

Contributions of Ibn Al-Nafis (1210-1288 AD) to the Progress of Medicine and Urology

A study and translations from his medical works

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ABSTRACT

هذه دراسة من دراسات المصادر الأصلية تشمل أربعة من الكتب الطبية التي ألفها الطبيب المسلم ابن النفيس أحد علماء القرن الثالث عشر الميلادي، والهدف منها تقييم أثره على تقدم كل من الطب وجراحة المسالك البولية. ولقد أثبتت الدراسة أن كتاب الموجز في الطب قد ألفه ابن النفيس ككتاب أصلي مستقل ليكون مرجعا مختصرا وافيا للطلبة وللممارسين وليس كملخص لكتاب القانون في الطب لابن سينا كما يظن كثير من المؤرخين الحديثين. وكتابه الآخر الشامل في الطب، وهو أكبر عمل طبي موسوعي من تأليف فرد واحد، يمثل موجة النشاط العلمي التي ازدهرت وانتشرت وسط علماء كل من القاهرة ودمشق عقب التدمير المروع للكتب والمكتبات الذي حدث مع تخريب بغداد على يد جيش هولاكو عام ١٢٥٨ م. ومثلما فعل سابقوه من علماء الحقبة الإسلامية فإن ابن النفيس قام بتقييم وتمحيص التراث العلمي لمن جاء قبله وذلك في ضوء تجاربه ونتائج ملاحظاته. ومن ثم فإننا نجد في كتابه شرح تشريح القانون أول وصف صحيح للدورة الدموية الرئوية. كما أنه قد بذر بذور الفهم السليم للدورة الدموية الكبرى. ويتضح هذا أيضا من نصوص له في كتابيه الآخرين رسالة الأعضاء والرسالة الكاملة. كما أن ابن النفيس هو أول من وصف الشرايين التاجية وأوضح إيضاحا صحيحا كيفية التروية الدموية للقلب. واكتشافات ابن النفيس هذه قام اندرياس ألباجوس، الأستاذ بجامعة بادوا، بترجمتها من العربية إلى اللاتينية وطبعت تلك الترجمة في البندقية عام ١٥٤٧. وبعد ذلك بستة أعوام كان وصف ابن النفيس للدورة الدموية الرئوية قد ظهر في كتاب إعادة المسيحية الذي ألفه سرفيتوس ثم في الطبعة الثانية لكتاب فيزيولوجيا الإنسان في عام ١٥٥٥. كما أن أوصافا للدورة الدموية مشابهة لوصف ابن النفيس ظهرت في كتب كل من فالناردي (عام ١٥٥٤) وكولمبوس (عام ١٥٥٩) وسيسالبينو (عام ١٥٧١) وأخيرا هارفي (عام ١٦٢٨). وبالإضافة لذلك، لقد وثقت هذه الدراسة عديدا من عطاءات ابن النفيس التي ساهمت في تطوير جوانب أخرى من علم التشريح الوظيفي في الإنسان وأدت، كذلك، إلى تقدم فنون الممارسة الطبية والجراحية.

This primary-source study of 4 medical works of the 13th century Muslim scholar Ibn Al-Nafis confirmed that his Kitab Al-Mujaz Fi Al-Tibb was authored as an

independent book meant to be a handbook for medical students and practitioners not as an epitome of Kitab Al-Qanun of Ibn Sina as thought by recent historians. His huge medical encyclopedia, Al-Shamil, represents a wave of intense scientific activity that spread among the scholars of Cairo and Damascus following the massive destruction of books by Hulako's Army during the devastation of Baghdad in 1258. Like his predecessors in the Islamic Era, Ibn Al-Nafis critically appraised the views of scholars before him in the light of his own experimentation and direct observations. Accordingly, in his books Sharh Tashreeh Al-Qanun, Risalat al-Aadaa and Al-Risalah Al-Kameleeyah, we find the first description of the coronary vessels and the true concept of the blood supply of the heart as well as the correct description of the pulmonary circulation and the beginnings of the proper understanding of the systemic circulation. Those discoveries of Ibn Al-Nafis, translated to Latin by Andreas Alpagus (printed in Venice in 1547), appeared, 6 years later, in the Christianismi Restituto of Servetus and, in 1555, in the De Fabrica Humani Corporis of Vesalius (2nd edition) then in the works of Valverde (1554), Columbus (1559), Cesalpino (1571), and finally Harvey in 1628. Furthermore, this study documented several other contributions of Ibn Al-Nafis to the progress of human functional anatomy and to advances in medical and surgical practice.

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Many historians documented that, in the 12th and 13th centuries, Damascus and Cairo took the place of Baghdad as leading centers for science and culture.¹⁻⁵ Despite the turmoil caused by the invading

Crusaders' and Moguls' armies, great medical schools continued to advance medical knowledge and nurture medical education in those 2 cities and other cities of the Muslim World. Ibn Al-Nafis, was one of the distinguished medical scholars who lived during that turbulent era. This study is to evaluate his contributions to the progress of medicine.

Who is Ibn Al-Nafis? Ibn Al-Nafis is the thirteenth century Muslim physician: Alaaul Deen Abu Al-Hasan Ali ibn Abi Al-Hazm Al-Qarshi, born in the year 1210 at Al-Qarsh near Damascus. He studied medicine in Damascus under the supervision of the distinguished professor Muhadhab Al-Deen Al-Dakhwar in Al-Bimaristan Al-Noori's Medical School. Ibn Al-Nafis moved to Cairo where he practiced and taught medicine in Al-Bimaristan Al-Naseri built by Salahuddin Al-Ayyobi. Then in 1285, he became the Chief Physician of the Mansouri hospital until he died in 1288 at the age of 80. Figure 1 shows the timeline of Ibn Al-Nafis in relation to some of his predecessors and contemporaries who, like him, pioneered the original contributions of the Islamic School of Medicine. According to Al-Dhahaby,⁶ Al-Sobky,⁹ Ibn Tagra Bardi Al-Atabki,¹⁰ al-Maqreezy,¹¹ Al-Yafeie,¹² Sarton,¹³ Ziedan and Abdel-Qader,¹⁴ Ziedan,¹⁵⁻¹⁶ and many other historians,¹⁷⁻³² Ibn Al-Nafis was a great physician and a prolific author, the best

among his contemporaries and the most distinguished scholar of his time in medical profession. Ibn Al-Nafis was also a distinguished authority on Quranic Studies, Prophetic Tradition, Islamic Jurisprudence, Islamic Philosophy and Arabic language studies.^{12,17,18,20,33-37} He wrote famous authoritative works in almost each of those sciences.

Method of the study. In order to evaluate the contributions of Ibn Al-Nafis to the progress of Medicine and Urology, authentic primary sources were utilized to review his biography and the original Arabic editions of his Book Al-Mujaz Fi Al-Tibb³⁸ (An epitome of Medicine) together with chapters from his other medical books: Sharh Tashreeh Al-Qanun³⁹ (A commentary on The Anatomy of the Canon of Medicine of Ibn Sina), Risalat Al-Aaada⁴⁰ (A monograph on Physiology) and Sharh Fusul Apocrat⁴¹ (Commentary on the Aphorisms of Hippocrates), were studied. Furthermore, pertinent references including books, periodicals and online history-of-medicine resources have been reviewed.

Ibn Al-Nafis' Contributions to the Progress of Medicine and Urology.

