With Ibn Sina great Canon came the “golden age of Arabic medicine”, almost to its peak. Since the beginning of XI century, when Ibn Sina died, until the middle of XIII century, when creative was Ibn al-Nafis, medical science continues to develop and progress, and had its brilliant minds. For that time characteristic is the fact that neither the strong authority as Avicenna was could paralyze the progress of medical science. Three hundred years before Paracelsus, in Cairo appears a medical scientist who dares to touch the authority of Ibn Sina-Avicenna in the infallibility of Canon—“Medical Bible”. The scholar was called Alauddin Ibn al-Nafis (1210-1288). He, 250 years ago Servet, (Michael Servetus, XVI century) reveals the truly describes the small or pulmonary circulation, but also gives a description of the great forerunner of the bloodstream. In his separate work on the anatomy, Ibn al-Nafis in five places contested arguments of Galen’s teachings, which also Ibn Sina was accepted. He very persuasively argues that the blood does not oxidize (“does not mix with air”), passing through some hypothetical pores in the partition between the right half of the heart, in which blood is collected and left half, in which, supposedly is the air, but that this happen when the blood is going from the right ventricle through the pulmonary artery into the lungs, where it is mixed with air and thus “converted” murmurs through the pulmonary vein into the left half of the heart. On occasion of the 800th anniversary of Ibn al-Nafis birth, one of the largest Arab and world doctors of all times we publish this article so that readers get something closer image his creative work, especially the one which relates to his contribution to the discovery of cardiac and pulmonary circulation, revolutionary discoveries in the world of medicine. In the year 1924 a heated debate started regarding the discovery of the pulmonary circulation. This discovery was attributed only to European scholars. It stemmed back to the sixteenth century. When Michael Servetus (1511-1553), Andera Cesalpino (1519-1603), Fabrici d’Aquaependent (1533-1619) and William Harvey (1578-1657) developed the concept. However, Muhyi-d-din At-Tatawi (1896-1945) presented his thesis “Der Lungenkreislauf nach El-Korachi. Dissert, z.eil. d. Doktorwrde, Freiburg im Brisgau 1924” of the blood circulation according to al Qurashi relaying on his discovery of his description of pulmonary circulation in one of ancient manuscripts, He proposed that the real credit for the discovery of the pulmonary circulation belongs this eminent physician of the thirteenth century: Ibn al-Nafis. Later another doctor Abdul Kareem Chihade (1922- ) presented another dissertation in Paris 1951 entitled “ decouverte de la circulatio pulmonaire chez Ibn an-Nafis”. Published by Institut Francais De Damas 1955. Other prominent professors like: Paul Galiounji and Salman Qatayyah researched extensively in his manuscripts and produced very important monographs. The general consensus is that Ibn al-Nafis’ work exerted great influence on the development of medical science, both in the Islamic world and Europe. A closer look on Ibn al-Nafis contribution would indicate that he also described the coronary circulation, the cranial nerves the gall bladder anatomy and many new aspect of ophthalmology. He advocated as well therapy through nutrition. His work integrated the medical knowledge with great clarity and emphasized precision. Keywords: Ibn al-Nafis, cardiac circulation, pulmonary circulation.

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1. INTRODUCTION

Alauddin Ibn al-Nafis, whose full name was ALI IBN ABI L-AL-HAZMI QARSHI IBN AL-NAFIS is one of the greatest Arab and world doctors of his time, but we can surely say of all times. He was born in the year 1210 in a village near Damascus called ‘Quersh’ (1,2,3,4,5,6,7,8,9,10). He joins the circles of medicine at the age of 22 (in the year
1232) in Aldakhoiriah School. Given the name of its founder; Al-Dakhwar (Died 1231). He studied the books of famous pioneers Muslims physicians such as Rhazes, and Ibn Sina (Avicenna) also he read Galen and Hippocrates. He practiced Medicine in al Nuri’s bimaristan.

Many famous doctors, who have had a chance to read some of his works, or learn about the conditions and ways in which he come to its findings, saying about high sagacity, estimation, expression, erudition and exceptional practical skills. Because of these qualities he was often compared with the greatest mind of the former Arab and world medicine–Ibn Sina-Avicenna and some have even said that he was unsurpassed in memory, creative writing, but also cited as a gifted teacher, great erudite and doctor practitioner (11,12,13,14,15).

