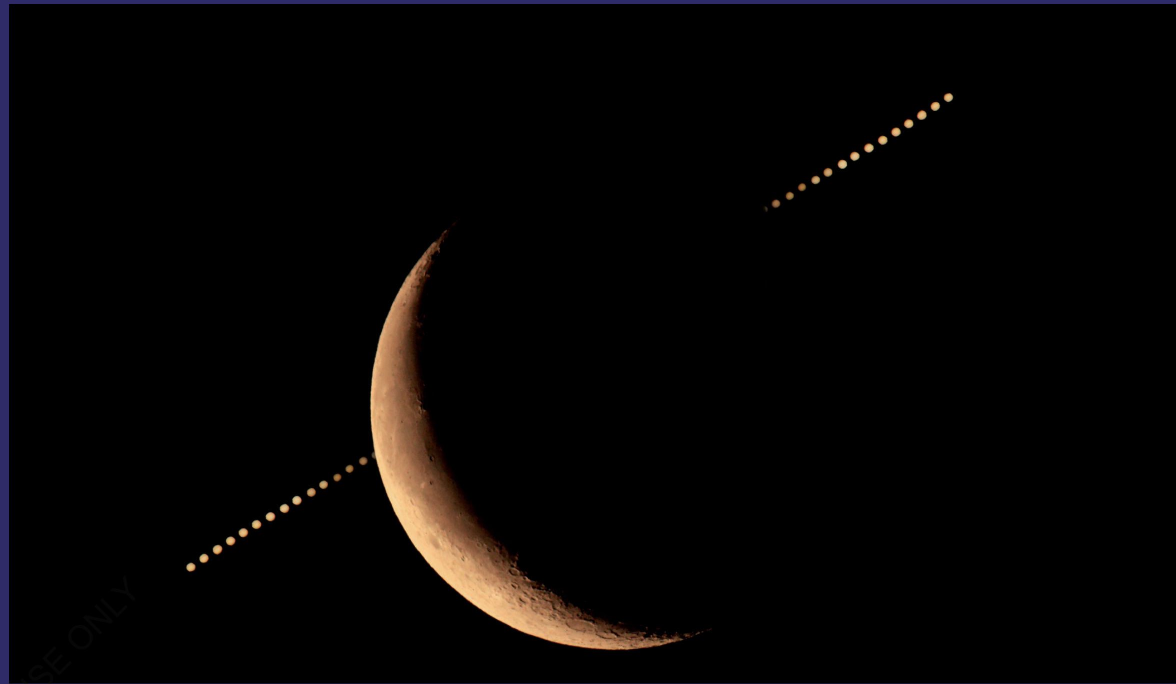
The testimony of the sighted crescent in Rihla Ibn Jubayr al-Andalusy during his journey from Spain to Mecca in Saudi Arabia from 578 AH - 581 AH to carry out the pilgrimage was something interesting to be analyzed from Astronomic and Fiqh Perspective. The Hijri calendar system in that era was a monthly calendar. The determination of begining of the month was based on normative sighting. The most successful sighting was on one day after a conjunction occured. Although at that time air pollution was not as severe as it is today, it was quite difficult to sight the crescent with the naked eye even though it’s altitude was more than 5 degrees.



Nur Aris

The Sighted Crescent Testimony in the Rihla of Ibn Jubayr al-Andalusy

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The Sighted Crescent Testimony in the Book of *Taẓkirah bi al-Akhbār ‘an Ittifāqāt al-Asfār* the Work of ibn Jubayr al-Andalūsy from Shari’a and Astronomic Perspectives

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(Islamic Law Lecturer at State Institute for Islamic Studies of Kudus Indonesia)

2019

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I. INTRODUCTION

The study of the Hijri calendar (i.e. specifically the visibility of the crescent) is a study that has been carried out for a long time, but until now, the adequate system has not been agreed upon. At what condition, the beginning of the Hijri month is still debatable. The existing agreement is that the Hijri calendar system makes the crescent (one of the Moon phases) as its reference. Hilal as a reference for being the epoch is clearly stated in the Qur'an.

يَسْأَلُونَكَ عَنِ الأهِلَّةِ قُلْ هِيَ مَوَاقِيتُ لِلنَّاسِ وَالْحَجِّ[1]

Meaning: They ask you about the crescents, say Muhammad! They are the determinant of time for humans and Hajj.

