FIBONACCI SEQUENCE AND ORDERLINESS AS OBSERVED IN THE CREATIONS OF ALLAH

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Abstract

There are numerous verses in the *Quran* that encourage Muslims to observe the many creations of Allah. This article is an exploratory discussion on the observation of a sequence of numbers known as the Fibonacci sequence (also known as the Fibonacci numbers) which can be observed in the creations of Allah. The history of Fibonacci sequence dated back to 1202 in the magnum opus of the Italian mathematician, Leonardo Pisano Fibonacci, entitled *Liber Abaci* (*Book of Calculation*). This article discusses verses in the *Quran* that encourage us to observe Allah's creations. There are many occurrences of the Fibonacci sequence in the animal and plant kingdoms, for example in the sunflower florets, ram's horn, spiralling shell, etc. This article will shed light on three occurrences, namely: (i) Structure of the coronary arterial tree; (ii) Branching of leaves; and, (iii) Seed distribution of flowers and conifers. From this article, it will be evident that the abundance of verses in the *Quran* that encourage mankind to observe the nature as a sign of Allah's existence and His Might in creating the world in such a perfect and orderly manner. One of such beauty is manifested in the sequence of Fibonacci sequence that can be easily observed in our surroundings.

Keywords: *Quran*, Fibonacci, number theory, observation of nature, orderliness.

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Introduction

The main theme in the *Quran* is the concept of *Tawheed*, where Allah is the "One and the Absolute Possessor of the universe" and that He is also "the Sustainer and unquestioned Master." [1] In Islam, Muslims hold to the belief that it is Allah who created everything in the universe in due measure, and brings everything into existence by His Will and Command, as stated in the Quran in 40:67, translated thus: "*It is He Who gives Life and Death; and when He decided upon an affair, He says to it, 'Be,' and it is.*" In everything that is created by Allah SWT, there is order, unity and harmony, which to a scientist denotes that "there are patterns, predictability, dispositions and trends" [2] in the natural world. That is why mankind has been instructed in various verses in the *Quran* to observe the creations of Allah.

It must be noted that when the *Quran* mentions of phenomena that occur in the universe, the focus is always on how the universe is orderly, systematic and predictable. As such, these phenomena can be observed and studied rationally, and subsequently be understood by mankind for the benefit of humanity.[3] Scientists have always been interested in identifying the patterns that can be found in the universe. The studies carried out has brought forth the advancements in many fields of science, and led to a better understanding of the natural world that Allah has created. That is why science is usually defined as

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[1] Ziauddin Sardar, *Reading the Qur'an: The Contemporary Relevance of the Sacred Text of Islam* (Oxford: Oxford University Press, 2011), 265-266.
[2] Sardar, *Reading the Qur'an*, 265-266.
[3] Sardar, *Reading the Qur'an*, 265-266.

an "organized knowledge, especially when obtained by observation and testing of facts, about the physical world, natural laws and society."[4]

This orderly and systematic characteristic of nature can be seen in the translation of the following verses in the Quran, i.e. 55:1-13, in which Allah says to the effect that: "*(Allah) Most Gracious! It is He Who has taught the Quran. He has created man: He has taught him speech (and intelligence). The sun and the moon follows courses (exactly) computed; and the herbs and the trees both (alike) bow in adoration, and the Firmament has He raised high, and He has set up the Balance (of Justice), in order that ye may not transgress (due) balance. So establish weight with justice and fall not short in the balance. It is He Who has spread out the earth for (His) creatures: Therein is fruit and date palms, producing spathes (enclosing dates); also corn, with (its) leaves and stalk for fodder, and sweet smelling plants. Then which of the favours of your Lord will ye deny?*"

Much has been written and said about the orderly nature of the universe. Oft-quoted examples include the orderly movements of the planets around the sun; the similarities that elements have that they can be grouped together into the Periodic Table of Elements; the mathematical harmony that can be seen in the Theorem of Pythagoras; the way in which organisms can be classified into families and genus; the way organic compounds can be classified into families based on the type of bonds and functional groups that they have; the systematic order in which bees organized themselves; and many others that can be observed in the natural world.

For mankind to realize all these, what is required is an endeavour to observe the universe and his surroundings, from the farthest reaches of the universe to the smallest of things at the subatomic level. In this article, the authors would like to highlight another intriguing example of how the world that Allah has created is not only beautiful, but also very orderly, harmonious, and systematic, so much so that a pattern in the form of what is known today in mathematics as the "Fibonacci sequence" or "Fibonacci numbers" can be observed. Therefore, the article is divided into the following parts: (i) *Quranic* instruction to observe creations of Allah; (ii) Brief background of the medieval mathematician known as Fibonacci; (iii) Fibonacci sequence; (iv) Fibonacci sequence as observed in the creations of Allah; (v) Discussion; and, (vi) Conclusion.