His theory of pulmonary blood flow was adopted by the Italian Medical School of anatomy from one of Latin translation. Unfortunately, only recently we learned the truth that the lung and small circulation, is not first described by Michael Servetus in the 16th century, nor William Harvey in the first half of the 19th century, but that this theory comes from Ibn al-Nafis (1,2,3,4,5,6,7).

From many of the Nafis works special place belongs to Nafis comment or abbreviation of the Canon (original name–the book is “Mugaz al-Qanun”). This work represents one of the most translated medical books from the period of medieval medicine. As its title says, it is an excerpt or abbreviation from Ibn Sina-Avicenna major medical encyclopedia Canon–Code of practice (“Kitab al-Qanun fit-Tibb), most quoted and most translated medical book of the Arab world, and medicine of all times.

Alaudin Ibn Nafis, reached its maximum professional status of teacher and director of large Mansuri Hospital in Cairo, but for the rest of his life he has not ceased to engage in fruitful creative work. Today, at the end of the twentieth century, we read and learn ibn al-Nafis theories and descriptions of practical experience, of which some to this day remained unsurpassed in the explanation since the time when Ibn al-Nafis described them (17,18,19,20).

2. TIME AND CIRCUMSTANCES IN WHICH IBN AL-NAFIS LIVED AND WORKED

Ibn-Nafis lived in an age of political conflicts and chaos in the Muslim world—the rivalry of dynasties, wars, and devastating invasion of the Mongols. However, despite all this, the academic activities in Damascus and Cairo were not significantly weakened, particularly in the field of medicine, for which there are obvious evidences of a permanent functioning of medical schools and hospitals. One of the major scholars who have dealt with this issue, Leclerc, notes that the medicine has progressed particular in this period. Regardless of political conflicts and wars still continued the construction of schools and hospitals, where they were guarded the traditional standards of education, and where specifically were taught about Ibn Sina-Avicenna (3,4,5).

3. BIOGRAPHICAL AND OTHER INFORMATION ABOUT IBN AL-NAFIS

Ibn-Nafis was born in Damascus 1210. After graduating at the Ad-Dakhwara school Nouri in Damascus, he went to Cairo, where he joined Mansoury School and contemporaries describe him as a great doctor and a teacher who is “day and night” available to anyone who needed his help (1).

Ibn-Nafis wrote article about the pulse, which is important in terms of Ibn-Nafis learning influence in the West and the establishment of prominent medical schools. This work is not preserved in its original form, but it appears in Latin translation in the early 16th century. A doctor from that era Andrea Alpago is credited for the transmission of Ibn-Nafis theory of lung (small) circulation in the West. As Alpago maintained links with the University of Padua, assume that the Italian school of anatomy, as well as Michael Servetus, claimed Ibn-Nafis theory from one of Latin translations of the remaining Andrea nephew Paulus, after Andrea’s death 1521 (2,9).

Otherwise, for long time was active learning about the circulation that gave the Galen. Ibn-Nafis did not give any importance to this, nor was interested in the Galen works. Much later, at the beginning of the twentieth century, in Germany was presented a doctoral thesis on Ibn al-Nafis learning about circulation.

4. IBN AL-NAFIS DESCRIPTION OF PULMONARY CIRCULATION

Although Ibn al-Nafis was called “Second Avicenna”, in this work Ibn-Nafis goes further than its predecessor, so this is, along with Comment of anatomy from Avicenna Canon, article which make Ibn al-Nafis famous and what indebted humanity the most. It was an epochal description of pulmonary and cardiac circulation which Ibn al-Nafis made in 16 points that are listed below.

Nafis theory of pulmonary circulation is given in sixteen points:

- The blood is processed in the right ventricle of the heart;
- Heart septum does not allow the blood flow;
- The heart has only two ventricles, not three, “as Avicenna says”;
- V. arteriosa (pulmonary artery) lead the blood from the right ventricle to the lungs where the blood mixes with air;
- The lung has a passages between the v. arteriosa and artery venosa (pulmonary vein);
- Mixing processed of blood with air starts (not in the heart, in the left ventricle, according to the traditional view, but) in the lungs;
Ibn Nefis

Figure 2. Description of pulmonary circulation by Ibn Nefis

This is a preparatory stage in the production of vital energy;
Artery venosa lead the mixture into the left ventricle;
Artery venosa pulsates;
The artery venosa contain a small amount of a mixture of processed blood and air;
A mixture of processed blood and the air is prone to become a vital energy;
Vital energy is produced in the left ventricle;
The left ventricle is wider than the right, wide enough for this purpose;
Quantity (of processed) blood in the left ventricle is small, but contains large amount of vital energy;
unused rest is ejected from the left ventricle through the pulmonary artery venosa, and exhaled; and
In the left ventricle there is innate warmth.