The above verse explicitly states that the crescent is the determinant of time for humans and the pilgrimage. Thus the Hijri calendar system has a strong foundation in Shari'a Law. However, Moslems are different in understanding the concept of the crescent (as a reference for calculating time). At least, there are three academic traditions in interpreting the crescent. The first is the Fiqh tradition. The crescent in the Fiqh tradition is being understood empirically-normatively which is based on the *shahādah* (testimony) of one or two people, regardless of astronomical visibility parameters. The second is the astronomical tradition that requires something empirical-verifiable. The third is the crescent in the tradition of Muhammadiyah (one of the largest Islamic organizations in Indonesia after Nahdatul Ulama) which is logical-hepotetic, out of any empirical criteria[2].

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[1] al-Baqarah: 189.

[2] The study of the crescent (Arabic: al-hilāl) category in these three traditions can be seen in Nur Aris, "Tulū' al-Hilāl: Rekontruksi Konsep

Historically, the practice of determining the beginning of the Hijri lunar month at the time of the Prophet and his companions was known as in the Fiqh tradition. The tradition of the Prophet about the crescent sighting and istikmal became a clear evidence of how the beginning of the lunar month was determined. As long as there are just witnesses, the crescent is said to have existed or published, although astronomically it has not met the minimum standards of the crescent visibility. The crescent with this definition is still found in the *ru'yat* school in determining the beginning of the fasting of Ramadan, Eid al-Fiṭr and Eid al-Adḥā in Saudi Arabia[3].

On the other hand, astronomers still cannot accept the concept of the crescent in the Fiqh tradition above, because it made Islam seem out of harmony with the development of science and technology. Moslem astronomers tried to eliminate the gap between Fiqh and the science and technology by developing astronomical parameters on the crescent visibility based on reports and observations.[4] Unfortunetly, the theorization of the crescent visibility has not reached the universal degrees, because the data being used were based on local obervation. The crescent visibility theory

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Dasar Hilal", *al-Ahkam Journal*, Vol. 24, Number 2, October 2014, p. 263-282.

[3] For example, on Friday, September 22, 2006, Majlis al-Qaḍā´ al-A'lā Saudi Arabia announced that the early crescent of Ramadan 1427 AH had been seen in the afternoon (Friday, September 22, 2006 AD) in Saudi Arabia, so that the day Saturday, September 23, 2006 AD was set as the beginning of the fasting of Ramadan 1427 AH, whereas the crescent at that time did not meet the minimum standards of the theory of the crescent's visibility.

[4] In order to respond to the gap between fiqh and science and technology held "al-Mu'tamar al-'Ālamy li Is̄bāt ash-Shuhūr al-Qamariyyah inda' Ulama' ash-Shari'ah wa al-Hisab al-Falakiy". This seminar was organized by Rābitah al-'Ālam al-Islāmy Majma' 'al-Fiqh al-Islāmy Division in Mecca on 19-21 Rabiulawal 1433 H / 11-13 February 2013 M.

that is used officially by the Indonesian government is known as the MABIMS criteria (the agreement between the Minister of Religious Affair of Brunei, Indonesia, Malaysia and Singapore). It was based on a number of traditional religious reports in the five countries. Recently, the crescent visibility of MABIMS was doubted by the National Aeronautics and Space Agency (LAPAN) of Indonesia. The MABIMS criteria have a real difference with the results of the international data-based of the crescent visibility theorization conducted by the Islamic Crescent Obsevation Project (ICOP)[5].

Historically, the Hijri calendar has been a system of time for Moslems since it was invented by Umar ibn Khattab. The use of the Hijri calendar system can be seen in the history books and also the Qur'anic commentaries. Likewise with the historical record of ibn Jubayr's journey in the 6th century AH (12th AD), exactly between 578 H (1182 AD) untill 581 H (1185 AD). The historical record of ibn Jubayr’s journey is known as *Riḥlah ibn Jubayr*. Ibn Jubayr himself gave the title of his note with *Taẓkirah bi al-Akhbār ‘an Ittifāqat al-Asfār*.

Ibn Jubayr's work has advantages and uniqueness compared to other historical books. The first advantage and uniqueness is the publication of the conversion of the Christian calendar for each Hijri calendar. The second uniqueness is that the term *istahalla* (the crescent was sighted) is always used which means the moon has been sighted as a sign that a Hijri month has begun. The term also shows a report that the hilal has been sighted. Ibn Jubayr himself is a scholar of Fiqh and hadith from Andalusia (Spain). He lived from 539 AH (1144 AD) untill 614 AH

[5] Odeh, Mohammad Sh., "New Criterion For Lunar Crescent Visibility", *Experimental Astronomy*, 2004, Vol. 18, p. 39–64.

