

Ibn al-Nafis

A Biographical Sketch of the Discoverer of Pulmonary and Coronary Circulation

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Summary

Ibn Nafis whose full name is recorded as: *'Alâ' al-dîn Abû'l-Hasan 'Alî ibn Abî'l-Hazm ibn al- Nafis al-Qurashî al-Misrî al-Shâfi'î al-Dimashqî'* (1) was a private physician to the ruler of Egypt, **Al-Zahir Baybars al-Banduqdari** (1260-1277) (2). Baybars appointed him as the Chief of Physicians and gave him authority over all the physicians of Egypt (3).

Ibn Nafis was not only a **practicing physician** but like most physicians of his time he was learned in theology, philosophy, linguistics, grammar and jurisprudence of the Shâfi'î school. He was given the well-earned title of **'the second Ibn Sînâ'**. He is reported to have initially worked as a physician in Damascus, where he graduated from the Medical School and but later on moved to Cairo (4), where he spent the major part of his life.

Because of his numerous contributions to the field of medicine, he was well known throughout the Islamic world, during his lifetime and after his death (in 1288). However his pioneering contribution to the understanding of circulatory anatomy and physiology of **the pulmonary circulation** was not discovered by historians of medicine until an Egyptian physician **Muhyi al-Din al-Tatawi** translated one of his manuscripts: *'Sharh Tashrih al-Qanun: A Commentary on the Anatomy of Ibn Sînâ'* into German. This MS was accidentally found by **Dr Tatawi** in the Prussian library in Berlin, (MS 912), while working on his dissertation for a doctorate at the Faculty of Medicine of Freiburg in 1924 (5).

Later research has unraveled that this pioneering discovery of **Ibn Nafis** had been cited by several Islamic authors including **Sadid al Din Muhammad ibn Mas'ud al-Kazaruni** in 1344 and **'Ali ibn Abdullah Zain al-Arab al-Misri** in 1350 (6) but remained undiscovered by the West until Dr Tatawi's thesis in 1924. It has since been confirmed in several manuscripts of Ibn Nafis's around the world (7) and lately by **Dr Albert Zaki Iskandar** in: (MS Ar.80) at the University of California, Los Angeles (8).

Ibn Nafis discovery of pulmonary circulation has been universally acclaimed and there has been a great deal written about it already. Much less has been written about his postulation of the coronary circulation. That Ibn Nafis had a firm idea of the function and distribution of the coronary circulation as well, is evident from his writings and I quote: "...again the notion (of Ibn Sînâ) that the blood in the right side of the heart is to nourish the heart **is not true** at all, for the nourishment of the heart is from the blood that goes through the vessels that **permeate the body of the heart**". Judging by this quotation Ibn Nafis was the first to put forward the **concept of the coronary circulation and its functional importance in 'feeding or nourishing' the heart.**

Key Words Ibn Nafis, Pulmonary Circulation, Lesser Circulation, Coronary Circulation



Ibn Nafis

His Life and Times:

Not much is known about his birth, but from accounts of al-Umari and al-Safadi (10) it is presumed that he was born near Damascus in the village of al-Qurash (Qasrs: beyond the river) in 1208 (607 AH) (11). He is described by Safadi as a tall, thin, smooth cheeked and a chivalrous man; a pious Shafi'ite and a bachelor. He studied medicine at the

famous Nuri hospital in Damascus. This famous hospital was built by the Turkish Sultan Nur al-Din Zangi in Damascus, after its conquest in 1154 (apparently by funds received from ransom of a Frankish prince) (12). He studied under the able tutorship of **Muhadhdhib al-Din ‘Abd al-Rahim ibn ‘Ali al Dimashqi** popularly called **al-Dakhwar** (1169-1230); an equally famous physician and teacher of his time, who taught many a prominent physicians. **Al-Dakhwar** was appointed as the Chief of Physicians of Egypt and Syria, by the Ayyubid ruler al-Adil and was later also appointed as head of the Nuri hospital in Damascus by ‘Adil’s successor al-Mu‘azzam. It is interesting to note that besides **Ibn Nafis** one of his other famous pupils was none other than the great medical historian: **Ibn abi Usaibi‘a** (13) whose famous book *‘Uyun al anba’ fi tabaqat al-atibba’* contains history of about 400 Muslim and non-Muslim physicians. This historical source remains the main source of information of many physicians of the early and medieval time, as well as one of the greatest sources of the history of Islamic Medicine. However, in the manuscript of Ibn abi Usaibi‘a translated by **Müller** into German there is no description of **Ibn Nafis**. This was initially attributed to a professional jealousy between **Ibn Nafis** and **Ibn abi Usaibi‘a**, as these two were contemporaries and may have been in competitive positions. But in a later manuscript of **Ibn abi Usaibi‘a** found in Zahiriyya Library (14) in Damascus there is a description of **Ibn Nafis**. In this MS **Ibn Usaibi‘a** gives him great credit as a notable and famous physician of his time.