1. **The art of writing a medical textbook:** Al-Mujaz³⁸ book shows the skill of Ibn Al-Nafis in classifying his medical knowledge and writing it down according to a plan and a rigorous orderly method (Figure 2 and Table 1)

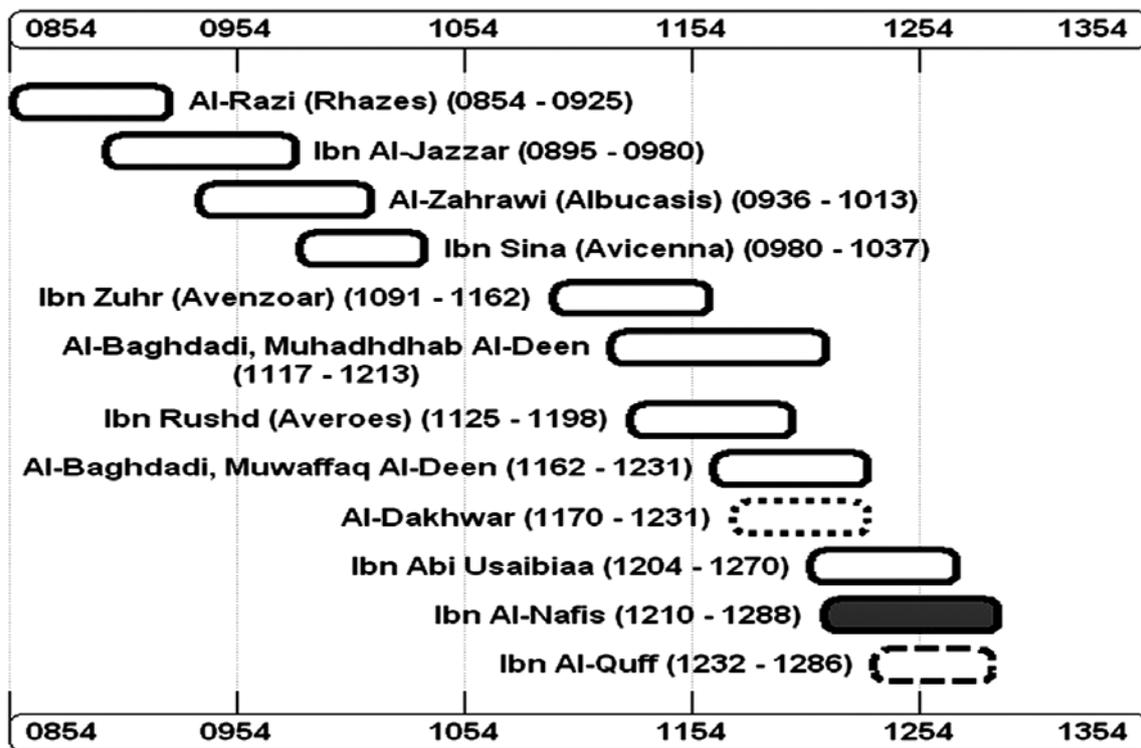


Figure 1 - Timeline (AD) of Ibn Al-Nafis in relation to some of his contemporaries and predecessors. (The filled-in event box is for Ibn Al-Nafis, the dotted-boundary box for his professor Muhadhdhabul Din Al-Dakhwar and the dashed-boundary box for Ibn Al-Quff one of his most famous students).

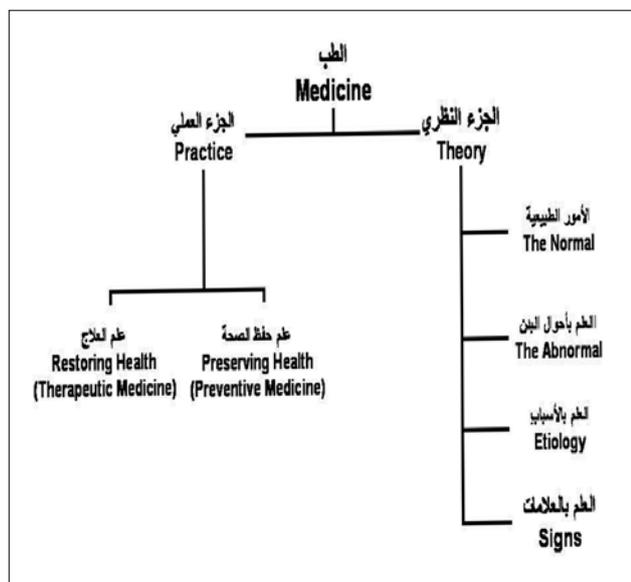


Figure 2 - Chart showing the subject classification of Kitab Al-Mujaz Fi Al-Tibb of Ibn Al-Nafis.

Table 1 - The general arrangement of topics in Kitab Al-Mujaz Fi Al-Tibb of Ibn Al-Nafis.

<p>Section I: General Principles</p> <p><i>Subsection 1: Of the theory of medicine</i></p> <p>Part 1: The normal</p> <p>Part 2: The abnormal</p> <p>Part 3: Etiology</p> <p>Part 4: Symptoms and signs</p> <p><i>Subsection 2: Of the practice of medicine</i></p> <p>1. The science of maintaining health</p> <p>2. The science of treating illness</p> <p>Section II: Medicaments & Diet</p> <p><i>Subsection 1: Simple drugs</i></p> <p>1. Generalities</p> <p>2. Mentioning of the simple drugs alphabetically listed</p> <p><i>Subsection 2: Compound drugs</i></p> <p>1. On the rules for compounding drugs.</p> <p>2. Some examples of compound drugs</p> <p>Section III: Diseases of organs (and systems)</p> <p>Diseases of organs, one by one starting from the brain downwards describing the causes, diagnosis and treatment.</p> <p>Section IV: Diseases not specific for a particular organ</p> <p>Chapter 1: Fevers</p> <p>Chapter 2: Crisis and lysis</p> <p>Chapter 3: Swellings, ulcers, leprosy, and the plague and how to avoid it.</p> <p>Chapter 4: Fractures, Contusions, Dislocations, Falls and Abrasions.</p> <p>Chapter 5: Care of skin, hair and figure (body weight).</p> <p>Chapter 6: On poisons and their avoidance.</p>	<p>in a lucid, concise but precise and up-to-the-point style. This represents a salient feature of medical textbooks authored during the Islamic period and is in agreement with Cumston⁴² and Leclerc⁴³ who admired the clarity of medical textbooks written by Islamic physicians when compared with those of ancient authors. In the early biographies of Ibn Al-Nafis^{6,9,10,18-20,44} the title of this book is given as: Kitab Al-Mujaz fi Al-Tibb (The Epitome in Medicine) or is shortened as Kitab Al-Mujaz (The Epitome). None of those early biographers did mention that the book was a summary of Kitab Al-Qanun fi Al-Tibb written by Ibn Sina 250 years back. However, almost all the recent biographers, starting from Hajji Khalifah⁴⁵ (1017-1067 H) identified the book as: “Kitab Mujaz Al-Qanun” (An epitome of the Canon book).⁴⁶ Most of them repeated a statement that Ibn Al-Nafis meant in Al-Mujaz to give a summary of Ibn Sina’s book: the Canon of Medicine.²¹⁻²³ This is not proven by our study which confirmed that: Kitab Al-Mujaz is authored by Ibn Al-Nafis as an independent book meant to be a handbook of general medicine for medical students and practitioners. In his introduction to the book,⁴⁷ Ibn Al-Nafis did not mention, at all, the Canon of Ibn Sina or any plan to summarize it. Furthermore, both the arrangement and content of the chapters are different in both books. Moreover, contrary to Iskander,⁴⁸ and for the same reasons, the Mujaz of Ibn Al-Nafis is, once more, not a summary of his other book: Kitab Sharh Al-Qanun. The most voluminous book of Ibn Al-Nafis is his encyclopedic work entitled Kitaab Al-Sahmel Fi Al-Sinaa Al-Tibbiyya (The comprehensive book on the art of medicine).⁴⁹ According to the 13th to 14th century historian Al-Dhahaby (1274-1348),⁶ judging from its preplanned table of contents, the book was intended to be 300 volumes. However, Ibn Al-Nafis lived only to write 80 volumes out of which, up until now, only 28 volumes could be found and are being edited and published in a series by Ziedan.⁴⁹ Al-Shamil is the 6th encyclopedic scientific work ever written by a single author. The 5 famous encyclopedic medical works that preceded Al-Shamil, are shown in Table 2. They were all written during the Islamic era in the period from the 9th to the 13th centuries. According to Ziedan,¹⁶ this encyclopedic work Kitab Al-Shamel of Ibn Al-Nafis represents a wave of intense scientific activity, that spread among the scholars of Cairo and Damascus, following the massive loss and destruction of books during the devastation of Baghdad by Hulako’s Army in the year 1258. Ibn Al-Nafis was then 50 years old at the peak of his medical experience. He wrote Al-Shamil, and many other scholars wrote similar huge encyclopedic works in different branches of science in an attempt to cope with the disaster and to preserve the scientific and cultural</p>
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Table 2 - The encyclopedic medical works that preceded Al-Shamil book of Ibn Al-Nafis.

