haytham has turned so helpful in revealing further facts about several diseases that infect eyes in extremely hot areas where sight deficiency is more common , and needs special glasses. [3]

Al-Doomili, the author of 'Science of Arabs and its Influence in Development of Global Science' says, "*Ibn-Al-Haytham was a great scholar of mathematics and physics as major fields, and his works in these fields are broader and deeper than others ' . His book on optics exerted a great influence upon Western science e.g. on the works of Roger Bacon*



(1214-1294), German Astronomer Johannes Kepler (1571-1630). and Whitlow." [3]

## II- HIS LIFE

Abu-Ali Mohammad Ibn-Al-Hassan Ibn-Al-Haytham Al-Basari, known in Latin [Alhazen], was born in Basra, Iraq in 965 and died in Cairo 1039. First he became well known to people as an architect. Once, the ruling Prince of Basra called him for building a special palace. Ibn-Al-Haytham obeyed telling the prince that he would abide himself for making of the building design, but the prince insisted that he wanted Ibn-Al-Haytham to take full assignment and construct the palace. Because, Ibn-Al-Haytham did not want to be involved in such business of builders, he escaped from the town accompanied by his two servants, and a donkey carrying his books.

He arrived at Assyria where he was welcomed by the ruler who allocated a 100 dinnar allowance to be paid monthly to Ibn-Al-Haytham, but the latter used to take four dinnars only and send back the remainder. Once, the ruler of Assyria proposed for him to be a vizier, but he apologized saying, "*I have fled Basra to avoid being involved in a governing position. I was not born for taking such post. You can't, dear prince, make the sun lights as a candle, and you can't ask me to provide less.*"

Meanwhile, news from Egypt reported that the country was suffering a severe draught season. Ibn-Al-Haytham thought of a solution for encountering such disasters and made a plan for the construction of a dam across the Nile to keep back a high level of water reservoir. [4] He gave the proposal to the director of the Science House Library in Cairo who was coincidentally in a visit to Damascus. The director conveyed the proposal to the ruler of Egypt who then invited Ibn-Al-Haytham to Cairo. In Cairo he was generously welcomed by the ruler (The Caliph) whose sister told Ibn-Al-Haytham to be credible and should not convey any fanciful ideas into the mind of the caliph. Having visited the site of the proposed dam with some constructors, Ibn-Al-Haytham apologized to the Caliph telling him that it was impossible to construct the dam at that time, but when sciences advance the plan would be implemented\*.

The Fatimid caliph of Egypt so called himself "*Al-Hakim Bi Amr Allah*" (The Ruler by the God's Order) (was a moody man sometimes was so sincere towards scholars, but at other times he would change his attitudes and be come against them. Decrees he used to issue were eccentric too, e.g. prohibition of eating mallow, prevention of woman from wandering outside their homes and killing dogs everywhere in the state. A tyrant ruler who could easily sentence anyone to death if he objected his will. People at that time expected that the caliph would execute Ibn-Al-Haytham, but instead, he buffered him in a trifle post as a clerk of an accountant. Ibn-Al-Haytham gave his consent to carry out the assignment imposed on him but in dread rather than in willingness. When it became evident to him that the ruler was governing arbitrarily, and conducting himself a bloodshed tyrant, Ibn-Al-Haytham sought to escape his post pretending that he was insane.

Four to three years later, he continued to feign madness: crying, laughing and making strange acts. The caliph stepped him down from post, allocating for him a monthly bursary of four dinnars and put him under home arrest and accompanied with two guards. The

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\*It is interesting to mention here that the 'fanciful' proposal of Ibn-Al-Haytham for constructing a dam across the Nile at Aswan was only confirmed valid and executed ten centuries after his death. The first Aswan dam was completed in 1902 and by mid-1968; construction of the Aswan high dam '*Al-sad Al-Aly*' was essentially completed. Ref.: Microsoft ® Encarta Reference Library 2005. 1993-2004 Microsoft Corporation.

guards made an opening in the window of his room to watch him from outside. When they stopped watching him, he lighted his lamp away from the opening and started reading and writing. Accidentally, the beam of the dim light coming out through the opening made a cocoon sphere that reflects shapes but in upside down position reflected on the opposite wall. When Ibn-Al-Haytham observed that he shouted " *Eureka!, I've found it Archimedes*", and that was the origin discovery which later led to the invention of camera.

When the ruler was murdered, his sister "Sit Al-Mulk" showed less tyranny. It was a good chance for Ibn-Al-Haytham to give up pretense and to persuade his visitors that he had recovered and that he had ample time for his scientific pursuits of learning and research. The new ruler also provided him close attachment to court as a companion in the regal suite and endorsed his position when he showed sincere nobility by giving back all money that he had received from the treasury of the state.

