

## **Contributions of Muslim Scholars Attributed to Other Scholars in Engineering and Medicine**

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### **Abstract**

*Muslim scholars during the Golden Age of Islamic history are known to have a great interest and respect in all kinds of knowledge especially knowledge related to applied science and technology; which can be useful in satisfying the needs of mankind. The developments of science and technology especially in engineering and medicine were actually available before the 14<sup>th</sup> century. However, historically, Muslim contributions towards science and technology have been neglected, ignored and to make it worse these contributions were attributed to other scholars and researchers.*

**Keywords:** Pulmonary circulation, Ibn Al-Nafis, Parkinson's disease, IbnRushd, Smallpox, Al-Razi, Flying machine, IbnFirnas.

### **1. Introduction**

This research investigates Muslim scholars' contributions during the Medieval Age. The main objective of this research is to identify the Muslim scholars' contributions which are attributed to other scholars especially in the fields of engineering and medicine. The significance of this research is to reveal the effort done by the Muslim scholars in science and technology. The methodology used in doing this research is library based as well as internet based research and most of the data are collected from accurate and reliable sources such as academic papers, journals and books. In this paper we select several important issues and finds in science and technology which attributed to other scholars.

### **2. Science and Technology Discovery**

During the Abbasid dynasty, also known as the Golden Age of Muslim history, the caliphs had great interest in intellectual matters. This was the time when Islamic civilization bloomed. It is a period where the Muslims gave great respect to all kinds of knowledge especially in applied science and technological subjects as well as the theoretical studies. Human being satisfactions at the time were improved because of the discoveries done by the Muslim scholars' in science and technology. However, historically, Muslim contributions towards science and technologies have been neglected or ignored when their contributions were attributed to the other researchers. The developments of fine technology were actually available before the 14<sup>th</sup> century (Masood, 2009)

### **3. Flying Machine**

Flying machine is a basic type of machine which was designed for flight that led to the existence of the modern airplane. During the ancient times; early Mayan civilization (3000 B.C.), Egypt (3105 B.C.), Greek (25000 B.C.), and Babylon (2000 B.C.); there are artifacts in the forms of sketches showing that humans have the ability to fly. These sketches are usually related to the legends, myths, supernatural powers, or miracles that only special man can accomplish (Jamsari et al., 2013; Rossi, 2015). According to the modern literature, the Wright brothers; Wilbur Wright and Orville Wright (1867-1948) are the pioneers in developing the basic idea of flight and are the first aircraft inventors (Johnson-Laird, 2005). However, according to Roger Bacon in 1260, the main idea and first draft of an aircraft clearly came from a Muslim scholar, IbnFirnas (Jamsari et al., 2013; Al-Khateeb, 2001; Masood, 2009).

Abu al-Qasim ‘Abbas IbnFirnasIbn Wardus, also known as IbnFirnas (810-880 A.D.) was born in Izn-Rand Onda; now known as Ronda. He was a scientist, musician, and an extraordinary inventor. He migrated to Cordoba to teach music as well as to pursuit knowledge especially in astrology, astronomy, engineering, and music. One of his legendary inventions would be the flying machine. The flying machine, designed by him was the first man-made object that has flown man in the air (Jamsari et al., 2013; Rossi, 2015; Masood, 2009; Karagozoglu, 2017; Suliman and Mirghani, 2011). Figure 1 is the glider of IbnFirnas.