The period of history (the thirteenth century) during which **Ibn Nafis** lived and practiced was a turbulent period for Islamic history. It was made especially turbulent by the Mongols’ sack of Baghdad in 1258, a devastating event in Islamic history. It was made worse by the continuous strife with the Crusaders. However, these events seemed to have little influence on the scholastic and learned environment, *‘the creative Weltanschauung’* that prevailed in Damascus and Cairo at the time. Great hospitals (15) were being built under the patronage of the rulers and these attracted a great number of learned and scholarly physicians. Nur al-Din who entered Damascus victoriously built the famous **Nuri Hospital and Medical School** already described where Ibn Nafis received his medical education. Amongst the other

famous hospitals and institutions built at the time was the one built by **Salahuddin Ayyubi** the great Muslim general who liberated Jerusalem. Despite being occupied by the Crusades, he built the **Nasiri Hospital** in Cairo which was to become famous as a teaching institution. The magnificent **Mansûrî Hospital** in Cairo was built by the ruler **Qala’un**. For the description of its opulence and appurtenances the reader is referred to other sources (16). **Ibn Nafis** had association which each of these institutions.

Ibn Nafis was to become as, or more famous than his teacher al-Dakhwar. He moved from Damascus to Cairo, where he got appointed as the Chief Physician of Egypt and a personal physician to the Sultan Baybars. He also became attached to the famous **Mansoury medical school and hospital**. Here he became actively involved in medical practice, in teaching and in writing. He made himself available day or night for the service of his patients.

Because of his thriving practice and royal patronage, he became rich and lived in a beautiful house in Cairo. The house was inlaid with expensive marble stones and had all needed amenities. Here he entertained princes, ministers of state, leading physicians and colleagues.

He is reputed to have had a tremendous memory and to have written most of his books from memory without reference to any books or compendia. **Shaikh al-Husain Rashidi** spokesman of the Prince Hussein Mosque described **Ibn Nafis’s** writing session in this manner: *“He used to turn his face to the wall and to write as fluently as a waterfall. And when the quill in his hand got blunt, he discarded it and took a fresh one from the collection made ready and placed before him. In this way he lost no time.”* An interesting story is told about how he wrote a treatise on ‘Pulse’. One day he had gone to a public bath and whilst in the middle of washing himself he decided to go to the dressing room and asked for pen and paper. There and then he started writing his treatise on pulse and did not return to his ablution until he had completed it. This treatise was to be later translated and quoted in Latin, by **Andreas Alpago** in his book *‘De Pulsibus’*.

Ibn Nafis was acclaimed by his contemporary physicians as the second **Ibn Sînâ (Avicenna)**. Some, however, criticized his regimen as being too simple. He prescribed a diet before he would pre-

scribe a drug or medication. He prescribed a simple drug before he would prescribe a compound medication. This led his druggist to remark to him (perhaps in jest!): “If you continue to write such prescriptions for your patients, you would be better to send them to a butcher’s, but if you would like me to be your druggist, pray prescribe all the fine drugs that I have” as quoted by al-‘Umari’s biographical account (17).

His Works

Ibn Nafis’s works can be divided broadly into five categories:

1. His scholarly commentaries on ancient Greek texts.
2. His commentaries on early Islamic texts.
3. His original contributions to medical texts of his time.
4. His writings on non-medical subjects including theology, philosophy.
5. His pioneering discoveries like that of the lesser or pulmonary circulation and perhaps the coronary circulation.

We shall try to summarize the first four and expound on the last one.

1. His commentaries on existing medical works. Ibn Nafis achieved fame amongst his contemporaries. He had several to his credit: His commentaries on the works of Hippocrates (*Al Buqrat*) and other Greek authors. Several of these are extant:

- I. *Sharh Fusul Al Buqrat*: Commentary on Hippocratic Aphorisms.
- II. *Sharh Taqdimat Al-Ma’rifa*: Commentary on Hippocratic Prognostics.
- III. *Ibidimiya li Buqrat Watafsiruhu l’Amrad Al-Wafideh*: Commentary on the Epidemiology of Hippocrates.
- IV. Commentary on Hippocrates’ *De Natura Hominis*
- V. Commentary on Galen’s Anatomy (Book viii)

2. His Commentaries Early Islamic Medical Texts:

- I. ‘*Mujiz al-Qanun*’: Commentary on Ibn Sîna’s *Qanun-fil-Tibb*. This commentary was the one that made him most famous. It has survived in innumerable manuscript copies. It has been published several times in India and Persia (18).