(1217 AD). Lisānuddīn ibn al-Khaṭīb called him a literary expert[6].

Most studies of ibn Jubayr focused on the detailed description of the state of cities, social phenomena and the culture of society at that time[7]. So far, no studies have been found that focused on the records of the sighting of the crescent in the work. Therefore, this research will focused on the study of the testimony reports of the visible crescent mentioned in it through astronomical and Fiqh approaches. The astronomical and Fiqh studies on reports of the crescent sighting in the book are important for understanding the determination of the beginning of the Hijri month at that time. The study of the crescent's visibility reports in the book can illustrate how the Hijri calendar system is based on the crescent sighting practiced at that time and at the same time becomes the basis for the formulation of visibility of the crescent with the naked eye.

From the background above, this book aims to discuss the sighting testimony report recorded by ibn Jubayr and the application of the Hijri calendar based on the sight of the new moon with the naked eye in the 6th Century AH (12th AD) by digging the astronomical data on the Moon and the Sun in the time of the sighting testimony was reported. In addition, this book tries to find the minimum criteria for visibility of the crescent with the naked eye based on the sighting report on the Riḥlah ibn Jubayr from a Fiqh and astronomical perspective.

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[6] See ibn al-Khatīb, Lisānuddīn Muḥammad, *al-Iḥāṭah fī Akhbār al-Garāniṭah*, Dār al-Amal li al-Dirāsāt wa al-Nashr, Algeria, 2009.

[7] For example, how he described the beauty of the harbor tower of the city of Alexandria in Egypt at that time.

This book was based on arcival research with a qualitative approach. The data were taken from the sighting report recorded by Ibn Jubayr in his travel from Spain to Saudi Arabia at 578 AH (1182 AD) - 581 AH (1185 AD). The astronomical data of the Moon and the Sun from each sighting report was taken from Mawaaqit2001 (astronomical application software by Dr.-Ing. Khafid). The use of this software was based on two arguments. The first is to avoid systemic errors. The second is that the software could provide astronomical data that is more complete with place coordinates that can be changed systematically. Astronomical data of the Moon and the Sun that have been found were analyzed by minimum and maximum values both on positive observation or negative observation, and then were formulated in a theoretical formula.

The main source of this book is the work of ibn Jubayr al-Andalūsy entitled Taẓkirah bi al-Akhbār 'an Ittifāqāt al-Asfār or known as the Rihlah ibn Jubayr. This book was published by Dār al-Ṣādir, Beirut. This work received tremendous appreciation from western academics who were concerned on Islamic studies. This can be seen in the incessant translation of this work into various languages, such as English, Spanish, Urdu and others.

The process of data analysis in this work used systemic analysis steps adopted from the steps commonly used in content analysis research methods[8]. Adoption was

[8] Content analysis according to David Silverman in Denzin and Lincoln can be used to analyze text (2000: 821-834). The content analysis technical steps are adopted systemically from Writing CSU, a project of Colorado State University (2010) in http://writing.colostate.edu/guides/research/content/. The technical steps above were also adopted from Kenneth S. Bordens (2008: 238-241). Earl Babbie and David Silverman argue that content analysis methods relate to research on human communication contained in printed materials. Earl

done systemically, so that this method is relevant to the theme of this work. The form of systemic adoption can be seen in the following steps:

1. Determine the level of analysis: the level of analysis of this study is not at the word level, but the concepts and statements contained in the data source.
2. Determine the categories that contain the "positive observation" and "negative observation" reports[9].
3. Do what is called coding. Coding is carried out on the existence or intensity of the emergence of powerful reports and determination of their public dates either positive or negative. Coding is carried out consistently and always maintained in coherence with the categories specified above, while still opening opportunities for new categories to emerge. Other information that is not relevant to the category is ignored or eliminated.
4. Code (marking) the text by reading several times the entire text, then the existence of relevant rukyat reports to be marked according to the categories specified.
5. The coding results are displayed in the form of a table containing the Moon and Sun data according to the recorded sighting category, both positive and negative sighting. Data from tables are displayed in the scatter plots, and then analyzed descriptively to make a conclusion.

Babbie seems to limit the topics that are used to using this method in a wider scope such as society or community, not for the study of personal printed materials (Babbie, 1998: 309). However, the authors see that the method has relevance to this research, considering that the ontological position of the unit of analysis in library research with the content analysis method is the same, namely concepts and statements in the text or a set of texts

[9] Positive observation means that the crescent can be seen by the naked eye. Meanwhile, a negative observation is when the crescent cannot be seen.