**Figure 1 shows the glider of IbnFirnas. This figure is adopted from: (Karagozoglu, 2017).**



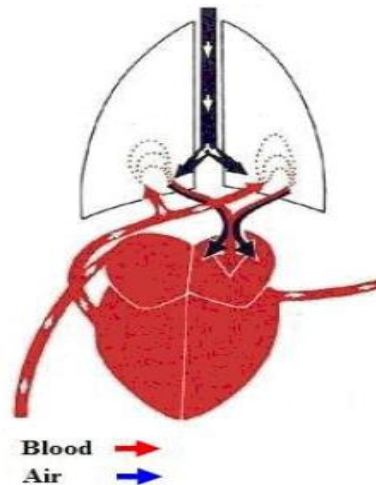
Ibn Firnas started inventing the flying machine in 875 A.D. It was made of silk and feathers from eagle which required him to be on a higher place for take-off and gliding down while flapping the wing with his hands. He kept on remodelling and redesigning the structural design of the flying machine from time to time. At the age of 65, he tested his flying machine, where he glide through the air flying for more than ten minutes before he had a bad landing which resulted in damaging his glide and cause him backbone injury. Since then he was unable to do further flight trials (Jamsari et al., 2013; Karagozoglu, 2017; Suliman and Mirghani, 2011). However, due to the flight trials accident, IbnFirnas realised the main problem of the flying machine. The tail end structure is a vital part for landing which is similar with how a bird uses its tail to decrease its speed. The improved structure was named as *ornithopher* by Leonardo Da Vinci. *Ornithoperis* a theory founded by IbnFirnas which can be confirmed in a manuscript written by Roger Bacon in an article, *On the Marvelous Power of Art and Nature*, in the year 1260 A.D. In the article, Roger Bacon explained two methods on how man can fly; with one of them being the *ornithopher* (Jamsari et al., 2013); “There is an instrument to fly with, which I never saw, nor know any man that hath seen it, but I full well know by name the learned man who invented the same.” (Jamsari et al., 2013) It is well known that Roger Bacon studied in Cordoba and coincidentally he was at the historical place when IbnFirnas made a first attempt to glide his flying machine. The descriptions on *ornithopher* by Roger Bacon could have been based on Muslim manuscript in Spain which has disappeared without trace. The world is prevented from acknowledging IbnFirnas as the pioneer in the study of aviation since the solid evidence of his contribution in *ornithopher* are missing. Even though he has not been given a proper acknowledgement in his contribution, the modern era aircraft has the capability in maintaining smooth and stable landing is altogether thanks to IbnFirnas who came up with the *ornithopher* theory (Jamsari et al., 2013).

#### **4. Pulmonary Circulation**

Pulmonary circulation is a passage of blood from the right side of the heart through arteries to the lungs where it picks up oxygen and is returned to the left side of the heart by veins ([https://www.merriam-webster.com/dictionary/pulmonary circulation](https://www.merriam-webster.com/dictionary/pulmonary%20circulation)). According to the Dictionary.com, pulmonary circulation in medicine means the passage of blood from the right ventricle through the pulmonary artery to the lungs and back through the pulmonary veins to the left atrium (<http://www.dictionary.com/browse/pulmonary-circulation>). Another source revealed that in modern medicine, there are two types of circulation which is known as blood circulation consist of the greater or systemic and the other is known as the pulmonary circulation or the lesser. The systemic circulation happens when the blood is pumped by the heart into the arterial system and then the blood is transported back to the right ventricle of the heart through the fine capillaries that reaches the venous system. The pulmonary circulation consists of the blood in the right ventricle being pumped and distributed in the lungs for oxygenation through the pulmonary artery. Then it returns again to the left atrium via the pulmonary vein (<https://www.ncbi.nlm.nih.gov/pubmedhealth/PMHT0023061/>; Azizi et al., 2008).