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[4] *Oxford Advanced Learner's Dictionary* (Oxford: Oxford University Press, 1991), 1130.

Quranic Instructions to Observe the Creations of Allah

The universe that Allah has created is made up of both the tangible and the intangible world. The tangible world is the world that we can see and observe using our faculties as well as able to be perceived by our mind, and hence is referred to as the physical world. It is this physical world, whether on the Earth itself or in the far reaches of the universe, either at the level that can be seen by the naked eye or at the subatomic level, that mankind has dedicated themselves to study. This has led to the formation of a body of knowledge collectively referred to as "science."

Science is a necessary tool for mankind to utilise in order to understand the surroundings. In essence, this is an effort to obtain the truth. If this effort is coupled with *taqwa*, then it would bring mankind closer to Allah.[5] That is why we see many verses in the *Quran* enjoining mankind to observe and think about the creations of Allah.

For example, Allah says in 26:7 to the effect that: "*Do they not look at the earth, how many noble things of all kinds We have produced therein?*" With regards to plants, Allah mentions in 13:4 of the *Quran*, thus: "*And in the earth are tracts (diverse though) neighbouring, and Gardens of vines and fields sown with corn, and palm trees – growing out of single roots or otherwise: watered with the same water, yet some of them We make more excellent than others to eat. Behold, verily in these things are Signs for those who understand!*" An example of an instruction in the *Quran* to observe animals can be seen in 88:17, translated thus: "*Do they not look at the camels, how they are made?*"

In essence, we can find many more verses encouraging mankind to observe the world that Allah has created. These verses also enjoin us to think and ponder upon the beauty, orderly, harmonious and systematic fashion in which all creations are created. Equally important to note is that the *Quran* also highlights the fact that all these are Signs of the Almighty Creator, and that these Signs can be seen in everything that He has created. One of the Signs that we can observe and think about is the pattern in the form of the Fibonacci sequence that is the topic for discussion in this article.

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[5] See: Shaikh Mohd Saifuddeen and Azizan Baharuddin, "Significance of science and scientific thought from the Islamic perspective," *International Journal on Quranic Research* 1(1) (2011): 73-87.

Who is Fibonacci?

Leonardo Pisano Fibonacci was born around 1170 into the Bonacci family of Pisa ("Fibonacci" is a contraction of "Filius Bonacci" or son of Bonacci).[6] Around 1190, when his father, Guglielmo (William) was appointed collector of customs in the Algerian city of Bugia (now Bougie) located on the north coast of Africa, he received his early education from a Muslim schoolmaster. It was here that Fibonacci was introduced to the Indo-Arabic numeration system and Indo-Arabic computational techniques. The famous mathematical book, *al-Jabr wa al-Muqabalah*, by al-Khwarizmi[7] (*c.* 780-850) was also introduced to him in this time period.[8]

As an adult, Fibonacci had many opportunities to make short visits to Arabian ports and many extended visits to Algeria, Egypt, Sicily, Greece and Syria during the latter part of the 12th century. During these visits, he became familiar with three languages, i.e. Latin, Arabic and Greek.[9] He also came in contact with early works of Eastern, Arabian and Greek mathematician, especially with arithmetic, algebra, and geometry.

Aside from al-Khwarizmi, Fibonacci was also influenced and exposed to another Muslim mathematician from Egypt namely Abu Kamil Shuja' ibn Aslam ibn Muhammad ibn Shuja' (*c.* 850-930).[10] It has been pointed out that Abu Kamil Shuja' ibn Aslam's work "was the basis of Fibonacci's books."[11] It was Fibonacci who introduced the field of algebra to Europe, which was initially developed by Muslim mathematicians such as al-Khwarizmi and Abu Kamil Shuja' ibn Aslam.[12]

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[6] Thomas Koshy, *Fibonacci and Lucas Numbers with Applications* (Hobboken, NJ: John Wiley and Sons, 2001), 1-3.

[7] Al-Khwarizmi, whose full name is Abu Ja'afar Muhammad ibn Musa, is the Father of Algebra and Father of Algorithm. He was a famous Muslim polymath who mastered many fields of knowledge such as mathematics, geography, cartography and astronomy who worked at Bayt al-Hikmah in Baghdad during the rule of al-Ma'mun Ibn Harun al-Rashid.

[8] Koshy, *Fibonacci*, 1-3.

[9] Lokenath Debnath, "A short history of the Fibonacci and golden numbers with their applications," *International Journal of Mathematical Education in Science and Technology* 42(3) (2011): 337–367.