II. THE CONCEPT OF CRESCENT IN THE ASTRONOMIC AND FIQH TRADITION

The crescent in the astronomical tradition was defined as the phenomenon of visibility of the Moon seen from the Earth after conjunction. It is as stated by EG Richards that the crescent is "the crescent moon as it first appears after a conjunction"[10]. The definition of the crescent is a luminous part of the moon, visible from the surface of the Earth, a phase between the new moon and the first quarter. In the new moon phase the dark side of the Moon faces the Earth while the bright side faces the Sun. This phase occurs during conjunction[11].

In the Oxford Dictionary of Astronomy, it is said that the crescent is one of the phases of the Moon, when its illumination is less than half as seen by observers [12]. Meanwhile, Philip's Astronomy Encyclopedia states that the hilal is the Moon phase between the new moon and first quarter, or between the last quarter phase and the new moon phase[13].

From the description of the scientific concept of the crescent above, it can be concluded that the crescent is a Moon shape that is seen empirically in the western horizon at sunset which was preceded by conjunction. This definition limits the crescent by the conjunction before it is seen. The

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[10] Richards, EG., *Mapping Time: the Calendar and Its History*, Oxford, Oxford University Press, 1998, p. 407.

[11] Moulton, Forest Ray, *an Introduction to Astronomy*, New York, The MacMilan Company, 1916, p. 191.

[12] Ridpath, Ian, *Oxford Dictionary of Astronomy,* New York, Oxfrod University Press, 1997, p. 109.

[13] Moore, Sir Patrick, *Philip's Astronomy Encyclopedia*, London, Philip, 2002, p. 106.

conditions for the conjunction are never mentioned in the normative Fiqh tradition. Thus, the last hilal of Ramadan 1433 AH on the afternoon of August 17, 2012 in an astronomical perspective has not yet been formed. But in the perspective of normative Fiqh, it is possible that the crescent is already there because it is seen, even though it has not been a conjunction because Ramadan has been already 29 days[14].

Thus the concept of the crescent in the astronomical tradition is a sensual empirical crescent with a condition that conjunction has been occurred before it is seen. But, on the other hand, there are some astronomers who try to characterize the visibility of the crescent. They tried to explain the parameters that influence the visibility of the cfrescent.

According to Ilyas, the theorization of the crescent visibility since the beginning of Islam until the year 500 AD has been carried out by the Babylonians. The parameter in the theory of crescent visibility built by the Babylonians is the difference in time between sunset and moonset. According to them, the crescent can be seen if the timelag between the Sun and the Moon is more than 48 minutes and the age of the Moon is more than 24 hours when observing in the afternoon. These criteria persisted until the Hindu period (500 AD-700 AD) and in the early Islamic period (700 M-1100 AD)[15].

For example, al-Battany argued that the age for the Moon more than 24 hours (arc of sparation more than 12°) is a good start despite its approximate nature, because in the past, Islamic knowledge was limited to estimates. But he added

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[14] As the appeal of *Majlis Qaḍā´ al-A'lā* Saudi Arabia to all Saudi societies for crescent observations at 29 Ramadan 1433 AH.

[15] Ilyas, Muhammad, *Astronomi of Islamic Calendar*, Kuala Lumpur, A.S.Noordeen, 1997, p. 77-80.

that other parameters such as the effect of the distance of the Earth and the Moon, thickness of the crescent and so on also need to be considered[16].

After 1100 AD till 1800 AD, the criteria developed by al-Battany which were also used since Babylon continued, for example in al-Sufi (10th century AD) and al-Kashani (15th century AD), both still using the arc of sparation more than 12°. No further development until the first half of the 19th century[17].

Entering the years 1860 AD till 1975, Schmidt in Athens collected six dozen crescent observations and recorded the relevant for a period of 20 years. These Schmidt data were then used by Fotheringham to develop altitude-azzimut parameters in the theory of crescent visibility. According to Fotheringham, the crescent could be seen must be more than 30 hours old[18].

The Fotheringham parameter was later revised by Maunder after he added some observation data. The Fotheingham parameter is similar to the parameters put forward by al-Biruny, so Fotheringham is considered to only repackage the parameters of al-Biruny. After Maunder, this parameter was developed again by Fotheringham himself and Ilyas[19].

