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

A study and translations from his medical works

Rabie E. Abdel-Halim, FRCS Ed.

ABSTRACT

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-Kameleyyah, 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 Valvarde (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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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,8, 11, 12, 13 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)
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 Cumston and Leclerc 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, 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 Khalifah (1017-1067 H) identified the book as: "Kitab Mujaz Al-Qanun" (An epitome of the Canon book). 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. 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, 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, 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). According to the 13th century historian Al-Dhahaby (1274-1348), 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. 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, this encyclopedic work Kitaab 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
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-Shamel is an encyclopedic data base for the researcher; Al-Mujaz 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-Aada (A Treatise on Physiology)52 and anatomy in Kitab Sharh Tashreeh Al-Qanun.53 Furthermore, Kitab Al-Mujaz contains general practice knowledge on diseases of the eye but Al-Muhadhhab Fil Al-Kuhl Al-Mujarab54 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.”55 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.”56 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

### Table 2: The encyclopedic medical works that preceded Al-Shamil book of Ibn Al-Nafis.

<table>
<thead>
<tr>
<th>Scholar</th>
<th>Century (AD)</th>
<th>Encyclopedic Book</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Razi (Rhazes)</td>
<td>9-10th</td>
<td>Al-Hawi</td>
</tr>
<tr>
<td>Ali ibn Al-Abb as</td>
<td>9-10th</td>
<td>Kamil Al-Sinaa</td>
</tr>
<tr>
<td>Al-Zahrawi (Albucasis)</td>
<td>10-11th</td>
<td>Al-Tasrif</td>
</tr>
<tr>
<td>Ibn Sina (Avicenna)</td>
<td>10-11th</td>
<td>Al-Qanun</td>
</tr>
<tr>
<td>Ibn Zuhr (Avenzoar)</td>
<td>11-12th</td>
<td>Al-Taiseer together with</td>
</tr>
<tr>
<td>Ibn Rushd (Averroes)</td>
<td></td>
<td>Al-Kulliyat†</td>
</tr>
<tr>
<td>Al-Baghdadi, Al-Mujahedhhab Al-Din</td>
<td>12-13th</td>
<td>Al-Mukhtar Fi Al-Tibb</td>
</tr>
<tr>
<td>Ibn Al-Nafis</td>
<td>13th</td>
<td>Al-Shamil Fil Al-Sinaa</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>The Book</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Shamel Fi Al-Sinaa Al-Tibbiyya</td>
<td>Massive Encyclopedia</td>
</tr>
<tr>
<td>(The Comprehensive Book on the Art of Medicine)</td>
<td></td>
</tr>
<tr>
<td>Al-Mujaz Fi Al-Tibb</td>
<td>Comprehensive Summary</td>
</tr>
<tr>
<td>(The Epitome in Medicine)</td>
<td></td>
</tr>
<tr>
<td>Sharh Al-Qanun</td>
<td>General Principles</td>
</tr>
<tr>
<td>(Commentary on the Canon of Medicine)</td>
<td></td>
</tr>
<tr>
<td>Sharh Tashrih Al-Qanun</td>
<td>Anatomy</td>
</tr>
<tr>
<td>(Commentary on the Anatomy of the Canon of Medicine)</td>
<td></td>
</tr>
<tr>
<td>Risalat Al Aada (A Treatise on Physiology)</td>
<td>Physiology</td>
</tr>
<tr>
<td>Al-Muhadhhab Fil Al-Kuhl Al-Mujarab</td>
<td>Textbook on Ophthalmology</td>
</tr>
<tr>
<td>(The Refined Book On Ophthalmology)</td>
<td></td>
</tr>
</tbody>
</table>

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*References and citations are not provided in this sample text.*
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,\(^56\) Isakender,\(^57\) Castiglioni,\(^58\) and others,\(^59\)-\(^77\) 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 Iskander\(^71\) 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-Aada\(^72\) and Al-Risalah Al-Kamelliyyah.\(^72\)-\(^77\) 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-Abar al-Misri’s Sharh al-qanun (completed in A.H. 751/ A.D. 1350).\(^51\)-\(^77\) 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.\(^51\)-\(^77\)

Early in the 16th century, Andrea Alpagus (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 Valvarde 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”.\(^77\) 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: Alpagus, 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 bookSharh 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. 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). 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, 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 Long 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. 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-Mukhtair of Muhadhdhabul Din Al-Baghdadi.

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, Ibn Al-Nafis, in his book Sharh Tashreeh Al-Qanun described the bladder wall as consisting of 2 layers. 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.

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

Figure 4 - Anatomical drawing of the maxillary sutures in another original manuscript of Ibn Al-Nafis’ book Sharh Tashrih Al-Qanun.
Ibn Al-Nafis’ full description of the veisco-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 lithotriptic 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 Hippocrates’ 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-Sinaaa Al-Tibbyaa,99 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


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