5. BIBLIOGRAPHY OF IBN AL-NAFIS WORKS

Meyerhof provides a list of available works, which proved to be incomplete. The task of making the final roster, which would include those works which lie in the private library, it is very far from completion. However, the list of Ibn-Nafis works that are known increased, and this is the latest version (4):
- Kitab Al-Shamil (Comprehensive / Book on Medicine);
- Kitab Al-Mukhtar Al Agdiya Min (Nutrition Selection);
- Introduction to the Medicine of Hippocrates;
- In Munich exist a manuscript entitled “Explanation of the etiology of the disease” it is assumed that it was written by Ibn-Nafis, but it is not certain;
- Commentary on Hippocrates’ De Natura Hominis;
- Commentary on Galen’s Anatomy (from book VIII);
- Kitab Al-Muhazzab f’il Kuhl (Ophthalmology);

The Obeid library, in Damascus, has a manuscript in which Ibn al-Nafis gives an introduction about the differences between the eyes in different animals, and finally compares them with the human eye. None of the researchers do not mention this work.
- Sharh Masa’il Hunain (Comments of Questions by Hunain Ibn Ishaq);
- Sharh al-Hidayat fi-it-Tibb (Comment of Avicenna’s Guide to Medicine);
- Mufradat Sharh al-Qanun (Comment on simple medications from Canon);
- Usaybia mentioned several papers in medicine, much of which none of the other biographers, including Umaruia and Safadia are not mentioned. This is somewhat surprising, especially in Umaruia, who must have owned most of the information to Usaybiya. Also is possible that Umar used another Usaybii manuscript, more comprehensive and detailed.
- Kitab Jame ‘Al-Daka’ik fil Tibb (Content of the exact medicine);
- Kitab Al-Shafa (Doctor);
- Kitab Al-Mawalid Thalasah (Birth of triplets);
- Risalah fi Awia’ Al-Atfaal (Dissertation on the diseases of children);
- Works from medicine without a title;
- Brockelmann states that the manuscript can be found in the Princeton library;
- There are also three manuscripts of Ibn-Nafis (about 300 sheets) in the Lane Library at Stanford University.

This comment is very extensive work and its importance is that Ibn al-Nafis, unlike Avicenna, by processing Canon extracts (books I and III), for the first time in the history of Arab-Islamic medicine, gives review of the anatomy as a separate and independent whole.

6. SOME OF THE EXPLANATIONS OF IBN AL-NAFIS WORK IN THE WESTERN LITERATURE

As it is known, Galen, a representative of the Greek medical thought, believed in the existence of invisible pores in interventricle cavity, through which blood from the right ventricle pours to the left. Doctors in the Arab-Islamic world have accepted this theory in its entirety, and even the Avicenna in his Canon faithfully followed the path of its predecessor (1,6,8).

On the other hand, to Ibn-Nafis the Galen theory was far from perfect and acceptable for his independent mind that always relied on “careful research and common sense.” For him the Galen’s theory about the invisible pores in chamber was a paradox. As longer he studied the works of Galen and Avicenna, he was more convinced about their mistakes, and his attitude towards Galen’s teachings even more sharpened. Exploring the anatomy in general and using inductive reasoning, he came to the conclusion that the ventricle is impermeable, and that blood from the right ventricle passes only through the left lung.

The difference between Ibn al-Nafis and Galen is not simply a difference of opinion of two doctors, but the difference between the two sets of anatomical-physiological data and their interpretation. Ibn al-Nafis is not afraid to stand up against the established beliefs of his time, nor Galen, nor afraid
of dealing with the theological implications of their new learning, in terms of “vital energy”.

At the beginning Ibn al-Nafis notes that his knowledge is based on observation, careful research and common sense, and that he is presenting his learning whether it is in accordance with the teachings of predecessors or not. Since Ibn al-Nafis considered aorta as large blood vessel through which the “vital energy circulates to all organs,” here is obviously that he did not have an image of a larger circulation. Galenic is in the sense that it leaves out that the blood is impelled by the strength of the left ventricle through the veins and returned in circular manner through the left ventricle. According to Ibn al-Nafis, the heart is the beginning of life, sun of the microcosm, the source of all the action. His works clearly show the brilliance and strength of his mind that, among other things, proved to be an author, compiler and commentator. His style is clear, lucid and logic, which is characteristic of the scientific mind. The commentary can be seen repeated and emphasized the point that it considers to be extremely important as a teacher who teaches students pointing out those who wish to remain in the minds of students, among whom mention should be anti Galenic which reaches its culmination in the description of a small (lung) circulation (9).