Scholar	Century (AD)	Encyclopedic Book
Al-Razi (Rhazes)	9-10th	Al-Hawi*
Ali ibn Al-Abbas	9-10th	Kamil Al-Sinaa*
Al-Zahrawi (Albucasis)	10-11th	Al-Tasrif*
Ibn Sina (Avicenna)	10-11th	Al-Qanun*
Ibn Zuhr (Avenzoar) Ibn Rushd (Averroes)	11-12th	Al-Taiseer together with Al-Kulliyat†
Al-Baghdadi, Muhadhdhab Al-Din	12-13th	Al-Mukhtar Fi Al-Tibb*
Ibn Al-Nafis	13th	Al-Shamil Fi Al-Sinaa Al-Tibbiyya*

*written by a single author, †the first multi-author medical textbook⁴⁴

Table 3 - Titles and description of some of the medical works of Ibn Al-Nafis.

The Book	Description
Al-Shamel Fi Al-Sinaa Al-Tibbiyya (The Comprehensive Book on the Art of Medicine)	Massive Encyclopedia
Al-Mujaz Fi Al-Tibb (The Epitome in Medicine)	Comprehensive Summary
Sharh Al-Qanun (Commentary on the Canon of Medicine)	General Principles Pharmacy
Sharh Tashrih Al-Qanun (Commentary on the Anatomy of the Canon of Medicine)	Anatomy
Risalat Al Aaada (A Treatise on Physiology)	Physiology
Al-Muhadhab Fi Al-Kuhl Al-Mujarab (The Refined Book On Ophthalmology)	Textbook on Ophthalmology

heritage of the whole world pioneered then by Baghdad, the leading centre of Islamic Civilization in that Era. This intense encyclopedic writing activity extended also to the Islamic scholars of the 14th and 15th centuries enriching and preserving the world heritage of knowledge.⁵⁰ Examining Table 3, showing a list of some of the medical works authored by Ibn Al-Nafis, will further reveal his skill in preplanning his works. All the books integrate together and complement each other. Al-Shamel⁴⁹ is an encyclopedic data base for the researcher; Al-Mujaz³⁸ is a hand book for medical students and the general practitioners. Anatomy, physiology or surgical details are not included in that book. Surgical details are available in Volume 42 of Al-Shamel;⁵¹ physiology in Kitab Risalat Al-Aadaa⁴⁰ and anatomy in Kitab Sharh Tashreeh Al-Qanun.³⁹ Furthermore, Kitab Al-Mujaz³⁸ contains general practice knowledge on diseases of the eye but Al-Muhadhab Fil Al-Kuhl Al-Mujarab⁵² is a book for the specialist ophthalmologist.

II. Critical appraisal of literature and reliance on observation and experimentation: Like his predecessors in the Islamic Era, Ibn Al-Nafis critically appraised the views of those who came before him in the light of his own experience, experimentation and direct observations. The following translation from his introduction to his book “Sharh Fusul Apocrat” (Commentary on the Aphorisms of Hippocrates) clearly shows his aim of rejecting what is superfluous and accepting only what is proved to be true: “In our previous commentaries on this book, copies (editions) varied according to the various purposes of those who requested them. However, in this copy (edition) we are going to follow what we believe is appropriate for commentary works and just right in composing and bringing together. Furthermore, with regard to throwing light on and standing by true opinions as well as denouncing those

which are false and wiping out their traces; that was the constant policy we followed in all studied subjects. And may Allah guide and help us to do that.”⁵³ This critical appraisal is, also, quite obvious in his other book Sharh Tashreeh Al-Qanun, where he disagreed with several of the Galenic and Hippocratic doctrines. In this book, Ibn Al-Nafis stated the following: “...However, as regard the function of organs, we rely only on what is dictated by investigative observations and accurate research; not caring whether it conformed with, or differed from, the opinions of those who came before us.”⁵⁴ Accordingly, in Sharh Tashreeh Al-Qanun, we find one of the great discoveries in the history of physiology; the first correct description of the pulmonary circulation (translated as follows from page 293-294): “In the human heart and in the hearts of similar beings possessing a lung, it is necessary to have another cavity where the blood becomes thin and ready to be admixed with air. Indeed, if air gets mixed with blood while it is still thick, the resulting mix will not be of homogeneous particles. That cavity is the right cavity of the two cavities of the heart. And when the blood in that cavity becomes thin, it must pass to the left cavity where the [“rooh”] vital spirit (pneuma) is formed. But, there is no connecting passage in between them (the 2 cavities) because the heart substance there is compact without any obvious passage, as thought by some, or invisible passage that could transmit that blood as thought by Galen. Indeed the texture of the heart, there, is compact and its substance is thick. Therefore that blood when becomes thin, must pass through the arterial vein (pulmonary artery) to the lungs to spread in its substance and mix with air in order to purify (filter, clear) the thinnest part of it then pass to the venous artery (pulmonary vein) to be carried to the left cavity of the two cavities of the heart admixed with air and, thus, made ready to generate the vital spirit. And the

*blood that remains less thinner will be used by the lung for obtaining its nutrients. It is for that reason that the arterial vein was made of greater compactness and with 2 layers so that what passes through its pores would be very thin while the venous artery was made thin walled with only one layer in order to easily allow in what comes out of that vein. For that reason, perceptible connecting passages were made between these two vessels.*⁵⁵

In agreement with Poynter,⁵⁶ Isakander,⁵⁷ Castiglioni,⁵⁸ and others,⁵⁹⁻⁶⁷ Ibn Al-Nafis in this unambiguous description of the pulmonary circulation, firmly denied the Galenic concept of the existence of invisible pores in the septum between the right and left ventricles of the heart. Furthermore, the last sentence of the above-mentioned new extended translation furnishes an evidence that Ibn Al-Nafis discovered the capillary circulation that connects the pulmonary artery branches to the tributaries of the pulmonary vein in the lung substance. The following translated quotations from Sharh Tashreeh Al-Qanun show some more places where Ibn Al-Nafis, using his own anatomical observations, disproved other Galenic doctrines, which were taken for granted for several hundred years: *“As regard his statement [the statement of Galen accepted by Ibn Sina] that the heart has 3 ventricles: this cannot be correct because the heart has only 2 ventricles. Indeed dissection disproves what they said”*⁶⁸ Furthermore, the first ever mention of coronary vessels is found on page 389 of Sharh Tashreeh Al-Qanun of Ibn Al-Nafis translated as follows: *“His attribution of the nourishment of the heart to the blood in the right ventricle, can never be accepted as true because the nourishment of the heart is actually from the blood passing to it in the vessels situated in its substance”*.⁶⁹ Another unmistakable description of the coronary vessels by Ibn Al-Nafis, is also found on page 316 of the same book and is, hereby, translated for the first time:

“And here is a question that we ought to verify its answer. Someone could say: why is it that the vessel arising from the heart to the other organs gives at its beginning two branches; one of them circles round the heart and spread in its different parts and the other penetrate into the right ventricle?. Whilst in the case of the liver, nothing separates from the vessel that arises from it, to the other organs, to spread in the different parts of the liver.