In 1977 AD, Bruin offered the crescent visibility parameters that he formulated by adding variables such as the sky brightness, background contrast, the crescent's intensity

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[16] *Ibid.* p, 83.

[17] *Ibid.*

[18] Fotheringham, J. K., "The Visibility of Lunar Crescent", *the Observatory*, NASA Astrophisics Data System, 527, October 1921, No. 569, p. 308-311.

[19] Ilyas, M., *A modern Guide to Astronomical Calculations of Islamic Calendar, Times & Qibla*, 1984.

and so on[20]. After Bruin, Danjon stated that the crescent cannot be seen if the distance of the Moon and the Sun (elongation) is less than 7°. Ilyas tried to do further studies on the minimum limit of elongation angle (Danjon limit) by constructing a crescent visibility criteria based on the age of the Moon and moonset lag, while improving the criteria for Fotheringham and Maunder. Ilyas found that the minimum limit of elongation for the hilal was 10.5°[21].

Then the parameters developed by Yallop appeared. Yallop introduced six types of visibility of the crescent based on 295 observations from 1859 AD to 1996 AD. The six types of crescent visibility were: 1) easily seen with the naked eye; 2) can be seen with the eye when the atmosphere is very good; 3) requires an optical device to find a thin hilal before it can be seen with the naked eye; 4) can only be seen with a telescope; 5) below the normal limit can be seen with the telescope and 6) can not be seen, under the Danjon limit[22]. In the end, Schaefer became the first person to try the using of photometric method completely to predict the visibility of the crescent. The model developed by Schaefer was a perfect representation of Bruin's work[23].

The concept of the crescent in the scientific (astronomical) tradition was theoretical-empirical, for two reasons. *First*, it was based on long-term observations to determine the universality of the crescent visibility. If there is

[20] Ilyas, *op.cit.,* p. 85.
[21] *Ibid.*
[22] Yallop, BD, NAO Technical Note No 69, *A Method for Predicting the First Sighting of the New Crescent Moon*, HM Nautical Almanac Office, Royal Greenwich Observatory, Cambridge, 1998.
[23] Schaefer, B.E. dan L. E. Doggett, "Lunar Cresecent Visibility", *ICARUS*, Vol. 107, 1994, 388; B. E. Schaefer, "Visibility of the Lunar Crescent"*, Quartely Journal of Royal. Astronomical Society*, Volu. 29, 1988, p. 511.

a report that a crescent being sighted, but it is not in accordance with the astronomical parameters formulated, then the reported crescent must be considered not to be the true crescent report. It may be another celestial body. *Second*, if at one time, the crescent's position is appropriate or even above the astronomical parameters set, but the crescent is not seen when observing, the crescent is considered to exist theoretically.

To analyze the astronomical data of the Moon and the Sun, three parameters of the crescent's visibility were used, namely the Moon's altitude, the elongation between the Moon dan the Sun and the Moon's age. The Altitude is the height of the Moon seen from the horizon of the observer. Elongation is the distance between the Moon and the Sun measured from the midpoint of both. The age of the Moon is the time difference between the time of conjunction and the sunset time. The three visibility parameters were used for extracting the crescent astronomical data that was reported in the The Rihlah of ibn Jubayr.

III. TESTIMONY FOR SIGHTING OF THE CFRESCENT

A. The Crescent Sighting in the Fiqh Academic Tradition

The crescent in Arabic is called *hilāl*. *Hilāl* (plural: *al-ahillah*) is *gurrah al-qamar*, which is the earliest shape of the Moon when it was seen by the human eye at the beginning of the lunar month. Some say that *hilāl* is the shape of the Moon for the first two nights of a lunar month. It's not called *hilāl* until the following month. However, some say that *hilāl* is the shape of the Moon on the first three nights of a lunar month, after that time, it was called *al-qamar* (the Moon)[24].

Etymologically, the term *hilāl* is derived from the word *halla-yuhillu-ihlāl*, which means to see the crescent. The original meaning of *ihlāl* is *raf'u al-ṣaut* which means loud or shouting. The person who raises his voice or yells is often called *muhillun*. *Ahalla bi al-hajj* means that the person who performs the pilgrimage increases his voice when reading *talbiyyah*. *Istahalla al-ṣabiyyu ṣarikhan* means a baby crying hard when born. And the shape of the crescent is called *hilāl* because of the habit of the Arabs screaming when they see it, while saying *takbīr* and praying[25].