According to the modern medical literature, William Harvey (1578-1657 C.E.), an English physician was the one who discovered the pulmonary circulation concepts. But, the actual discoverer of the pulmonary circulation should be credited to a Muslim scholar who is Ibn Al-Nafis (Azizi et al., 2008; West, 2008; Sharif Kaf Al-Ghazal, 2002). Ala-al-Din Abu al-Hasan Ali IbnAbi al-Hazm al-Qarshi al-Dimashqi also known as Ibn Al-Nafis (1210-1288 A.D.) was an Arab physician who made a significant contributions to the early knowledge of the pulmonary circulation. He was born in Damascus and had his medical education at the Medical College Hospital (Bimaristan al-Noori). He published his most vital work which is the *Commentary on Anatomy in Avicenna's Canon* that included his pioneering views on the pulmonary circulation and heart. He also worked on the one of the largest medical encyclopedia to be attempted at the time; *The Comprehensive Book of Medicine*, which was never completed due to his death but is still consulted by the scholars (Azizi et al., 2008; West, 2008; Sharif Kaf Al-Ghazal, 2002; Akmal et al., 2010; Al-Ghazal, 2007). The discovery of pulmonary circulation is commonly believed that it started in Europe in the sixteenth century by Servetus, Vesalius, Colombo, and then the latest one would be William Harvey who has been given the real credit by the modern era people (Azizi et al., 2008; West, 2008; Sharif Kaf Al-Ghazal, 2002; Akmal et al., 2010; Androustos et al., 2012; Ribatti, 2009). However, according to the discovery of ancient manuscripts, it was proposed that the real credit on the concept of the pulmonary circulation should be given to Ibn Al-Nafis who was a physician from the thirteenth century (Sharif Kaf Al-Ghazal, 2002). Figure 2 illustrates the minor circulation of the blood according to the Ibn Al-Nafis theory.

**Figure 2 shows an illustration of the minor circulation of the blood based on Ibn Al-Nafis concepts. This figure is adopted from: (Al-Ghazal, 2007).**



In *Commentary on Anatomy in Avicenna's Canon*, the clarification of pulmonary circulation by Ibn Al-Nafis stated that: "The blood, after it has been refined in this cavity [i.e., the right ventricle], must be transmitted to the left cavity where the [vital] spirit is generated. But there is no passage between these two cavities; for the substance of the heart is solid in this region and has neither a visible passage, as was thought by some persons, nor an invisible one which could have permitted the transmission of blood, as was alleged by Galen. The pores of the heart there are closed and its substance is thick. Therefore, the blood after having been refined, must rise in the arterious vein [i.e., pulmonary artery] to the lung in order to expand in its volume and to be mixed with air so that its finest part may reach the venous artery [i.e., pulmonary vein] in which it is transmitted to the left cavity of the heart. This, after having been mixed with the air and having attained the aptitude to generate the [vital] spirit. The part of the blood which is less refined is used by lung for its nutrition." (Al-Ghazal, 2007; Pioreschi, 2006) Besides explaining the pulmonary circulation, Ibn Al-Nafis also explained the anatomy of the lungs and the nutrition of the heart is extracted from the vessels passing through its wall (Al-Ghazal, 2007). Moreover, Ibn Al-Nafis showed high degree of originality by denying the existence of the Galenic foramina between the ventricles by openly opposing Galen's concept (Pioreschi, 2006; Haddad and Khairallah, 1936). These crucial interpretations was not known in Europe until 300 years later, when some of Ibn Al-Nafis works were translated into Latin by Andrea Alpago of Belluno in 1547. Andreas Vesalius mentioned in his second edition book, *De Fabrica* published in 1555 and Realdus Colombo in 1559 in his book *De re Anatomica* have similar explanations on pulmonary circulation as those mentioned by Ibn Al-Nafis (Al-Ghazal, 2007).

Besides that, William Harvey published *Exercitatioanatomica de motucordisetsanguinis in animalibus* in 1628 where he clarified in details the circulation in the human body supported by his experiments on animals (Numan, 2014). In order to understand the nature of the blood circulation, human race took a long winding road as was done by the above mentioned scholars. However, it is unfortunate for Ibn Al-Nafis because none of the above-mentioned European scholars gave the appropriate credit to him as the pioneer of the pulmonary circulation theory. The pulmonary circulation discovery was documented in Ibn Al-Nafis textbook 300 years earlier compared to the description given by the European medical literature. Hence, the above evidence is convincing that the European scholars obtained the knowledge on pulmonary circulation from the written works by Ibn Al-Nafis (Numan, 2014).