*The answer (to that question): the reason is that the vessel arising from the heart to the other organs serves to supply the vital spirit and life to the organs. It arises from the left ventricle of the heart, the place of the pneuma (vital animal spirit). Therefore if nothing separates off that vessel to supply the other parts of the heart, those parts will be devoid of the vital spirit and the power of life...”*⁷⁰

Moreover, in agreement with Iskander⁷¹ and Ziedan,⁷² Ibn Al-Nafis rejected the so called ebb and flow movement of the blood described by Galen and laid the

seeds of the correct description of the systemic greater blood circulation. This is, also, clearly evident from statements by Ibn Al-Nafis in his other books: Risalat Al-Aadaa⁷² and Al-Risalah Al-Kamelliyyah.^{72,73} Those findings of Ibn Al-Nafis in relation to the circulation, and the coronary vessels together with his other anatomical and physiological discoveries, were accepted by scholars who came after him and were included in their works such as Sharh Al-Qanun (Commentary on [Ibn Sina's] 'Canon') by Sadid al-Din Muhammad Ibn Masoud al-Kazaruni, who completed his commentary in A.H. 745/ A.D. 1344 and in Ali Ibn Abdallah Zayn al-Arab al-Misri's Sharh al-qanun (completed in A.H. 751/ A.D. 1350).^{51,74-77} Ibn Al-Nafis description of the pulmonary circulation, together with other parts of his Sharh Tashreeh Al-Qanun, was also included as marginal notes added to the widely spread copies of Ibn Sina's Canon of Medicine and its commentaries.^{51,75-77}

Early in the 16th century, Andrea Alpamus (1450-1522), a professor of Medicine in Padua University who spent 30 years in Syria studying Arabic Medical manuscripts, translated into Latin, sections of Ibn Al-Nafis Book Sharh Tashreeh Al-Qanun including his views on the pulmonary circulation.^{29,51,63,74-76} This translation, printed in Venice in the year 1547, helped to spread Ibn Nafis' description of pulmonary circulation to Medieval European scholars and, thus, raise their doubts on Galen's anatomy. Six years later, Ibn Al-Nafis description of pulmonary circulation was accepted by Michel Servetus (1511-1553) who included it, verbatim, in his book Christianismi Restituto.^{29,51,63,75-77} Then, in 1555, Andreas Vesalius (1514-1564), another Padua University professor, described the pulmonary circulation in a manner similar to Ibn Nafis' description, in the second edition of his famous book the “De Fabrica Humani Corporis”.⁷⁵⁻⁷⁷ Another similar description was given by Juan Valverde in 1554 and Realdus Columbus (1510-1553) in 1559 in their books on anatomy^{29,63,75-77} and in 1571 by Andrea Cesalpino (1519-1603) in his book Quaestionum Peripateticarum Libri Quinque, which documented more elaboration and experimentation including the first use of the word “circulation”.^{77,78} Finally William Harvey (1578-1657) who got his doctorate from Padua university in 1602 gave the full description of the blood circulation in his lectures in 1616 then in his famous book “Exercitatio anatomica de motu cordis et sanguinis in animalibus”: printed in 1628.^{29,63,75-77} According to Jaleely,⁷⁶ the description given for the coronary vessels in Harvey's book is similar to that given by Ibn Al-Nafis. It is also significant, in this evolution chain, that out of the above mentioned medieval European medical scholars, 3 were fluent in Arabic language: Alpamus, Servetus and Vesalius.⁷⁶

III. Emphasis on the study of anatomy for physicians and further progress in anatomical drawings in medical textbooks: Ibn Al-Nafis, like the other Muslim scholars before him, emphasized, in his book *Sharh Tashreeh Al-Qanun*, that the doctor should be quite knowledgeable in anatomy to be able to identify the state of the organs and how they are related to each other. He allocated a special chapter titled “on the benefits of studying the science of anatomy” and showed how essential this study is for reaching diagnosis and for practicing medicine and performing different surgical, orthopedic or ophthalmologic procedures.⁷⁹ Furthermore, in this book, he wrote a special chapter on the best mode for dissecting the following parts: bones, peripheral vessels and internal organs of the chest (heart, lung, big vessels and the diaphragm).⁸⁰ Meanwhile, both of Ibn El-Nefis in this book and Alrazi (Rhazes) in his treatise on anatomy, in his book *Al Mansouri*, frequently mentioned the word “Al-Musharrihon,” which according to the Arabic language etymology, is derived from the Arabic verb “Yusharrih”. According to *Lisan Al Arab* lexicon,⁸¹ this verb means dissecting the flesh and dissecting the flesh out of bones. Thus the word “Musharrihon” subsequently means the dissectors. Therefore, in contradiction with Long⁸² and many others, the practice of dissection for medical teaching, was not prohibited in either the religion of Islam or the Islamic world. On the contrary, all the eminent Islamic physicians of that era stated that

knowledge of anatomy leads to a deeper appreciation of God’s wisdom and omniscience.⁸³⁻⁸⁵ Furthermore, the presence of anatomical drawings within the text in that book of Ibn Nafis; *Sharh Tashreeh Al-Qanun* is a further step forward in illustrating medical text books; a trend that started and flourished in the Islamic period reflecting the role of direct observations and experience. This illustration of the maxillary sutures (Figures 2 and 3) in *Sharh Tashreeh Al-Qanun* is more sophisticated than the anatomical illustrations we have shown before in the *Canon of Avicenna* and the *Mansouri Book of Rhazes* and the *Al-Mukhtar of Muhadhdhabul Din Al-Baghdadi*.⁸⁵

IV. Contributions to the progress of urology: All the above-mentioned contributions of Ibn Nafis did help in the establishment of the foundation of urology, as well as all other branches of medical and surgical subspecialties. However, of particular urological interest are the advances made by Ibn Al-Nafis in uro-physiology. Contrary to Galen who described the bladder wall as formed only of one layer,^{86,87} Ibn Al-Nafis, in his book *Sharh Tashreeh Al-Qanun* described the bladder wall as consisting of 2 layers.⁸⁸ Carrying on with this original observation made by Al-Razi, Ibn Sina, Al-Zahrawi, and Al-Baghdadi; his description of the anti-reflux and micturition mechanisms were also contrary to Galen but conformed well with our contemporary understanding.⁸³

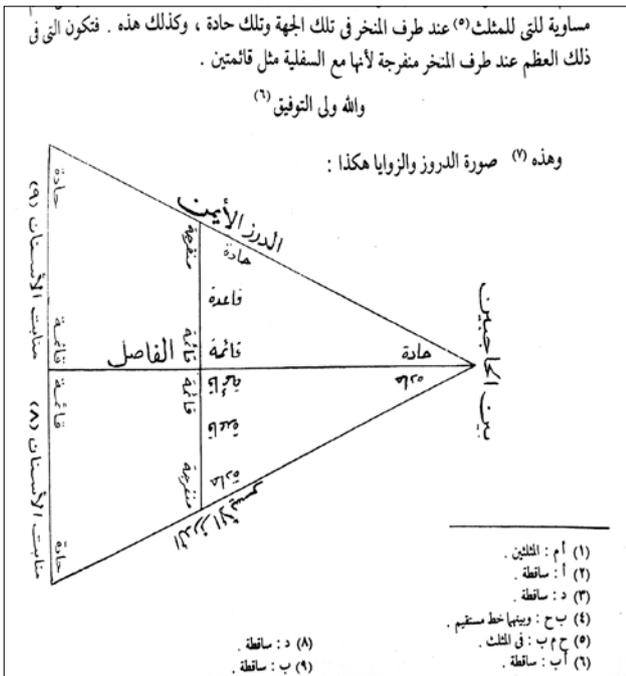


Figure 3 - Anatomical drawing of the maxillary sutures in one of the original manuscripts of Ibn Al-Nafis’ book *Sharh Tashreeh Al-Qanun*.³⁹