II. *Sharh Al Qanun*: Commentary on the Canon.

III. *Sharh Tashrih Al Qanun*: Commentary on the Anatomy of the Canon.

IV. *Sharh Masai’l Hunain*: Commentary on the questions of Hunain Ibn Ishaq.

V. *Sharh Al Hidayah fil Tibb*: Commentary on Ibn Sîna’s Guide to Medicine.

VI. *Sharh Mufradat Al-Qanun*: Commentary on the simple medicines of Qanun.

3. His Original Contributions to Medical Texts:

I. *Kitab Al-Shamilli*: The Comprehensive book on the art of Medicine: According to Khalil Ibn Aybak al-Safadi’s biography of Ibn Nafis he undertook to write an encyclopedic medical reference in 300 volumes. Only eighty volumes were completed during his lifetime and these were donated together with his house to the Mansoury Hospital in Cairo. Dr. N. Heer has made a study of this book and identified its contents (19). More recently Dr Albert Zaki Iskander has analyzed and presented the surgical sections in this book from a manuscript in the Lane Medical Library (MS Z 276) at Stanford University (20).

II. *Kitab Al-Mukhtar Min al Aghdiya*: The Book of Selections of Nutrition.

III. *Kitab Al-Muhazzab f’il Kuhl*: The well arranged book on Ophthalmology. No copies of this book are known extant.

IV. *Kitab Jame’ Al-Daka’ik fil tibb*: The composite of Exactitudes in Medicine.

V. *Kitab al-Shafii*: Book of the healer.

VI. *Kitab Mawalid Al-Thalash*: Book of the Triple Born.

VII. *Risalah fi Awia’ Al-Atfaal*: Dissertation on diseases of children.

4. His Contributions to Non-medical Texts Included contributions to Shari’a (theology), Logic, Philosophy, Linguistics, Grammar and Language.

I. *Al Risala Al-Kamiliyya fi’l Sira al Nabawiyya* also known by the title ‘*Fadil bin Natiq*’ a

counterpart of Ibn Tufail's '*Hayy Ibn Yaqzan*' (21).: This most outstanding work is his *Epistle on "The Perfect Man"* a life story of the Prophet of Islam. It was meant to be a reply to Ibn Sîna's '*Hayy ibn Yaqzaan*'. In it Ibn Nafis defends the tenets of Islam: the divine laws the ethics, the prophecies, decay of this world and physical resurrection. In the plot and content it is more similar to the '*Hayy ibn Yaqzaan*' written by the Andalusia physician and philosopher Ibn Tufayl a century before. For a great expose of this work see Al-Roubi's excellent presentation (22).

II. *Al-Isharat (the signs) and Al Hidayah (the guidance)*: commentaries on two works of Ibn Sina.

III. *Al Wuraiqat (The little papers)* A summary of Aristotle's Organon and Rhetoric.

IV. *Tareeq Al-Fasaha (Road to eloquence)* explanation of '*Al Fusous*' (*the segments*) by the linguist Said Hassan bin Al-Rab'i al-Baghdadi.

V. *Al Mukhtasar fil Ilm Usoulil Hadith (A short account of the methodology of Hadith)*.

VI. An explanation of '*Al Tanbeeh*' (*Exhortation*) by Al Shirazi.

4. Ibn Nafis' Description of the Pulmonary or Lesser Circulation:

Of all the important contributions made by **Ibn Nafis** one of the most important and original, is his description of the lesser or pulmonary circulation. It was this description which earned him the credit of being the first one to propose the existence of the pulmonary circulation as it is known today. This challenged the then widely held Galenic concepts of circulation of blood within the heart and lungs. In his *Qanun-fil-Tibb* (the Canon) even the great **Ibn Sîna** had not dared to challenge **Galen**, considered one of the greatest medical authorities of his times. We will elaborate on this in the rest of this paper.

An ad verbatim translation of the '*Sharh Tashrih al Qanun*' or commentary on the anatomic sections of the **Ibn Sîna's Cannon** has been provided to us by Bittar in his doctoral dissertation on '*A Study of Ibn*



Galen

Nafis' (23), This is the section that contains his views on the 'Pulmonary Circulation' and which raises him to the position of a pioneer, an original thinker and a discoverer.