### 5. Parkinson's Disease

Parkinson's disease also known as "paralysis agitans" is a type of progressive nervous disease that usually occurs to people after the age of 50. The disease is related to the destruction of brain cells that produce dopamine which can lead to muscular tremor, slowing of movement, partial facial paralysis, peculiarity of step and posture, and weakness (<http://www.dictionary.com/browse/parkinson-s-disease>). According to Meriam-Webster online dictionary and Oxford dictionary definition, it is a disease that is related to the nervous system that causes muscular rigidity, slow and imprecise movement, impaired balance and tremor of resting muscles. It is commonly happens to the middle-aged and elderly people who have low dopamine production (<https://www.merriam-webster.com/dictionary/Parkinson%27s%20disease>; <https://en.oxforddictionaries.com/definition/parkinson'sdisease>). According to the modern medical literature, in 1817, James Parkinson, a physician in London was the one who discovered the Parkinson's disease (Mandal, 2013; Raudino, 2012). But, the actual discoverer of the Parkinson's disease should be credited to IbnRushd, a Muslim scholar (Tbakhi and Amr, 2008; Mohamed, 2008; Raudino, 2012; Modell et al., 2014; Cox, 2009). Abu Al-Walid Muhammad Ibn Ahmad Ibn Muhammad IbnRushd also known as IbnRushd (1126 – 1198 A.D.) was born in Cordoba and died in Marrakech, Morocco, used to be Avicenna's (IbnSina) pupil. He was known as Averroes or Aven Ruiz or Averrhoes by the Western community. He became the "Prince of Science" since he was a walking encyclopaedia in the field of philosophy, Islamic law (jurisprudence), medicine, astronomy, mathematics, physics, and geography.

In medicine, his most vital publication would be *Al-Kulliyat fi Al-Tibb* (*Colliget* in Latin or *Generalities on Medicine*) which was written between 1153 and 1169. Ninety years later, the *Colliget* was translated to Hebrew and Latin and taught in Europe until the 18<sup>th</sup> century. The treaty was subdivided into seven books which are *Tashrih al-a'lda* (*Anatomy of Organs*), *al-Sihha* (*Health*), *al-Marad* (*Sickness*), *al-Alamat* (*Symptoms*), *al-Adwiyawal-aghghiya* (*Drugs and Foods*), *Hifz al-sihha* (*Hygiene*), and *Shifa al-amrad* (*Therapy*) (Tbakhi and Amr, 2008; Modell et al., 2014). IbnRushd was the one who suggested the existence of Parkinson's disease, it's symptomatic, and described clearly the rest tremor in the neurology and neuroscience field as early as 12<sup>th</sup> century B.C. (Cox, 2009; Tbakhi and Amr, 2008; Mohamed, 2008; Papiasvili and Mayers, 2013; Raudino, 2012). Besides that, he viewed the practice of dissection as knowledge of truth which are based on faith, philosophy, and intellectual studies (Modell et al., 2014). But, unfortunately, James Parkinson was given the credit for discovering this disease because he formally wrote a description of the Parkinson's disease in his essay entitled *An Assay on the Shaking Palsy* which was published in 1817 even though the true discoverer was IbnRushd.

### 6. Smallpox

Smallpox defined by World Health Organization (WHO) is an acute and contagious disease caused by the variola virus which is one of the members of the orthopoxvirus family. It is a disease that can be spread from person to person via infectious droplets during contact with the symptomatic people (<http://www.who.int/csr/disease/smallpox/en/>). According to Collins English dictionary, it is a disease that causes high fever, severe prostration, and a pinkish rash changing in form from papules to pustules, which dry up and form scabs that are cast off, leaving pitted depressions (<http://www.dictionary.com/browse/smallpox>). Generally, Edward Jenner is considered as the founder of the smallpox disease by the modern generation. However, in reality he is the founder of the smallpox vaccine while the actual founder of this disease should be credited to a Muslim scholar known as Al-Razi (Gross and Sepkowitz, 1998; Barquet and Domingo; 1997; Saad et al., 2008; Modanlou, 2008). Abu Bakr Mohammad Zakariya Al-Razi also known as Razi in Persian and Rhazes by the Latins was a flexible physician that was born in 865 A.D. and died in 924 A.D. However, some scholars suggested that he was born in 864 A.D. and died in 930 A.D.