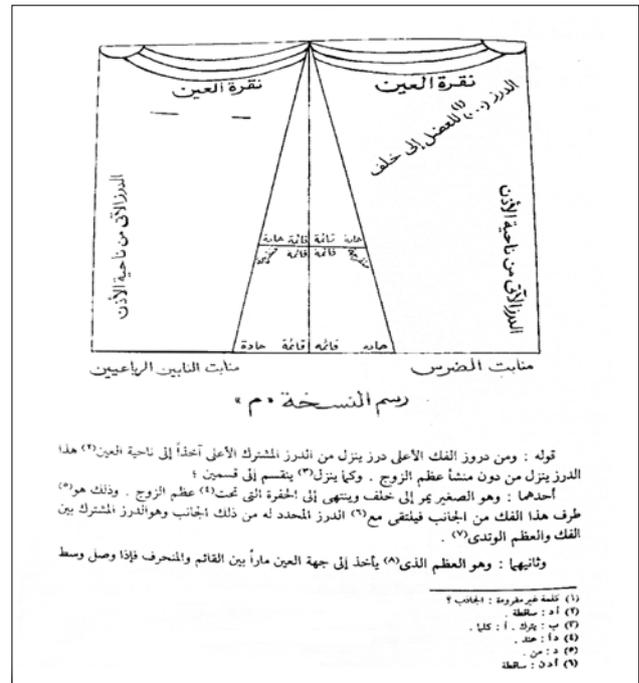


Figure 4 - Anatomical drawing of the maxillary sutures in another original manuscript of Ibn Al-Nafis’ book *Sharh Tashreeh Al-Qanun*.³⁹

Ibn Al-Nafis' full description of the vesico-ureteric anti-reflux mechanism is, hereby, translated:

*"...For this reason the base and back of the bladder is made of two layers and when the two canals known as ureters penetrate it, they first penetrate through the superior layer and continue for a distance then they penetrate the inferior layer opening into the bladder cavity. The benefit of that (arrangement) is that when the bladder is filled up and the inner layer presses upon the outer layer, the two canals (ureters) going in between the two layers will be compressed and thus occluded preventing the reflux of urine (retrogradely)..."*⁸⁸

In this description, Ibn Al-Nafis differed from Al-Razi,^{89,90} Ibn Sina,⁹¹ Al-Zahrawi,⁹² and Al-Baghdadi⁹³ in specifying the base and back of the bladder as the regions where the bladder wall is made of 2 layers. This is another proof that he was not a copyist or a mere compiler and is another evidence of the scientific spirit that spread during the Islamic era and stimulated its scholars to rely on their own findings and describe their own observations. With regard to urological practice, Ibn Al-Nafis, same as all his predecessors in the Islamic era, stressed, the importance of clinical medicine. In Al-Mujaz book, in addition to an introductory general chapter on physical signs, he started each of the chapters dealing with regional diseases by mentioning the related specific symptoms paying a lot of attention to differential diagnosis and prognosis. This is in agreement with Cumston who described the Arabian physicians as keen observers who excelled in diagnosis and prognosis with their description of symptoms showing a precision and an originality that could be only obtained by direct study of the disease.⁹⁴

Accordingly, in his book Al-Mujaz, Ibn Al-Nafis distinguished between kidney stones and bladder stones with regard to their pathogenesis and clinical picture. He discussed how to differentiate renal from intestinal colic, bladder infections from kidney infections as well as the different types of inflammatory and non inflammatory renal swellings.⁹⁵ In the conservative management of renal stones Ibn Al-Nafis, advised diuresis only for short periods of time; not constantly as recommended by Ibn Sina.⁹⁵ In line with his general policy in Kitab Al-Mujaz Fi Al-Tibb, Ibn Al-Nafis listed only the commonly used and well known lithonryptic medicaments. Among those medicaments, he included a medicament which is not mentioned in Ibn Sina's Canon of Medicine.^{95,96} Both of Ibn Sina and Ibn Al-Nafis recommended the same dietary management for urinary stone patients. However, Ibn Al-Nafis did not pay attention to the type of water intake whilst Ibn Sina advised avoidance of "turbid waters".^{95,96} This again proves the originality of Ibn Al-Nafis and shows, in addition to many other pieces of evidence, that Al-Mujaz fi Al Tibb is not just

a summary for the Canon of Medicine as claimed by some modern historians. He, also, did not agree with Hippocrate's statement that penetrating wounds of the urinary bladder are always fatal.⁹⁷ Moreover unlike Paulus,⁹⁸ Ibn Al-Nafis did not recommend venesection in the management of patients presenting with stone impaction and acute pain.⁹⁵ As preplanned by Ibn Al-Nafis, Al-Mujaz book does not contain any details on operative treatment or surgical instrumentation. These are to be found in Vol. 42 of his encyclopedia Al-Shamil Fi Al-Sinaa Al-Tibbyaa,⁵¹ a manuscript which is still waiting for editing and publication. Accordingly, in conclusion, it is evident from this study that Ibn Al-Nafis is the greatest physiologist of Middle Ages and the main forerunner of Servetus, Vesalius, Columbus and Harvey in the description of pulmonary circulation as we know it today. He was also the first to describe the coronary vessels and the true concept of the blood supply of the heart. Moreover he described the presence of connecting passages in the substance of the lung between the branches of pulmonary artery and tributaries of pulmonary veins and pointed out to the greater systemic circulation of blood from the heart to all organs and vice versa.

Ibn Al-Nafis was, also, a talented physician and a gifted medical writer. His discoveries and medical works, greatly contributed to the progress of medical knowledge and the advancement of medical practice. His influence on the generations of doctors and scholars who came after him, both in the East and West, is well documented up to the seventeenth century.

References

1. Castiglioni A. A history of medicine. New York (NY): Jason Aronson Inc; 1975. p. 278.
2. Bu Malham A. Introduction. In: Bu Malham A, Attawi AN, Al-Sayyed F, Aser Al-Din M, Abdel-Satir A, editors. Ibn Katheer. Al-Bidayah Wa Al-Nihayah, x3rd ed. Beirut; Dar Al-Kutub Al-Elmeyyah; 1978. p. Aleph-Kaf.
3. Muntasir A. Tarikh Al-Elm Wa Dawr Al-Ulmaa Al-Arab Fi Taqaddumihi. 8th ed. Cairo: Dar Al-Maarif; 1990. p. 177.
4. Ziedan Y, Abdel-Qader M. Introduction. Ziedan Y, Abdel-Qader M, editors. Sharh Fusul Apocacrat. 1st ed. Beirut (EG): Al-Dar Al-Mesreyya Al-Lobnaneyyah; 1991. p. 42.
5. Maarof BA. Forward. In: Al-Dhahaby MAO, Seyar Aalam Al-Nobalaa, Aranaouty S, editors. Publications of Imam Muhammad ibn. King Saud University (KSA): Muassasat Al-Risalah; 1981. p 12.
6. Al-Dhahaby MAO. Tarikh Al-Islam Wa Wafayat Al-Mashaheer Wa Al-Aalaam. In: Maarof BA, editor. Beirut: Dar Al-Gharb Al-Islami; 2003. p. 597-598.
7. Al-Dhahaby MAO. Al-Ibar Fi Khabar Man Ghabar, Zagloul BM, editor. 1st ed. Beirut: Dar Al-Kutub Al-Ilmeyyah; 1985. p. 356.
8. Al-Dhahaby MAO. Duwal Al-Islam, Haidaerabad. 2nd ed. Hyderabad (IN): The Bureau, Osmania University; 1365 p. 143.