In the book Mu'jam Lugah al-Fuqahā', it was stated that the term *istihlāl* is a derivation of the word *hilāl* in Arabic poetry means the earliest verse. *Istihlāl al-maulūd* means to speak loudly. Anything that *istahalla* means to speak loudly. *Hilāl* is called *hilāl* because people scream

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[24] Ibnu Faris, Abbiy al-Husain Ahmad, *Maqayis al-Lughah*, Ittihad al-Kitab al-'Arab, 2002, Juz. 6, p. 701.

[25] *Ibid*.

loudly when they see it[26]. *Hilāl* is a noun from the word *halla*. The plural form is *ahillah* or *ahālil*, which is the Moon at the beginning of the lunar month until the 7th day, and from the 27th day to the end of the month[27].

In the book Aisar al-Tafāsīr li Kalām al-'Aliyy al-Kabīr also mentioned that *hilāl* is the shape of the Moon at the beginning of its appearance on the first three nights because people shouted "*al-hilāl*! *Al-hilāl*!!" when they saw it[28], likewise the opinion of al-Bagdady in his book Tafsīr al-Khāzin[29]. Ibn 'Asyūr in his book al-Taḥrīr wa al-Tanwīr added that *hilāl* is the Moon at the beginning of the meeting with the Sun on the first and second night[30]. According to al-Samīn al-Ḥalabiy in his book al-Durr al-Maṣūn fi 'Ilm al-Kitāb al-Maknūn, *hilāl* is a celestial body that has been known and has become the name for that celestial body[31].

The basic concept of crescent in the tradition of conventional Fiqh can be referred to as a pure-empirical concept, because it was associated with empiric on the basis of observation. If the concept of the crescent is associated with "loud/shouting)" when it is seen empirically, it means that the crescent is called empirically. Conversely, the crescent is called non-existent, if it is not seen empirically. Thus, in the Fiqh point of view, the

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[26] Qal'ahjiy, Muhammad Rowās, *Mu'jam Lugah al-Fuqahā'*, Beirut: Dār al-Nafā'is, 1988, p. 72.

[27] *Ibid.*, p. 106.

[28] al-Jazā'iry, Abū Bakr, *Aisar al-Tafāsir li Kalām al-'Aliyy al-Kabīr, 2003,* Juz I, p. 170.

[29] al-Khāzin, Alā'uddin 'Aliy ibn Muḥammad,*Tafsīr al-Khāzin au Lubāb al-Ta'wīl fi Ma'āniy al-Tanzīl* , 1979, p. 66.

[30] Ibn 'Ashūr, Muḥammad al-Ṭāhir*, al-Taḥrīr wa al-Tanwīr*, Dār al-Tunisiyyah li al-Nashr, 1997, Juz I, p. 192.

[31] Al-Halabiy, al-Samīn, *al-Durr al-Maṣūn fi 'Ilm al-Kitāb al-Maknūn,* t.t.h, Juz I, p. 705.

presence of the crescent does not depend on the particular position of the Moon, Earth and Sun. It does not depend on a certain standard of illumination, at a certain elongation angle. It does not depend on a certain Moon age or other parameters. In other words, the concept of the crescent in conventional Fiqh traditions is sensual pure-empiric (sensory/observable).

This conclusion is also supported by the discourse in the Fiqh tradition about the sight of the crescent during the day, like the discussion conducted by ibn ‘Ābidīn in his book Ḥāshiah Radd al-Mukhtār ‘alā al-Durr al-Mukhtār Sharḥ Tanwīr al-Abṣār Fiqh Abū Ḥanīfah[32]. Al-Qarāfy in his book al-Ẓākhirah even mentioned that there is a group of people who see the crescent during the day [33]. Long before the Fiqh experts above, Mālik in al-Mudawwanah al-Kubrā also alluded to the sight of the crescent during the day[34].

The basic concept of the crescent in the tradition of conventional Fiqh has implications for the start of the 1st day of the lunar month based on the sensual empirical crescent which has actually been observed with the naked eye. Such a concept of the crescent is widely adopted by Fiqh expert scholars since the time of early Islam even today. This empirical sensual concept of hilal leads to understanding, if the hilal cannot be observed on the 29th of the lunar month, although astronomically it is very likely to be observed, so the current month is fulfilled 30

[32] Ibn ‘Ābidīn, *Hāshiah Radd al-Mukhtār ‘alā al-Durr al-Mukhtār Sharḥ Tanwīr al-Abṣār Fiqh Abī Ḥanīfah,* 2000, Juz 2, p. 392-393.