He contributed in the field of alchemy, medicine and philosophy, ethics in medicine, and metaphysics by publishing 184 books and treatise. George Sarton in his book *Introduction to the History of Science* mentioned that Al-Razi was the greatest physician during the Medieval Age. Besides that, WHO also recognized his contribution towards smallpox and measles in May 1970 (Modanlou, 2008): “His writings on smallpox and measles show originality and accuracy, and his essay on infectious diseases was the first scientific treatise on the subject.” (Modanlou, 2008) Al-Razi was a pioneer in the field of paediatrics and infectious diseases. The most influential publication compared to all of his other work would be the Razi's treatise *Kitab al-Judariwa al-Hasbah (De variolisetmorbiliis)* which was translated into Latin and English in 18<sup>th</sup> century. In this book, he gave clear explanation on smallpox and measles where he made a prescient observation which was not described in his previous books. Some of his observations on smallpox are (Modanlou, 2008): “Smallpox appears when the blood boils and infected, resulting in vapors being expelled. Thus juvenile blood (which looks like wet extracts appearing on the skin) in being transformed into richer blood, having the color mature wine. At this stage, smallpox shows up essentially as bubbles found in wine-as blisters. This disease can also occur at other times-meaning not only during childhood. The best thing to do during this first stage is to keep away from it otherwise this disease might turn into an epidemic.” (Modanlou, 2008) Al-Razi also stated that this disease can be transmitted from person to person. In addition, he gave clear description of why survivors of smallpox do not develop the disease for a second time. According to him, this is because the human body have already generated immunity towards this disease.

The differentiation between smallpox and measles was explained in the same book where he wrote (Modanlou, 2008; Saad et al., 2008; Stride, 2009): “The eruption of the smallpox is preceded by a continued fever, pain in the back, itching in the nose, and terrors in sleep. These are the more peculiar symptoms to approach, especially a pain in the back with fever all over his body; a fullness of the face, which at times comes and goes; an infectious color, and vehement redness in both cheeks; a redness of both eyes, heaviness of the whole body; great uneasiness, the symptoms of which are stretching and yawning; pain in the throat and chest, whit slight difficulty in breathing and cough; a dryness of breath, thick spittele and hoarseness of the voice; pain and heaviness of the inquietude, nausea and anxiety; (with this difference that inquietude, nausea, and anxiety are more frequent in the measles than in the smallpox; while on the other hand, the pain in the back is more peculiar to the smallpox that to the measles) heat of the whole body; and an inflamed colon, and shining redness, especially an intense redness of the gums.” (Modanlou, 2008)

After the discovery of this disease, Edward Jenner (1749-1823) an English country doctor came up with a solution by introducing the vaccine of the smallpox. Jenner applied the principle of immunity in order to fight against the smallpox disease (<http://www.sciencemuseum.org.uk/broughttolife/people/edwardjenner>). As a result, Jenner eventually received the acclamation of the medical profession by discovering the smallpox vaccine (Hammarsten et al., 1979; Riedel, 2005) even though the real credit should be given to Al-Razi as the discoverer of smallpox disease, since without Al-Razi's clear explanations on this disease, Jenner would not be able to solve this problem.

## 7. Conclusion

Muslims during the medieval period were eager in acquiring new knowledge in order to improve the needs of the human being. The discoveries and inventions by the Muslim scholars in engineering (flying machine) and in medicine (pulmonary circulation, Parkinson's disease, smallpox) are some of the contributions that have been neglected or ignored which are later attributed to the other researchers. Therefore, this article fulfils its purpose by directing the researchers in acknowledging the contributions of Muslim scholars since these works form the foundation and the stepping stone for science and technology for generations to come.

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