The above-mentioned Andrea Alpago spent about thirty years in the Middle East, mainly in Syria, where he studied the customs, religion, science, culture and language. Most of the time he spent translating the famous works into the Latin language and by printing them. It has been confirmed that he did not wrote all that he published. It would be unlikely that he did not write about Ibn al-Nafis, so research and the search for other unknown works of Ibn-Nafis, as well as parts of the famous, be directed towards the literal legacy of Andrea Alpago.

7. MAIN FEATURES OF MU'GIZ AL-QANUN

Mu'giz al-Qanun for several centuries was the primary medical literature on the medical faculties of almost all the universities of East and West. Its importance was the fact that Ibn al-Nafis, unlike the author of the Canon—Ibn Sina, by processing the extracts from the first and third book of Canon, for the first time in the history of Arab-Islamic medicine gave a presentation of anatomy, as a separate and independent entity. By his description of the anatomy in Mu'giz he significantly clarified and contested and suppressed sufficiently explained by the anatomical theory of Galen, which dominated some fifteen centuries. Qanun al-Mu'giz as its name says, is an abbreviation from Ibn-Sina's (Avicenna) medical encyclopedia “Kitab al-Qanun fit-Tibb” (7,9,11).

Mu'giz was a popular medical handbook in a few centuries. Many famous medical writers commented on it, and it usually would be the first to literally print a part from Mu'giz, and then immediately add the text of his explanation (hall) (21,22,23,24,25). To the readers of Mu'giz is clear that in t XIII century the understanding and interpreting was the peak of medical science in the West and the East. With the low level of development of natural sciences, chemistry and physics, biology and physiology, and anatomy and pathology, it is not at that time possible a higher level in medical diagnostics and therapy, neither in surgery nor in preventive medicine and hygiene (26,27).

Since Ibn Nafis Mu'giz, mostly more abbreviation (excerpt), than feedback of Avicenna's Canon, and given that the Canon already in the XII century was translated into Latin, the interest for Nafis Mu'giz, and its translation into other languages was little. In Spain it was used by Ibn Rushd and Ibn Zuhr. Only in the XVI century in Venice is printed Latin translation of another al-Nafis work (Tesrih) in which Ibn al-Nafis discuss matters of anatomy and physiology.

However, the most important chapter of this al-Nafis work is related to small or pulmonary circulation, on which he has already, wrote before printing of the Latin translations of Tesrih at the beginning of the XVI century.
wrote Servetus. Only then begin the increased interest in al-Nafis works, because it began to discuss whether the discovery of a small blood circulation is al-Nafis or Servetus or whether Servetus knew that Ibn al-Nafis back in the XIII century described a small circulation.

Ibn al-Nafis, also, in his description of the anatomy of the heart in Thesrih gives, at that time, the closest description of cardiac blood flow, which will be described in detail later by the Englishman William Harvey in 1628 (3,9). As for the interest in al-Nafis Mu‘giz at the East, it was from the beginning very great. With comments or without it was printed and copied by lithography countless times in the vast number of copies. In particular, it was much used until the thirties of this century in India and the other Far East countries. No matter what medicine has already been advanced in all its aspects and disciplines, and what is the scientific and technical affairs was already at an enviable level, which Englishmens brought with them to India, a colony, Mu‘giz in that climate was sacrosanct medical tutorial. One of the most important reasons for this is that this part of the world very much oriented towards traditional methods of treatment, and Mu‘giz is perfect for this type of medical education (22,23,24,28,29,30,31).

8. CONCLUSION

The discovery of a small blood flow and cardiac circulation by Ibn al-Nafis in the 13th century, and many other important but less important, which are partially attributable to other, mostly western authors in recent times, deserves to be ranked in the Islamic great men, but also the all medical scientific thinkers of all times. About this our doctors know very little. Hence it was necessary to write and publish a very brief record about this universal doctor, scholar and philosopher who, in his discoveries and his entire medical oeuvre put legacy to all of humanity.

REFERENCES