[33] Al-Qarāfy, Shihābuddīn Aḥmad ibn Idrīs, *al-Ẓākhirah,* Beirut: Dār al-Garb, 1994, juz 2, p. 424.

[34] Mālik, Ibn Anas ibn Mālik, *al-Mudawwanah al-Kubrā,* Beirut: Dār al-Kutub al-‘Ilmiyyah, T.th., Juz I, p. 267.

days. Such a concept can also lead to the understanding, that to carry out the crescent sgihting on the 29th even though the crescent has set before sunset is justified by Sharia.

An example is the announcement of the High Judiciary Council of Saudi Arabia which called on Moslems to make observations of the early crescent of Shawwal 1433 AH. At the coordinates of Mecca at sunset on the 29th of Ramadan 1433 AH (Friday, August 17, 2012 AD), the crescent was not seen by people who practiced sighting in Saudi Arabia, so Ramadan 1433 AH was fulfilled to 30 days, so that 1 Shawwal 1433 AH (Eid Al-Fitr) was decided to coincide with August 19, 2012 AD as the High Judiciary Council of Arabia decided on the beginning of Shawwal 1433 H[35].

The announcement above confirmed that the concept of the crescent in the tradition of conventional Fiqh is a pure empirical concept. This implied an order from the High Judiciary Council to carry out the crescent observation which was held on August 17, 2012, although astronomically, the crescent could not be seen or even had not yet existed because there had not been a conjunction. Modern astronomical calculation systems ensured that at sunset in Mecca, no conjunction had occurred. Conjunction took place at 6:55 p.m., the Sun set at Mecca at 6:49:52 and the Moon set at 18:29:59[36].

The logical structure of the crescent which is pure empirical above must also be supported by normative variables known as *shahādah*. As long as the sight claim is supported by *shahādah* (witness/testimony), it will

[35] http://www.fatwa-online.com/news/0120817.htm
[36] Khafid, *Software Mawaqit 2001.*

accepted. In the tradition of Fiqh, *shahādah* plays a very important role in the concept of the crescent sighting. Without confession or *shahādah*, then a report on the appearance of the new moon will be rejected. Thus, it can be said that the concept of the crescent in the tradition of Fiqh is an empirical-normative concept.

B. The Crescent Sighting in the Academic Tradition of Astronomy

Unlike the concept of the crescent in the tradition of Fiqh, the *hilāl* in the tradition of Astronomy was defined as the phenomenon of crescent visibility seen from the Earth after a conjunction has occurred. This was supported by the hilal devinition presented by EG Richards in his book Mapping Time: the Calendar and Its History that *hilal* is "The crescent Moon as it first appears after a conjunction"[37].

Hilāl in English is called crescent. It is a luminous part of the Moon that appears from the surface of the Earth which is the phase between the new Moon and first quarter. In the new Moon phase, the dark side of the Moon faces the Earth while the bright side faces towards the Sun, this phase occurs during the conjunction[38].

In the Oxford Dictionary of Astronomy, it was stated that the hilal is one of the phases of the Moon, when its illumination is less than half as seen by the observer[39]. In Philip's Astronomy Encyclopedia, it was stated that the

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[37] Richards, E.G., *Mapping Time: the Calendar and Its History*, New York: Oxford University Press, 1998, p. 407.

[38] Moulton, Forest Ray, *an Introduction to Astronomy*, The MacMillan Company: New York1916, p. 191.

[39] Ridpath, Ian, *Oxford Dictionary of Astronomy*, Oxford University Press: New York, 1997, p.109.

hilal is the Moon phase between new Moon (first month) and first quarter, or between the last quarter phase and the new Moon phase. *Hilāl* is also called the phase of an inferior planet between inferior conjunctions with the largest elongation, when the illumination side is less than half visible[40].

From the description above, it can be concluded that the hilal in the astronomy tradition is one of the shaped Moon phases that is seen empirically around the western horizon at sunset which was preceded by the conjunction. This definition includes the conjunction before the crescent is seen, while the conjunction is never mentioned in the conventional Fiqh tradition. Thus, the end of the month of Ramadan 1433 AH on the afternoon of August 17, 2012 AD in the astronomy perspective, the crescent had not yet been formed, but in the perspective of Fiqh, it is possible that the crescent was already visible, even though there had not been a conjunction, since Ramadan was the 29th, as the High Judiciary Council called all Saudis to see the hilal at 29 Ramadan 1433 AH.