9. Al-Sobky, Tajul-Din. *Tabaqat Al-Shafeyyaa Al-Kobrah*. Vol. 5. Beirut: Dar Al-Maarifah Lilltibaah Wa Al-Nashr Wa Al-Tawzei. p. 129.
10. Ibn Taghbra Bardi Al-Atabki Y, Shamsul-Deen MH. *Al-Nojoom Al-Zahirah Fi Muluk Misr Wa Al-Qahirah*. Vol. 7. Dar Al-Kutub Al-Elmeyyah; 1992, Vol 7: p. 318.
11. Al-Maqreezy AA. In: Att MA, editor. *Al-Solook Limaarifat Duwal Al-Mulook*. Vol. 2. Beirut: Manshorat Mohammad Ali Baidoon; 1997. p. 209 .
12. Al-Yafeie. *Miraat Al-Janan Wa Ibrat Al-Yaqzan Fi Maarifat Hawadith Al-Zaman*. Al-Warraq Net Online Heritage Library, p. 721. Available from URL: <http://www.alwaraq.net/index2.htm?i=120&page=721>.
13. Sarton G. *Introduction to the History of Science*. Carnejie Institution of Washington. Baltimore: Williams & Wilkins Company; 1927-1931. Reprinted: New York: Robert E. Krieger Publishing Co, Inc; 1975. p. 1099-1101.
14. Ziedan Y, Abdel-Qader M. Introduction. In: Ziedan Y, Abdel-Qader M, editors. *Ibn Al-Nafis. Sharh Fusul Apocacrat*. 1st ed. Beirut (Cairo): Al-Dar Al-Mesreyya Al-Lobnaneyyah; 1991. p. 35-65.
15. Ziedan Y. Introduction. In: Ziedan Y, editor. *Ibn Al-Nafis, Risalat Al-Aadaa, Maa Dirasah Hawal Ibn Al-Nafis Wa Manhajahu Wa Ibdadatah*. Cairo (Egypt): Al-Dar al-Masreyyeh Al-Libnaneyyah; 1991. p 13-69.
16. Ziedan Y, Introduction (Dirasah Mumahidah). In: Ibn Al-Nafis, editor. *Al-Shamil Fi Al-Sinnat Al-Tibbiyyah*. 1st ed. Abu Dhabi: Al-Mojammaa Al-Thaqafi; 2000. p. 1-12. Al-Warraq Net Online Heritage Library. Available from URL: <http://www.alwaraq.net/index6.htm?i=3015&page=1&newformat=true>
17. Ibn Al-Ghazzi, Shams Al-Deen Abu Al-Maali Muhammad ibn Abdel-Rahman, Diwan Al-Islam, Al-Waraq Net Electronic Heritage Library, p 91, Available from URL: <http://www.alwaraq.net/index2.htm?i=249&page=91>
18. Al-Soyoti, Husn Al-Muhadarah Fi Akhbar Misr Wa Al-Qahirah, Al-Waraq. Net Electronic Heritage Library. p. 182. Available at URL: <http://www.alwaraq.net/index2.htm?i=3150&page=182>
19. Ibn Al-Imad. *Shadharat Al-Dhahab Fi Akhbar Man Dhahab*. Al-Arnaouti M, Al-Aranaouti Abdel-Qader, editors. 1st ed. Damascus and Beirut: Dar Ibn Katheer; 1991. p. 701-702.
20. Ibn Qadi Shohbah, *Tabaqat Al-Shafeyyeh, Al-Waraq Net Electronic Heritage Library*, page 107. Available from URL: <http://www.alwaraq.net/index2.htm?i=292&page=107>
21. Al-Babani, Ismaeil ibn Muhammad Ameen ibn Meer Saleem. *Hadeyyat Al-Aarefeen Fi Asmaa Al-Moallifeen Wa Aathar Al Musannifeen*. Istanbul: Wikalat Al-Maarif Al-Jaleela fi Matbaatiha Al Baheyyah; 1951. 3rd ed. reprinted in Tehran: Maktabat Al Islamiat Wa Al-Jaafari Tabreezi; 1387 H. p. 714.
22. Al-Zarkaly, Khairul Deen, Al-Aalam. *Qamus Tarajim Lishhar Al-Rijal wa Al-Nisaa Mina Al-Aarab Wa Al-Mustaaribeeb Wa Al-Mustashriqeen*. 5th ed. Beirut: Dar Al-Elm Lilmalayeen; 1980. p. 270-271.
23. Van Deek E. *Iktifaa Al-Qqnaa Bima Huwa Matboa Min Ashar Al-Taaleef Al-Arabeyyeh Fi Al-Matabei Al-Sharqeyyaaah and Wa Al-Gharbeyyeh*. In: Al-Bibillawy AMA. *Al-Fajjalah*, Misr. Egypt: Al-Hilal Press; 1896. p. 223-225. Al-Warraq Net Electronic Heritage Library, page 74 and 79. Available from URL: <http://www.alwaraq.net/index2.htm?i=2004&page=79>
24. al-Safadi KA. *Aayan Al-Asr Wa Aawaan Al-Nasr*. In: Abu Zaid A, Abu Amsha N, Maeid M, Salim M, editors. *Publications of Jumaa Al-Majid Centre for Culture and Heritage*. 1st ed. Damascus: Dar Al-Fikr and Beirut: Dar Al-Fikr Al-Muaasir. 1998; Vol. 2: p. 404; Vol 4: p. 222 and p. 448.
25. Al-Mohibby. *Nafkhat Al-Rayhanah wa rashhat Tilaaa Al-Hanah*, Al-Waraq Net Electronic Heritage Library. Available from URL: <http://www.alwaraq.net/index2.htm?i=209&page=325>
26. Essa A. *Moajam Al-Atibbaa From 650H till this day (1361H/1942AD)*: Dhayl Uyunul-Anba Fi-Tabaqat Al-Atibbaa Li Ibn Abi Usaibiaa. Ibn Al-Nafis Biography. 2nd ed. Beirut: Dar Al-Raeid Al-Arabi; 1982. p. 292-296.
27. Muntasir A. *Tarikh Al-Elm Wa Dawr Al-Ulmaa Al-Arab Fi Taqaddumihi*. 8th ed. Cairo: Dar Al-Maarif; 1990. p. 133-135, 177-178.
28. Abdel-Qader M. *Muqaddemah Fi Tarikh Al-Tibb Al-Arabi*, Beirut (Lebanon): Dar Al-Ulum Al-Arabiyyah Lilltibiaa Wa Al-Nashr; 1988. p. 95-110.
29. Omar AM, Hareedy AA, editors. *The life and era of Ibn Al-Nafis and his works*. In: Ibn Al-Nafis, Al-Risalah Al-Kameliyyah fi Al-Sirah Al-Nabaweyyeh,. Omar AM, Hareedy AA, editors. 2nd ed. Cairo: Islamic Heritage Revival Committee, Supreme Council for Islamic Affairs, Ministry of Endowments; 1978. p. 23-72.
30. Ghaliogy P, Shawqy J, Mounis H, Abu Rayyan MA, Al-Sayyad MM, Musa RS, editors. *Ibn Al-Nafis Biography*. Mawsoat Al-Ulum Al-Islameyyah Wa Al-Uluma Al-Muslimeen. Beirut: Maktabat Al-Maarif. p. 175-176.
31. Al-Ezbawy A. Introduction. In: Ibn Al-Nafis. *Al Mujaz Fi Al-Tibb*. Al-Ezbawy A, editor. 4th ed. Cairo: Islamic Heritage Revival Committee, Supreme Council for Islamic Affairs, Ministry of Endowments; 2004. p. sheen-25.
32. Badran I. Forward. In: Ibn Al-Nafis, editor. *Al Mujaz Fi Al-Tibb*. 4th ed. Cairo (Egypt): Islamic Heritage Revival Committee, Supreme Council for Islamic Affairs, Ministry of Endowments; 2004. p. taa-ccen.
33. Al-Soyoti. *Al-Itqan Fi ulum Al-Quran*. Available from URL: <http://www.alwaraq.net/index2.htm?i=4&page=343>
34. Al-Soyoti. *Al-Mizher Al-Waraq Net Electronic Heritage Library*. Available from URL: <http://www.alwaraq.net/index2.htm?i=37&page=63>
35. Ibn Masoom A. *Sulafat Al-Asr Fi Mahasin Al-Shuaraa Bikul Misr*. Available from URL: <http://www.alwaraq.net/index2.htm?i=342&page=68>
36. Ibn Masoom A. *Anwar Al-Rabei Fi Anwaa Al-Badei*. Available from URL: <http://www.alwaraq.net/index2.htm?i=3179&page=494>
37. Al-Zibaidy M. *Taj Al-Aroos, Al-Wabaa, Al-Warraq Net Electronic Heritage Library*. Available from URL: <http://www.alwaraq.net/index2.htm?i=282&page=248>.
38. Ibn Al-Nafis. *Al-Mujaz Fi Al-Tibb*. Al-Ezbawy A, editor. 4th ed. Cairo: Islamic Heritage Revival Committee, Supreme Council for Islamic Affairs, Ministry of Endowments; 2004.
39. Ibn Al-Nafis. *Kitab Sharh Tashreeh Al-Qanun*. Qattaya S, editor. Cairo: The Supreme Council for Culture and the Egyptian Book Bureau; 1988.
40. Ibn Al-Nafis. *Risalat Al-Aadaa*. Ziedan Y, editor. Cairo: Al Dar Al-Masreyya Al Lubnaneyyah; 1991.
41. Ibn Al-Nafis, *Sharh Fusul Apocrat*. Ziedan Y, Abdel-Qadir M, editors. Cairo: Al Dar Al-Masreyya Al Lubnaneyyah; 1991.
42. Cumston CG. *Islamic Medicine*. In: Cumston CG, editor. *An introduction to the history of medicine from the time of the pharaohs to the end of the XVIII century*. London (UK): Kegan Paul, Trench, Trumbner and Co. Ltd. New York, (NW): Alfred A. Knopf; 1926. p. 191.
43. Leclerc L. *Histoire de la médecine arabe*. Paris: Ernest Ledaux; 1876. p. 91-92
44. Ibn Katheer. *Al-Bidayah Wa Al-Nihayah*. Abu Malham A, Attawi A, Al-Sayyed F, Nasir Al-Din M, editors. 3rd ed. Beirut: Dar Al-Kutub Al-Ilmeyyah; 1978. p. 331.