In order to explain this further we have to go into the Galenic concepts of cardio-pulmonary circulation:

Claudius Galen (130-201 CE) (24) was a celebrated Greek Physician. He was born in Pergamos, Mysia. He studied medicine in Alexandria and became Physician to the Gladiators. He then went to Rome and gained great reputation as a physician. He attended the Roman emperor Marcus Aurelius. He collected all the medical knowledge of his time and wrote exhaustively. His work remained authoritative for centuries and few dared to challenge his concepts even until the 17th century. He revived the teachings of **Hippocrates** for whom he had the greatest respect. Amongst his vast contributions to medical literature he wrote fifteen books on Anatomy of which six are extant in Arabic. **Ibn Nafis** wrote a commentary on his anatomical works already alluded to above.

As regards the Circulatory System, **Galen** believed like his predecessors that the arteries took origin from the heart and the veins from the liver. Ingested food was converted by the liver into blood. It was then taken by the veins to the right ventricle. From here a sufficient quantity was spilled through the pulmonary artery (arterial-vein) into the lungs. A smaller portion passes

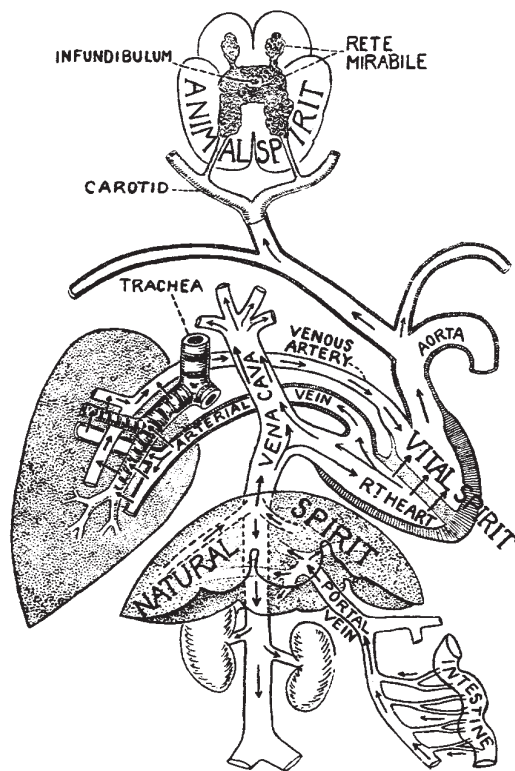
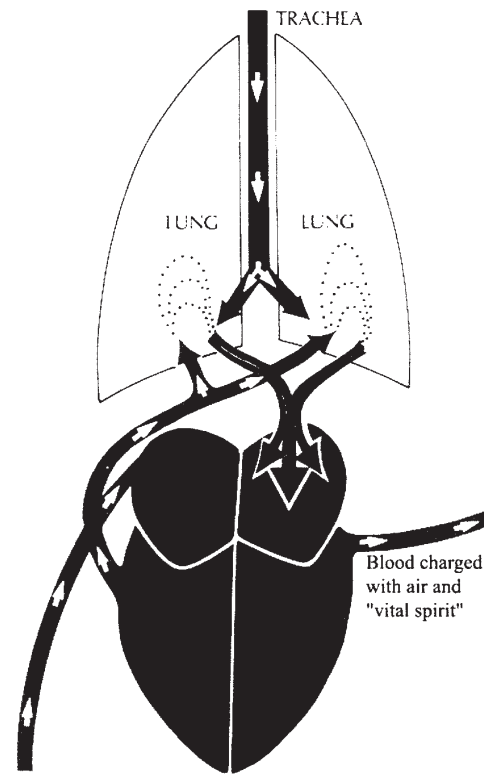


Diagram illustrating Galen's physiological scheme of circulation

Figure 2- Galen's concept of Circulation.

through “tiny pores” in the septum to the left ventricle. Here it mixes with the pneuma entering the heart from the lungs via the pulmonary veins during diastole. From the ventricle the mixed blood and pneuma gets distributed to the rest of the body by the arteries. The arteries and veins anastomose throughout the body via tiny pores (capillaries) and exchange with each other blood and spirit (Fig 1).