[10] Abu Kamil Shuja' was also famously known as *al-Hasib al-Misri* (the calculator from Egypt), and had written at least nine voluminous works on many branches of mathematics.

[11] John J. O'Connor, and Edmund F. Robertson, "Abu Kamil Shuja ibn Aslam ibn Muhammad ibn Shuja," accessed February 8, 2014, http://www-groups.dcs.st-and.ac.uk/~history/Biographies/Abu_Kamil.html.

[12] O'Connor and Robertson, "Abu Kamil Shuja."

Fibonacci also lived for a time at the court of the Roman Emperor, Frederick II (1194-1250), and engaged in scientific debates with the Emperor and his philosophers.[13] After returning home to Pisa at the age of 30, Fibonacci published his book entitled *Liber Abaci* (*Book of Calculation*) in 1202. This was one of the earliest and influential text book on arithmetic and algebra ever written in Europe during the Middle Ages.[14] Besides *Liber Abaci*, Fibonacci published other books including *Practica Geometriae* (*Practice of Geometry*) in 1220, and *Liber Quadratorum* (*Book of Square Numbers*) in 1225. The first book dealt with a large collection of material on geometry and trigonometry, and the second one was concerned with his novel and outstanding research on indeterminate analysis.[15]

Fibonacci Sequence

In his magnum opus, *Liber Abaci*, there were a number of mathematical problems discussed by Fibonacci. One of the problems is with regards to rabbit population: "How pairs of rabbits will be produced each month, beginning with a single pair, if every month each 'productive' pair bears a new pair which becomes productive from the second month on?"[16] This problem led to a sequence of numbers that is called the "Fibonacci numbers" or "Fibonacci sequence" which was coined in May 1876 by a French mathematician, François Édouard Anatole Lucas (1842-1891).[17]

The rabbit problem is described as follows:[18]

In the first month, one pair of rabbit will give birth to another pair of rabbit, making it two pairs. During the second month, the old pair will give birth to another pairs of rabbits, making the total number of rabbits to three; and the third month will witness the two pairs of rabbits to produce two more pairs of offsprings, totalling to five rabbits, and so on. This gives birth to the sequence of 1, 1, 2, 3, 5, 8, 13, 21, ..., F_n, F_{n+1}, ..., and this sequence is called the

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[13] Koshy, *Fibonacci*, 1-3.
[14] Debnath, "A short history," 337-367.
[15] Debnath, "A short history," 337-367.
[16] Debnath, "A short history," 337-367.
[17] Koshy, *Fibonacci*, 1-3.
[18] Debnath, "A short history," 337-367.

Fibonacci sequence or series. This sequence can be defined by the following formula: $F_n = F_{n-1} + F_{n-2}$, where $n \geq 3$ with the initial values of $F_1 = 1$ and $F_2 = 1$.

The sequence of the rabbit population (as described above) is illustrated in Diagram 1 below:

Month	Pairs	Number of pairs of adults (A)	Number of pairs of babies (B)	Total pairs
January 1	A	1	0	1
February 1	A B	1	1	2
March 1	A B A	2	1	3
April 1	A B A A B	3	2	5
May 1	A B A A B A B A	5	3	8
June 1	A B A A B A B A A B A A B	8	5	13
July 1		13	8	21
August 1		21	13	34
September 1		34	21	55
October 1		55	34	89
November 1		89	55	144
December 1		144	89	233
January 1		233	144	377

The number of pairs of mature rabbits living each month determines the Fibonacci sequence (column 1): 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, ...

Diagram 1: Fibonacci Sequence for Rabbit Population[19]

[19] "The use of Fibonacci tools in technical analysis, Part 1 – A conceptual analysis," accessed on March 11, 2014, http://www.bull-fx.com/8527/forex-news/the-use-of-fibonacci-tools-in-technical-analysis-part-i-%E2%80%93-a-conceptual-introduction/.

It is from this initial problem mentioned in *Liber Abaci* that the sequence that we know today as the Fibonacci sequence was developed.[20] The sequence in its modern usage begins with 0 in the following sequence: "0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, …" and this sequence can be defined with the formula $F_n = F_{n-1} + F_{n-2}$ with initial or seed values F_1 = 1, F_2 = 1 or F_1 = 0 and F_2 = 1.