45. Hajji Khalifah MA. Kashf Al-Zunun Aan Asami Al-Kutub Wa Al-Funun. In: Yaltaqaya MS, Al-Klais RB, editors. 3rd ed. Tehran: Maktabat Al-Islamiyyah Wa Al-Jaafary Tabreezi; 1378H. p. 1024.
46. Kahya E. Ibn Al-Nafis and his work Kitab Mujiz Al-Qanon. Studies in the history of medicine and science. Vol. 9. 1985. p. 89-94.
47. Ibn Al-Nafis. Al-Mujaz Fi Al-Tibb. Al-Ezbawy A, editor. 4th ed. Cairo: Islamic Heritage Revival Committee, Supreme Council for Islamic Affairs, Ministry of Endowments; 2004. p. 31.
48. Iskander AZ. A catalogue of Arabic manuscripts on medicine and science in the Wellcome Historical Medical Library. London: The Wellcome Historical Medical Library Series; 1967. p. 52-53.
49. Ibn Al-Nafis. Al-Shamil Fi Al-Sinaa Al-Tibbiyyah. Ziedan Y, editor. Abu Dhabi (UAE): Al-Mujammaa Al-Thaaqfi; 2000. Vol. 1 & 2.
50. Darweesh A. Introduction. In: Darweesh A, editor. Ibn Qadhi Shohbah A. Tarikh Ibn Qadhi Shuhbah Al-Asadi Al-Dimashqi. Damascus: The French Scientific Istitute for Arabic Studies; 1994. p. 11.
51. Iskander AZ. Comprehensive book on the art of medicine by Ibn Al-Nafis. The second International Islamic Medicine Conference. Kuwait, 1982. Available from URL: <http://www.islamset.com/isc/nafis/index.html>
52. Ibn Al-Nafis. Al-Muhadhdhab Fi Al-Kuhl Al-Mujarrab. Wafai MZ, Qalaji MR, editors. 2nd ed. Riyadh: Safir Press; 1994.
53. Ibn Al-Nafis. Sharh Fusul Apocrat. Ziedan Y, Abdel-Qadir M, editors. Cairo: Al Dar Al-Masreyya Al Lubnaneyyah; 1991. p. 93-94.
54. Ibn al-Nafis. Kitab Sharh Tashreeh al-Qanon. Qattaya S, editor. Cairo: The Supreme Council for Culture and the Egyptian Book Bureau; 1988. p. 17.
55. Ibn al-Nafis. Kitab Sharh Tashreeh al-Qanon. Qattaya S. Cairo: The Supreme Council for Culture and the Egyptian Book Bureau; 1988. p. 293-294.
56. Poynter FNL. Forward. In: Iskandar AZ, editor. A catalogue of Arabic manuscripts on medicine and science in the Wellcome Historical Medical Library. London: The Wellcome Historical Medical Library Series; 1967. p. v-viii.
57. Iskander AZ. Introduction. In: Iskander AZ, editor. A catalogue of Arabic manuscripts on medicine and science in the Wellcome Historical Medical Library. London: The Wellcome Historical Medical Library Series; 1967. p. 38-42.
58. Castiglioni A. A history of medicine. Edited: Krumbhaar EB. Translated from the Italian. New York (NY): Jason Aronson Inc; 1975. p. 278-279.
59. Ducasse E, Speziale F, Basle J C, Midy D. Vascular knowledge in Medieval times was the turning point for humanistic trend. *Eur J Vasc Endovasc Surg* 2006; 31: 600-608.
60. Al-Dabbagh SA. Ibn Al-Nafis and the pulmonary circulation. *Lancet* 1987; 1: 1148.
61. Khan IA, Daya SK, Gowda RM. Evolution of the theory of circulation. *Int J Cardiol* 2005; 98: 519-521.
62. Abdul-Aziz L A S. Does history repeat itself in medicine? *Postgrad Med J* 2001; 77: 743.
63. Nagamia HF. A biographical sketch of the discoverer of the pulmonary and coronary circulation, JISHIM, 2003, 1: 22-28. Available from URL: <http://www.ishim.net/ishimj/3/05.pdf>
64. PortraitsDeMedicins. Ibn Al-Nafis connu sous le nom Ala-al-Din Abu al-Hasan Ali Ibn Abi al-Hazm al-Qarshi al-Damashqi al-Misri 1213-1288, Médecin et anatomiste arabe. Available from URL: <http://www.medarus.org/Medecins/MedecinsTextes/ibnalnafis.html>
65. Bylebyl JJ, Pagel W. The chequered career of Galen's doctrine on the pulmonary veins. *Med His* 1971; 15: 211-229.
66. Cattermole GN. Michael Servetus: physician, Socinian and victim. *J R Soc Med* 1997; 90: 640-644.
67. Meade RH. The evolution of our knowledge of anatomy. In: Meade RH, editor. An introduction to the history of surgery. Philidelphia (PA): London (UK), Toronto; WB Saunders Company; 1968. p 5.
68. Ibn al-Nafis. Kitab Sharh Tashreeh al-Qanon. Qattaya S. Cairo: The Supreme Council for Culture and the Egyptian Book Bureau. 1988. p. 388.
69. Ibn al-Nafis. Kitab Sharh Tashreeh al-Qanon. Qattaya S. Cairo: The Supreme Council for Culture and the Egyptian Book Bureau; 1988. p. 389.
70. Ibn al-Nafis. Kitab Sharh Tashreeh al-Qanon. Qattaya S. Cairo: The Supreme Council for Culture and the Egyptian Book Bureau Manuscript Editing Centre; 1988. p. 316.
71. Iskander AZ. Introduction. In: Iskander AZ, editor. A catalogue of Arabic manuscripts on medicine and science in the Wellcome Historical Medical Library. London: The Wellcome Historical Medical Library Series; 1967. p. 40.
72. Ziedan Y. Introduction. Ibn Al-Nafis, Risalat Al-Aadaa, Maa Dirasah Hawal Ibn Al-Nafis Wa Manhajahu Wa Ibdatuh. Al-Dar al-Masreyyah Al-Libnaneyyah. Al-Dar al-Masreyyah Al-Libnaneyyah; 1991. p. 63-66.
73. Ibn Al-Nafis. Al-Risalah Al-Kameliyyah fi Al-Sirah Al-Nabaweyyah. Omar MA, Hareedy AA, editors. 2nd ed. Cairo (Egypt): Islamic Heritage Revival Committee, Supreme Council for Islamic Affairs, Ministry of Endowments; 1978. p. 155-156.
74. Iskander AZ. Introduction. A catalogue of Arabic manuscripts on medicine and science in the Wellcome Historical Medical Library. London: The Wellcome Historical Medical Library Series; 1967. p. 50.
75. Soubani AO, Khan FA. The discovery of the pulmonary circulation revisited. *Ann Saudi Med* 1995, 15:185-186.
76. Jaleely M, Tatheer al-tibb al-Arabi fi al-tibb al-Ururuppi fi al-quroon al-wosta. Reprint from Part III and Part IV, Vol 32. Baghdad: Mijalat Al-Majmaa Al-Elmy Al-Iraqi; 1981. p. 186-210.
77. Ghalioungui P. Was Ibn Al-Nafis unknown to the scholars of the European Renaissance? *Clio Med* 1983; 18: 37-42.
78. Lilly Library (Indiana University, Bloomington). Medicine: an exhibition of books relating to medicine and surgery from the collection formed by J.K. Lilly. An Exhibition: a machine-readable transcription. Available from URL: <http://www.indiana.edu/~liblilly/etexts/medicine/#MD07062>
79. Ibn al-Nafis, Kitab Sharh Tashreeh al-Qanon. Qattaya S, editor. Cairo: The Supreme Council for Culture and the Egyptian Book Bureau; 1988. p. 21-24.
80. Ibn al-Nafis, Kitab Sharh Tashreeh al-Qanon. Qattaya S, editor. Cairo: The Supreme Council for Culture and the Egyptian Book Bureau; 1988. p. 30.
81. Ibn Manzoor. Lisan Al-Arab. Alkabeer AA, Hasballah MS, Al-Shathly HM, editors. Vol. 4. Cairo: Dar Al-Maarif. p. 2228.
82. Long ER. A history of pathology. New York: Dover Publications, Inc; 1965. p. 22-27.
83. Abdel-Halim RE, Abdel-Maguid TE. The functional anatomy of the uretero-vesical junction. A historical review. *Saudi Med J* 2003; 24: 815-819.
84. Abdel-Halim RE. Contributions of Ibn Zuhr (Avenzoar) to the progress of surgery: a study and translations from his book Al-Taisir. *Saudi Med J* 2005; 26: 1333-1339.