We would really glorify this savant for his patience and scientific resilience, notwithstanding the harsh times marked by corruption, and deterioration of scientific activities and political affairs. At that time, in which Ibn-Al-Haytham lived, the Islamic domain underwent division; and in Baghdad, antagonist to caliphs began fighting each others. Some Turks who were involved in such dreadful affairs did not only kill the caliph, but also insulted his dead body dragging it openly in streets.

At the age of seventy, Ibn-Al-Haytham suffered aging diseases. At his last night he was visited by his pupil Bishr Ibn-Fatic, and Ibn-Al-Haytham turned to him and said, "*That book of Mine, the book of optics, is the most valuable thing that would remain after my death*"

## II- IBN-AL-HAYTHAM'S WORKS

Looking into his main writings, which run to 200 or so we can notice that most of his researches were focused on mathematics, astronomy, physics and medicine [2]. His book, *kitab AlManatheer*" (The Book of Optics) is his most notable work which initiated for this field to develop as independent discipline. The book gained great respect and consideration during the medieval ages being translated five times into Latin, and then into English and other European languages. A comprehensive book ever written about light and with well oriented objectives and analysis as if it had been written in the modern times. With respect to its contents, it deals with light deflection, anatomy of the eye, and how it receives light in the retina. [5] The book is divided into seven sections each with further classification into several chapters. [6]

Ibn-Al-Haytham was the first to describe accurately the various parts of the eye and to give a scientific explanation of the process of vision speculated on the physical nature of light and explanation of the binocular vision, a description that provided much to the European scientists in this field such as Roger Bacon, Leonardo da Vinci (1319) and Johannes Kepler (1630) [7]. He described the eye saying that it is of circular shape surrounded at the backward by a hard opaque cover or the sclera which coats  $5/6^{\text{th}}$  of its surface penetrated also from the back by the optic nerve. The front side is covered by a transparent convex envelope called cornea which makes a frontier extension of the sclera. Directly behind the cornea lies eye iris which varies in colors in people. Around the iris there is a circular opening canal that can contract or stretch called eyeball (pupil). Directly behind the iris also is the lens with two convex sides, but the back side turns rather rounded attached at the edges with ciliary muscles that can stretch or squeeze. In fact, this elaborate description is similar to what modern specialized books say about the anatomy of the eye.

His Thesaurus and research in optics led him to contradict the old theory of light and vision which speculated in Ptolemy's and Euclid's theses that eye vision comes from the brain and transmits from thence into the eye before it dissents out to the object in focus and returns to the eye. Ibn-Al-Haytham verified that the vision as a process occurs adversely to the manner of that description. He clarifies, "*Vision results from the rays of light that arise from external objects when the eye focuses on , then the specter of the object figuration is received into the eye lens which in turn transmits it through eye nerves to the brain .*" He says, "*Light falls on the retina in the same manner as it falls on a surface in a darkened room through a small aperture, thus conclusively proving that vision happens when light rays pass from objects towards the eye from different angles of incidence and reflection.*"

In addition to this clarification, he coined that the projection angle in the eye is equivalent to reflection angle. He also studied the sky zenith and deduced that it is composed of nine consecutive circles springing out of a unified center, [8],[9],[10] the same idea that was later concluded by Italian Poet Dante Alighieri (1265-1321), who pointed out to it in his *the Devine Comedy* written 1321.. It brought about a great progress in experimental methods. Ibn-Al-Haytham's research in catoptrics centered on spherical and parabolic mirrors and spherical aberration. He made the important observation that the ratio between the angle of incidence and refraction does not remain constant, and investigated the magnifying power of a lens. His catoptrics contains the important problem known as Alhazen's problem. It comprises drawing lines from two points in the plane of a circle meeting at a point on the circumference and making equal angles with the normal at that point. This leads to an equation of the fourth degree. Furthermore, he wrote a special book on the effect of music on the extrasensory of human and animal, a self-fulfilling anticipation and discovery of art therapy as psychic intervention. [11]