Fibonacci Sequence as Observed in the Creations of Allah

There have been many studies on how Fibonacci sequence can be observed in the natural world. Mitchison for example highlighted that the Fibonacci sequence can be observed in inheritance patterns, the design of flowers, and the branching of leaves.[21] A similar observation was made by Ricketts who wrote that "the logarithmic spiral is found in the simplest of primitive life forms, the snails," and can also be found in the sunflower, the three-leafed clover, the five-petaled daisies, and many other flowers with eighty or thirteen petals, with all illustrating connections to the Fibonacci sequence in nature.[22] Ricketts also pointed out that "the proportion of the fingers and toes of species of animals, being 1, 2, 3, and 5" also coincides with the Fibonacci sequence.[23]

Hejazi listed down a myriad of examples of which the Fibonacci sequence can be seen in the natural world, for instance the chronology of rabbit population, the sequence of leaf patterns twisted around a branch, the snake coil, an elephant trunk, the cochlea of the inner ear, the shape of the *Nautilus pompilius* shell, and the distribution of seeds of sunflowers.[24]

Another fascinating example can be observed in the heart as highlighted by Ashrafian and Athanasiou whereby the Fibonacci sequence are present can be seen in the structure of the coronary arterial tree, and that diseased atherosclerotic lesions in

[20] Matthias Beck and Ross Geoghegan, *The Art of Proof: Basic Training for Deeper Mathematics*, (New York: Springer, 2010).

[21] G.J. Mitchison, "Phyllotaxis and the Fibonacci series," *Science* 196 (1977): 270-275.

[22] R.M. Ricketts, "The biologic significance of the divine proportion and Fibonacci series," *American Journal of Orthodontics* 81(5) (1982): 351-370.

[23] Ricketts, "The biologic significance," 351-370.

[24] Mehrdad Hejazi, "Geometry in nature and Persian architecture," *Building and Environment* 40 (2005): 1413-1427, accessed February 12, 2014, doi:10.1016/j.buildenv.2004.11.007.

coronary arteries follow a Fibonacci distribution.[25] This observation on the structure of the heart was also commented by Henein, *et al.* who wrote that healthy hearts are in accordance to the golden ratio[26] (represented by the Greek letter phi, φ) where the ratio of the sequential elements of the Fibonacci sequence approaches the golden ratio asymptotically.

A detailed discussion on the spiral, cone-shaped osseous structure of the cochlea which resembles certain other spiral forms in the natural world was conducted by Marinković, *et al.*, where the authors pointed out that the cochlea is designed to redistribute sound wave energy toward the outer cochlear wall to detect low-frequency sound at the apex of the cochlea while increasing the hearing octave range. The authors of the article observed that the shape of the cochlea design are arranged according to Fibonacci sequence.[27]

For the purpose of this article, we shall highlight three of the above examples as to the observation of the Fibonacci sequence in the creations of Allah. The examples are: (i) Structure of the coronary arterial tree; (ii) Branching of leaves; and, (iii) Seed distribution of flowers and cones.

Structure of the Coronary Arterial Tree

The heart is an important organ that enables mankind to be alive. In the Islamic civilization, the 13th century Muslim physician Ibn al-Nafis (1213-1288)[28] was known to have studied the physiological circulatory system extensively. In his work, *Sharh Tashrih Ibn Sina* (*Explanation of the Dissection of Ibn Sina*), Ibn al-Nafis outlined accurately, for the

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[25] Hutan Ashrafian and Thanos Athanasiou, "Fibonacci series and coronary anatomy," *Heart, Lung and Circulation* 20 (2011): 483, accessed February 12, 2014, doi:10.1016/j.hlc.2011.02.008.
[26] M.Y. Henein, Y. Zhao, R. Nicoll, L. Sun, A.W. Khir, K. Franklin and P. Lindqvist, "The human heart: Application of the golden ratio and angle," *International Journal of Cardiology* 150 (2011): 239-242, accessed February 12, 2014, doi:10.1016/j.ijcard.2011.05.094.
[27] S. Marinković, P. Stanković, M. Štrbac, I. Tomić and M. Cetković, "Cochlea and other spiral forms in nature and art," *American Journal of Otolaryngology – Head and Neck Medicine and Surgery* 33 (2012): 80-87, accessed February 12, 2014, doi:10.1016/j.amjoto.2011.01.006.
[28] Ibn al-Nafis is the Father of Circulatory Physiology, whose real name is 'Ala al-Din al-Hasan 'Ali ibn al-Hazm al-Qarshi al-Dimashqi. He was a Muslim polymath who mastered branches of knowledge such as medicine, jurisprudence, literature, philosophy and theology.

first time in the history of mankind, the pulmonary circulation by correcting the view of the Greek physician Galen (*c.* 129-200).[29] According to Ibn al-Nafis:

> 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 be clarified and 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. That part of the blood which is less refined is used by the lung for its nutrition.[30]