85. Abdel-Halim RE Contributions of Muhadhhab Al-Deen Al-Baghdadi to the progress of medicine and urology. A study and translations from his book Al-Mukhtar. *Saudi Med J* 2006; 27: p. 1631-1641.
86. May MT. Translator. Galen on the uses of different parts of the body. Vol. II. Ithaca (NY): Cornell University Press; 1968. p. 269 & 275.
87. Singer C. Galen on anatomical procedures. De Anatomicis Administrationibus. In: Cumberlege G, editor. A Wellcome Historical Medical Museum Publication. Book VI. London (UK), New York (NY), Toronto (CA): Oxford University Press; 1956; p. 168.
88. Ibn Al-Nafis. Kitab Sharh Tashreeh Al-Qanun. Qattaya S, editor. Cairo: The Supreme Council for Culture and the Egyptian Book Bureau; 1988. p. 431-432.
89. De Koning P. Trois Traités D'Anatomie Arabes Par Muhammad Ibn Zakariyya Al-Razi, Ali Ibn Al-Abbas et Ali Ibn Sina, Texte Inedit De Deux Traités, Traduction de P. De Koning, Leide: Libraire et Imprimerie E.J. Brill, 1903; reissued in 1986 by Institut Fur Geschichte der Arabisch-Islamischen Wissenschaften and der Johann Wolfgang Goethe Universitat, Frankfurt am Main. p. 72, 82.
90. Alrazi (Rhazes). Kitab Alhawi Fi Al Tibb (Rhazes Liber Continens). 1st ed. Vol. 10. Hyderabad (IN): Dairatul Maarif Al-Osmania; 1961. p. 154-156.
91. Ibn Sina. Kitab Al-Qanun Fi Al-Tibb (The Canon of Medicine). Boulaq edition of the Canon. Vol. II. Cairo: Dar Sadir; 1877. p. 507.
92. Alzahrawi (Albucasis). Kitab Al-Tasreef, Manuscripts No. 4009 and 4932. Dublin (Ireland): The Chester Beatty Library.
93. Al-Baghdadi Muhadhhabul-Din. Al-Mukhtarat Fi Al-Tibb. Vol. 1. Hyderabad: Osmania Oriental Publication Bureau; 194. p. 60.
94. Cumston CG. Islamic Medicine. In: Cumston CG, editor. An introduction to the history of medicine from the time of the pharaohs to the end of the XVIII century. London (UK): Kegan Paul, Trench, Trumbner and Co. Ltd. New York: Alfred A. Knopf; 1926. p. 192.
95. Ibn Al-Nafis. Al-Mujaz Fi Al-Tibb. Al-Ezbawy A, editor. 4th ed. Cairo(Egypt): Islamic Heritage Revival Committee, Supreme Council for Islamic Affairs, Ministry of Endowments; 2004. p. 239-241.
96. Ibn Sina, Al-Qanun Fi Al-Tibb (The Canon of Medicine). Vol. II. Cairo: Boulaq Ameereyyah Press; 1877. p. 501-504.
97. Ibn Al-Nafis, Sharh Fusul Apocrat. Ziedan Y, Abdel-Qadir M, editors. Cairo: Al Dar Al-Masreyya Al Lubnaneyyah; 1991. p. 436-439.
98. Paul of Aegina. The Seven Books of Paulus of Aeginata. Translated from the Greek with a commentary. Vol. 3. London: Sydenham Society; 1844-1847 H. p. 541-543.

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