Ibn Nafis's description of the Circulatory system is somewhat similar but differs in several important aspects. He succinctly states that **Galen** and **Ibn Sîna** were in error about the pores in the ventricular septum. He emphasizes that no such pores exist. In fact he states that the septum is particularly thick between the ventricles and would not allow passage of blood from the right to the left. Instead he proposes that the blood after thinning and heating passes via the pulmonary artery (vena arterialis) to the lungs and seeping through the interstices of this vessel mixes with air in the lungs. The aerated blood gets refined and passes through the pulmonary veins (arteria-venalis)



Blood Blood Heated and refined in the right ventricle
Air Blood from lungs charged with air & Vital SP

Figure 3- Ibn Nafis' Concept of Pulmonary Circulation.

to reach the left cavity, of two cavities of the heart where it mixes with the animal spirit. Here Ibn Nafis challenges the view that the arteria-venalis (pulmonary vein) serves to transport nourishment from the heart to the lungs. He states that this view is unfounded and the true function of this vessel is to transport the rarefied blood mixed with the air already in the lungs to the left cavity of the heart where it mixes with the vital spirit, to be distributed to the rest of the body. (Fig:2)

Ibn Nafis also points out that **Ibn Sîna's** concept that there are three ventricular cavities in the animal or human heart is also erroneous. He states that there are only two ventricles. The one on the right is full of blood, while the one on the left is full of the blood and vital spirit. Moreover there is absolutely no openings between these two ventricles, as otherwise the blood would pass into the region of the spirit and destroy its essence. Thus the statement (of Ibn Sîna) that the septum is porous is fallacious.



Ibn Sina (Avicenna)

These interesting comments of **Ibn Nafis** in the *Tashreeh* clearly shows that **Ibn Nafis** did not accept the **Galenic** views of the pulmonary circulation, which were perpetuated by **Ibn Sîna** in his **Canon**. The descriptions of his findings are so emphatic and clear that he could have not conceivably arrived at these conclusions by just deduction as suggested by **Mayeroff**. We can almost assume that **Ibn Nafis** had himself undertaken dissection of animals or cadavers (perhaps in secret) and out of religious and societal concerns denied that he had ever done so. The latter argument is professed by **Dr Sulaiman Oataya** also who has done exhaustive study of the subject and presented his findings (25).

The passing Away of Ibn Nafis:

Ibn Nafis's life was entirely devoted to practice of Medicine. He never married and remained a bachelor. He continued working and writing almost until his death. Like his teacher **Al-Dakhwar** he bequeathed his house and his entire library to the Mansourya hospital and medical school where he taught. Close to the 80th year of his life he suddenly took ill and took to bed. His fellow physicians recommended that he take wine as a remedy. But like a true Muslim he refused saying: "*I would not face my cre-*

ator with a single drop of wine in my body". He knew of his impending death and on the sixth day of his illness on Friday December 18th, 1288 he quietly passed away in Cairo (26).

Conclusions:

Ibn Nafis was one of the greatest physicians that practiced during the era of Islamic Epoch. His title as the '*Second Ibn Sîna*' is well deserved. His contributions to the medical literature and to medicine remain voluminous. He will be long remembered for his original thought, pioneering discovery and succinct description of the of Pulmonary Circulation full 300 years before any such description occurred in the literature of the West. Until **Dr Tatawi** discovered his manuscript in the German library in 1924 the credit of this discovery was given to **Michael Servetus** in 1553 and to **Realdo Colombo** in 1559.

Michael Servetus who published his findings in '*Christianismi restitutio*' was declared a heretic and burned at stake for his views in 1553 (27). According to **Haddad** (28) '*he who reads Servetus cannot help noticing that it is almost a literal translation of the writings of Ibn Nafis*'. Whether or not **Servetus** had access to **Ibn Nafis** MS in Arabic or as a Latin translation, is still subject of much debate and controversy and as more investigations continue, it is being suggested that perhaps he did have knowledge of Ibn Nafis' writing through the works of **Andreas Alpago** a Latin scholar who traveled extensively in the Arab lands and collected a large number of medical MS including those of **Ibn Nafis**. In 1520 he returned to Padua and ultimately was given the Chair of theoretical medicine prior to his death in 1522. One of his publication is '*De Pulsibus*' which contains references of both **Serapion** and **Ibn Nafis**. He was also influential on his nephew **Paulus Alpago** who ultimately studied medicine and continued to publish Latin translations of Arabic works including the Canon of Ibn Sîna in 1544. As for **Realdo Colombo**, he was an anatomist, who taught in Pisa. His description of the Pulmonary Circulation appeared in '*De re Anatomica*' in 1559 (29). It was very similar to that of Servetus. It was not until the dissections and experimentation of William Harvey in the early seventeenth century, that the path of pulmonary and systemic circulation was finally and

unequivocally established. In 1628 he published his findings in his book: *De Motu Cordis Et Sanguinis In Animalibus* (On the movement of the heart and blood in animals) (30). It is interesting to note that **William Harvey** also studied his medicine in Padua (1561-1616) and is likely to have been influenced by the works of **Servetus**, **Alpago**, **Colombo** and indirectly perhaps also of **Ibn Nafis**..

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