It has been pointed out that various aspects of the cardiovascular system are mentioned in the *Quran*, in particular "the importance of the heart, blood and its circulation, and how they are vital in the maintenance of life".[31] Of particular interest is the term *al-aatin* which has been used in the *Quran*, and has been translated to either "aorta" or "artery."[32] The term *al-aatin* appears in 69:46 which is translated thus: "*And We should certainly then cut off the artery of his heart.*"

By carefully studying the heart and its blood vessels, Ashrafian and Athanasiou hypothesized that "the structure of the coronary arterial tree can be considered analogous to the leaf branching seen in trees."[33] The authors studied data from 36 mammalian species and noted that the coronary arteries reveal a morphological spread that follows a Fibonacci series of 2, 3, 5, 8 and 13. According to Ashrafian and Athanasiou, the Fibonacci number theory is useful in developing an innovative biomathematical

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[29] M. Loukas, Y. Saad, R.S. Tubbs and M.M. Shoja, "The heart and cardiovascular system in the Qur'an and Hadeeth," *International Journal of Cardiology* 140 (2010): 19-23, accessed February 12, 2014, doi:10.1016/j.ijcard.2009.05.011.

[30] Loukas, *et al.*, "The heart and cardiovascular system," 19-23.

[31] Loukas, *et al.*, "The heart and cardiovascular system," 19-23.

[32] Loukas, *et al.*, "The heart and cardiovascular system," 19-23.

[33] Ashrafian and Athanasiou, "Fibonacci series," 483.

models of the coronary system as well as coming up with new techniques in cardiac arterial imaging.[34]

The sequence branching of the coronary arterial tree is shown in Table 1 while the structure of the coronary arterial tree is shown in Diagram 2 which follows.

Table 1

Sequence Branching of the Coronary Arterial Tree[35]

Number of branches												
2	LCA	RCA										
3	LAD	LCx	RCA									
5	LAD	LCx	RI	AM	PDA							
8	LAD	LDiag1	LCx	OM1	Sep1	PDA	RDiag1	AM				
13	LAD	PLV1	PRV1	Sep3	Sep4	OM2	LDiag2	Sep2	OM3	PLV2	PLV3	PRV2	PRV3

LCA = Left Coronary Artery, RCA = Right Coronary Artery, LAD = Left Anterior Descending, LCX = Left Circumflex, OM = Obtuse Marginal, AM = Acute Marginal, PDA = Posterior Descending Artery, LDiag = Left Diagonal, RDiag = Right Diagonal, PLV = Posterior Left Ventricular (1) = lateral; (2) = intermediate; (3) = medial, PRV = Posterior Right Ventricular (1) = lateral; (2) = intermediate; (3) = medial, Sep = Septal, RI = Ramus Intermedius.

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[34] Ashrafian and Athanasiou, "Fibonacci series," 483.
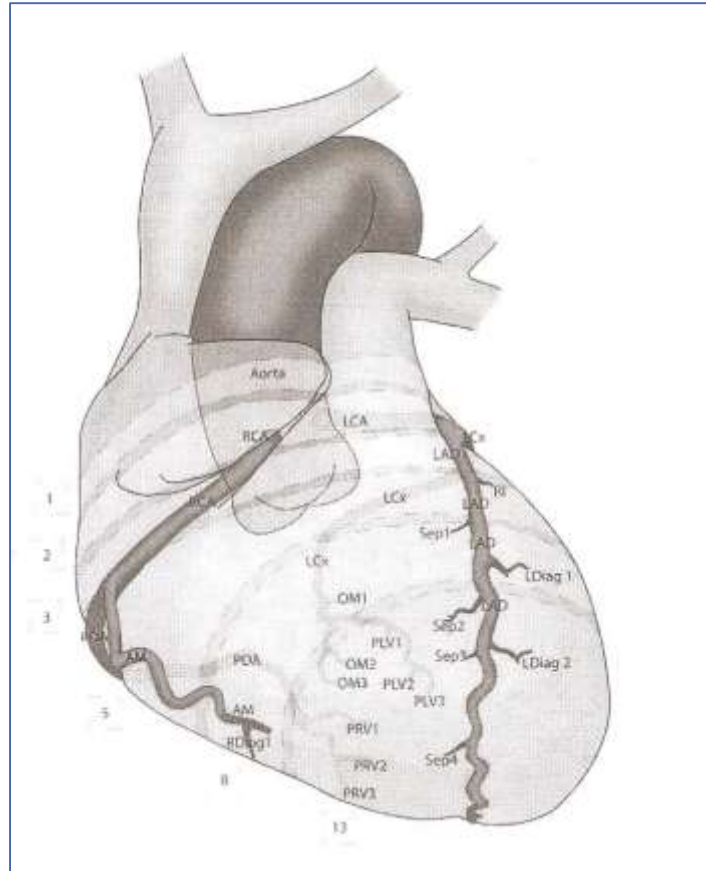[35] Ashrafian and Athanasiou, "Fibonacci series," 483.