### III- IBN-AL-HAYTHAM'S SCIENTIFIC METHODOLOGY

According to Mustafa L. Abd Al-Ghani the scientific method of Ibn-Al-Haytham is unconventional, but certainly a new one depends on testing hypotheses, and deduction of results that he retested again dialectically to verify the results by experimentation and analogies of models. His scientific methods vary each time he was conducting a research on a different matter. With mathematics, he employed analytical approach, but when he dealt with physics, he followed deduction/induction methods. Moreover , he followed skeptical scholastic approach that denies the correctness of any concept before being verified empirically [12] , or in the words of Ibn-Al-Haytham, "*The searcher of truth is not that who looks to the writings of predecessors he trusts and undertakes them as valid and correct facts. Of course, he should be questionable about credibility of what he reads, asking himself if he comprehends their sayings , and if they have written true facts supported by argument and verification. I am not telling this to those who are arrogant , or those wanting to see deficiencies of others and quarrel with everyone , but I mean those who want to learn facts , and tour into books and their annotations as critics accusing themselves before accusing others, but still without prejudice nor compliment. If a reader behaves so , he will surely arrive at the truth and discover pitfalls and deficiencies in the books he reads.*" [13]

Furthermore, Dr. Hikmat Najeeb Abd Al-Rahaman and Mustafa Nadheif have studied Ibn-Al-Haytham's methodology and concluded, "*Ibn-Al-Haytham followed a special method to study light and optics based on deduction/induction and analogy of things in a special scientific respect.*

*He adopted this scientific method before Bacon who is said to be founder of the empiricism. In fact, the latter may have learned this methodology from Ibn-Al-Haytham.* "[14][15]

To conclude, Ibn-Al-Haytham's influence on physical sciences in general, and optics in particular, has been held in high esteem and, in fact, it ushered in a new era in optical research, in both theory and practice. Truly, as it is said, a sublime scientist who emerged with grandiose tendencies, insight and wisdom, was one of the most eminent physicists, whose contributions to optics, mathematics, medicine and the scientific methods are outstanding.

Ibn-Al-Haytham's theory on vision and light initiated a scientific wave and revolution in medicine and optics. Certainly, his writings about anatomy and physiology of the eye led to reorientation of old theories in this field from misconception to the righteous standing at the knowledge of the eye and its function. Virtually, his writings made a clear development of the scientific methods as developed and applied by the westerns and comprised the systematic observation of physical phenomena and their linking together into a scientific theory. This was a major breakthrough in scientific methodology, as well as distinct scientific pursuit foundation comprising systematic relationship between observation, hypothesis and verification. Again, compromising bona fide academic texts and reference compendia in western institutions.

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## ابن الهيثم

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### مكاتبه

قال عنه سارتون في كتابه مقدمة في تاريخ العلم: " أكبر عالم طبيعي في العصور الوسطى وأهم من بحث في البصريات في جميع العصور وهو الواضع الحقيقي لعلم الضوء وتكشف بحوثه عن الرقي العظيم الذي انتهت إليه الطريقة التجريبية"

ويقول ابن أبي أصيبعة في كتابه " عيون الأنباء في طبقات الأطباء " : إن ابن الهيثم كان فاضل النفس قوي الذكاء متفناً في العلوم، لم يمثله أحد في أهل زمانه في العلم الرياضي، وقد لخص كثرة من كتب أرسطو طاليس ونشر فيها وكذلك كتب جالينوس في الطب وكان خبيراً بأصول صناعة الطب وقوانينها وأمورها الكلية إلا أنه لم يباشر أعمالها.

يقول روز بول في كتابه (المختصر في تاريخ الرياضيات) : "إن ابن الهيثم قد برهن على نظريات كثيرة في علم الفيزياء الحديث كإسقاط الأشعة، مما أدى إلى تقدم هذا العلم ووصوله إلى ما هو عليه الآن" .... ويقول في موضع آخر: " إن عمل ابن الهيثم في البصريات يفوق عمل إقليدس وبطليموس".

ويقول سينجر في كتابه (ملخص تاريخ العلوم) : "إن كتاب ابن الهيثم- المناظر- يستبعد جداً أن يكون له مثيل بين مصنفاة اليونان أو أن يكون له نظير في تراث الحضارات السابقة".

ويؤكد برنال في كتابه (العلم في التاريخ) على الأهمية الفسيولوجية للوصف الدقيق الذي قدمه ابن الهيثم لتكوين العين في مناطق شديدة الحرارة كثرت فيها أمراض العيون، وعلاقة هذا بضعف البصر والحاجة إلى عدسات خاصة لتحسين الرؤية.

ويقول ألدوميللي في كتابه: (العلم عند العرب وأثره في تطور العلم العالمي): "كان ابن الهيثم رياضياً وعالماً بالطبيعات على وجه الخصوص. ولكنه تجاوز كثيراً في مجاله المحدد هذا أهمية جميع الفيزيقيين، وقد ترك كتابه المناظر أثراً عميقاً بل كان فيما بعد باعثاً على البحوث والأعمال التي قام بها كل من روجر بيكون ووايتلو".