Diagram 2: Structure of the Coronary Arterial Tree[36]

The way in which the branches of the coronary arteries are arranged, which follows the Fibonacci sequence is indeed food for thought. Such beauty, harmony, precision, and systematically-arranged vessels can only be the planning and creation of Allah.

Branching of Leaves

There are numerous verses in the *Quran* that give mention to plants. One such verse is from 6:99 which is translated thus: "*It is He Who sendeth down rain from the skies: with it We produce vegetation of all kinds: from some We produce green (crops), out of which we*

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[36] Ashrafian and Athanasiou, "Fibonacci series," 483.

produce grain, heaped up (at harvest); out of the date palm and its sheaths (or spathes) (come) clusters of dates hanging low and near: and (then there are) gardens of grapes, and olives, and pomegranates, each similar (in kind) yet different (in variety): when they begin to fruit, feast your eyes with the fruit and the ripeness thereof. Behold! In these things are Signs for people who believe."

To the untrained eye, the distribution of leaves may look haphazard, chaotic, or unsystematic. In reality, the sequence of leaf patterns twisted around a branch follow a pattern. Around a central stem of a tree, it has been noted that the distribution of trees (scientifically called "phyllotaxis") follow the Fibonacci sequence, namely one will find 3 leaves in 5 turns, and 5 leaves in 8 turns.[37] In other words, phyllotaxis spirals follow Fibonacci ratios. This means that when leaves alternate up a stem, one rotation of the spiral touches two leaves.

Different trees have different ratios but the corresponding ratios are always two of the Fibonacci numbers. To take a few examples, the ratio in hazel is 1/3, the ratio in apricot is 2/5, the ratio in pear is 3/8, and the ratio in almond is 5/13. The numbers 1, 2, 5, 8 and 13 are part of the Fibonacci sequence.[38]

The reason for such a distribution is obvious. Arranging leaves based on Fibonacci ratios allow for the best exposure to sunlight without any of the leaves being hidden from the sunlight that is needed for photosynthesis. Diagram 3 that follows shows an illustration of how leaves are distributed around a central stem.

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[37] Hejazi, "Geometry in nature," 1413-1427.
[38] H.S.M. Coxeter, *Introduction to Geometry* (Hobboken, NJ: John Wiley and Sons, 1969).
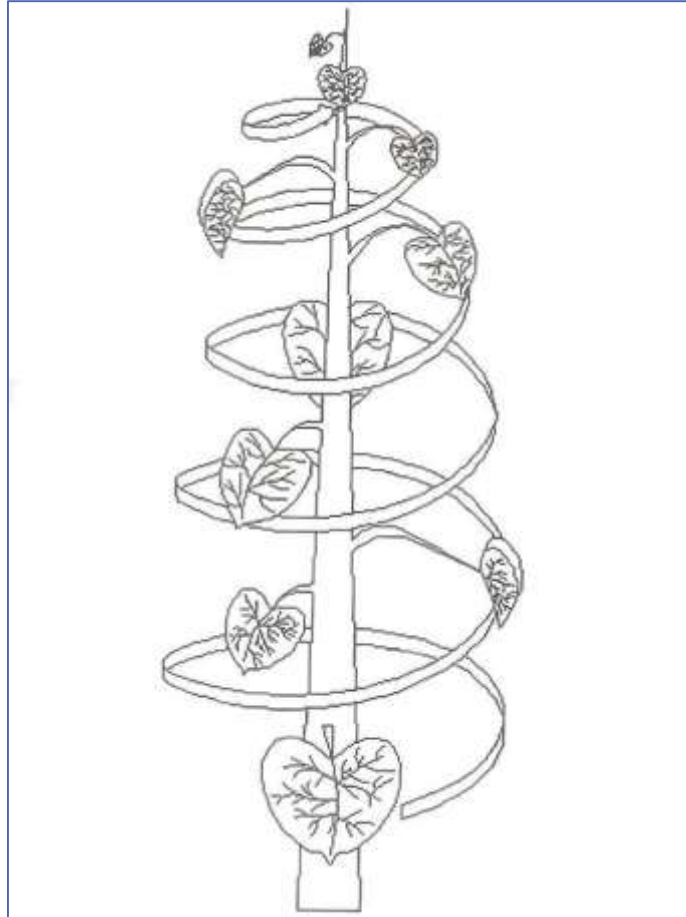
Diagram 3: Distribution of Leaves around a Central Stem

Here again, we see the beauty in the way that Allah has created plants, as stated in 27:60 of the *Quran* to the effect that: "*Or, who has created the heavens and the earth, and Who sends you down rain from the sky? Yea, with it We cause to grow well-planted orchards full of beauty of delight: it is not in your power to cause the growth of trees in them. (Can there be another) god besides Allah? Nay, they are a people who swerve from justice.*" The way the leaves are distributed enables plants to obtain optimal sunlight. This is no doubt another sign of the Might of Allah for the believers.

Seed Distribution of Flowers and Cones

In the *Quran*, a number of verses touch on seeds and grains. For example, it is stated in 36:33-35 thus: "*A Sign for them is the earth that is dead: We do give it life, and produce grain therefrom, of which ye do eat. And We produce therein orchard with date palms and vines, and We cause springs to gush forth therein: That they may enjoy the fruits of this (artistry): It was not their hands that made this: will they not then give thanks?*"
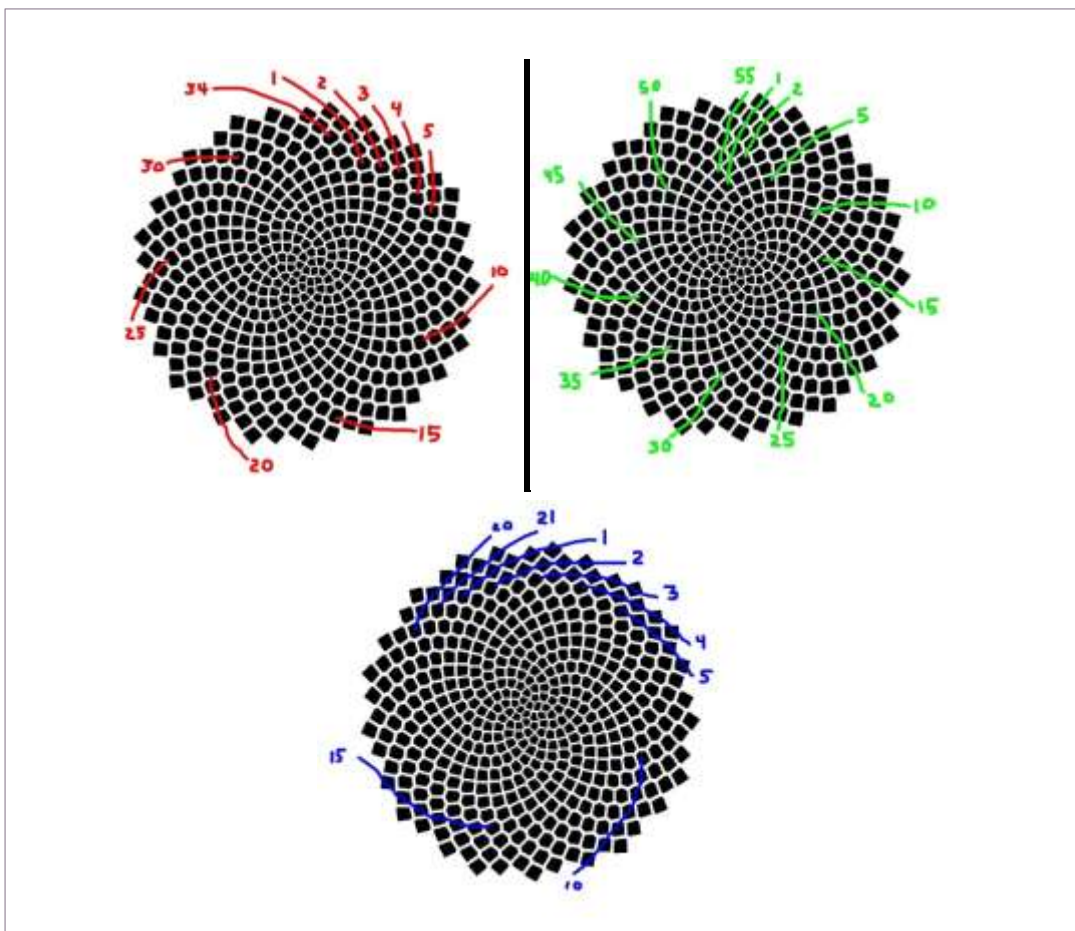

Diagram 4: Overlaying Sunflower Spirals[39]

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[39] "How to count the spirals," accessed March 2, 2014, http://momath.org/home/fibonacci-numbers-of-sunflower-seed-spirals/.

If we observe seeds on flowers and cones, we will notice that they are actually arranged in spirals. These spirals are again arranged in accordance to the Fibonacci sequence. These spirals are present in the growth patterns of many plants such as the sunflower.[40] It can be observed that sunflower seeds are distributed on 55 clockwise spirals overlaid onto either 34 or 89 counter-clockwise spirals.[41] Note that 34, 55 and 89 are Fibonacci numbers. Diagram 4 shows the overlaying spirals of sunflower seeds.

Aside from sunflowers, it can also be observed that overlaying spirals on conifers also correspond to Fibonacci numbers. The spirals on conifers are less complex compared to sunflower seeds, and therefore are easier to count. For example, Diagram 5 shows there are two overlaying spirals on a conifer with 8 spirals bending to the left, and 13 spirals bending to the right. Both 8 and 13 are Fibonacci numbers.
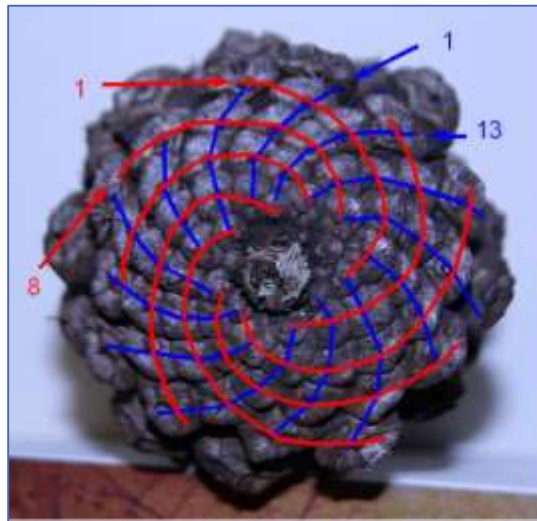

Diagram 5: Overlaying Conifer Spirals[42]

As with the distribution of leaves on a stem, the distribution of seeds on flowers, such as sunflowers, and the spiral patterns found on conifers, it is noted that there exists

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[40] Hejazi, "Geometry in nature," 1413-1427.

[41] Hejazi, "Geometry in nature," 1413-1427.

[42] "Mona Lisa and Fibonacci pinecones," accessed March 2, 2014, http://www.warren-wilson.edu/~physics/PhysPhotOfWeek/2011PPOW/20110225FibonacciPinecone/

a pattern that can be mathematically described using Fibonacci sequence. Such beauty and harmony serve to highlight another Sign of Allah the Almighty Creator.

Discussion

Everything that is created by Allah is beautiful and in due proportions. It is our task as the vicegerent of Allah on this world to observe and think about His creations. One such beauty is manifested in the form of Fibonacci sequence that can be easily observed in our surroundings – on flora and fauna, and even on ourselves. For Muslims, all these are Signs of the existence and might of the Creator. Imam al-Ghazzali has stated in his magnum opus *Ihya'* that: "The science which is beneficial up to the end is the science of knowing God, His attributes and His works, His laws affecting the world and the hereafter. This is the science by which the blessings of the hereafter is gained."[43]

The Fibonacci sequence is but one of the many examples of which mankind can utilise in order to appreciate the creations of Allah, and hence establishing closeness with the Creator. It is difficult to argue that the structure of the coronary arterial tree, branching of leaves, and seed distribution of flowers and cones are chance coincidence that happen at random without Divine Programming. These three examples highlighted in this article are only a selected few of many other examples in the natural world that can be observed with regards to the harmony and beauty as shown through the understanding of the Fibonacci series.

It is imperative therefore for Muslims to continue to observe the natural world as enjoined by the *Quran*. At the same time, Muslims must also continue to strive in mastering science and mathematics in order to fully appreciate and understand the creations of Allah. When this is done, the strength of *taqwa* will be strengthened.

Conclusion

As stated in the introduction of the article, the main theme of the *Quran* is the concept of *Tawheed*. This concept is manifested in the universe that Allah has created. If one were to

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[43] Al-Ghazali, *Al-Ghazali's Ihya Ulum-id-Din* Vol. 1, trans. Al-Haj Maulana Fazul-ul-Karim (Lahore: Book Lovers Bureau, 1971).

heed the directives in the *Quran*, that is to observe and to think about the creations of Allah, one would be enlightened with the beauty, harmony, and systematic way in which Allah has created everything.

One such beauty comes in the form of the Fibonacci sequence which can be seen in many things in our surroundings, including ourselves. The Fibonacci sequence may be looked at as a branch of mathematical application. However, the precise way in which Allah has put everything in order which corresponds to the Fibonacci sequence is really something to think about, as it can bring about the realization of the Might of Allah. This realization can increase the level of *taqwa* within Muslims, and bring Muslims closer to Allah.

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