Thus, the concept of the crescent in the tradition of observational astronomy is the empirical-logical crescent with the parameter that conjunction has occurred before the crescent is seen. On the other hand, there were some astronomers who try to characterize the visibility of the crescent. This theory tried to explain the parameters that influence its visibility. For example, the Babylonian crescent visibility parameter is the time lag between moonset and sunset and the age of the Moon[41]. There were

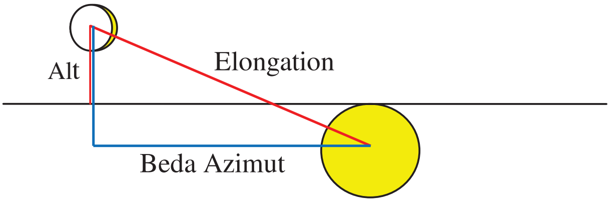
[40] Moore, Sir Patrick (ed.), *Philip's Astronomy Encyclopedia*, London: Philip's Group, 2002, p. 106.

[41] Ilyas, Muhammad, *Astronomy of Islamic Calendar,* AS Noordeen: Kuala Lumpur, 1997, p. 77.

also combination parameters between age, altitude and elongation like those offered by MABIMS[42] and others.

From the description above, it can be concluded that the concept of the crescent in the tradition of observational astronomy is empirical-logical-verification. It is said to be empirical because the concept of the crescent is based on long-term observations to determine the universality of its visibility. It is logical because: first, if there is an observable crescent report, which its position does not in accordance with the parameters that have been formulated, then the crescent sighted is considered not the true crescent, but may be other celestial body or error sighting. Second, if at one time the crescent is in a position that is appropriate or even above the parameters set by the theory, but when the crescent is not seen empirically, then the hilal is considered to have existed theoretically. Such a crescent concept places the crescent as an object whose existence does not depend on the subject. The crescent does not depend on the sight by the observer. The following figure is an illustration of the concept of the crescent in the tradition of observational astronomy.

Figure 1
The Crescent Concept in the Observational Astronomy



[42] See Workshop Decision "Looking for the Format of Early Criteria for Hijriyah in Indonesia 2011" held at the USSU Bogor Hotel on September 19-21, 2011.

The basic concept of the crescent in the *Wujūdul Hilāl* Muhammadiyah tradition differs logically from the logical structure of the two previous concepts. *Wujūdul Hilāl* comes from two words, namely *wujūd* and *al-hilāl*. The form comes from the word *wajada*, *yajidu*, *wujūdan*. *Wajada* means to exist or to exist by itself[43]. Thus, *wujūdul hilāl* in language means the presence of the crescent.

The crescent in *wujūdul hilāl* was not a purely empirical-normative concept like as in the fiqh tradition and not empirical-logical-verification like as in the tradition of observational astronomy. The crescent in *wujūdul hilāl* was a logical-hepotetico-mathematical concept. It was not formulated based on empirical through observation but through rational-theoretical reasoning.

In the tradition of *wujūdul hilāl*, the crescent does not have to be observed empirically by observers from the surface of the Earth. Its basic concept refers to three theoretical parameters of astronomy that are cumulative (all three parameters must be fulfilled) as references. The three parameters are:

1) Conjunction has occurred;
2) Conjunction occurs before sunset; and
3) The Moon (the upper disk) is still above the horizon at sunset[44].

The crescent concept in the tradition of *wujūdul hilāl* with the theoretical parameters above made it detached from the empirical aspects. Thus the existence of the crescent in the *wujūdul hilāl* cannot be proved

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[43] Ibnu Mandzur, *Op. Cit.*, Juz 3, p. 445.

[44] Majlis Tarjih Team and Tajdid PP Muhammdiyah, Hisab Muhamamdyah Guidelines, Majlis Tarjih and Tajdid Muhammadiyah: Yogyakarta, 2009, p. 23.

empirically. It can only be proven logically-hepotetically. Any attempt to test empirically the existence of it is a futile act.

Proofing of the existence of the crescent in the *wujūdul hilāl* tradition can only be done logically-hepotetically. One of the logical tests that can be taken is starting with an axiom or postulate which states that shortly after the conjunction occurs, the illumination of the Moon will increase in magnitude and its value will definitely be more than 0%. When the Sun sets and the conjunction occurred a few moments before, there is a face of the Moon which is illuminated even though it is very small. The following table contains conjunctions and illumination data of the Moon when the Sun sets for each beginning of the Month in 1433 AH. The conjunction and illumination data are calculated with the Mawaqit 2001 software.

Table 1
Data on Conjungction and Moon Illumination
for every month in 1433 AH (Mawaqit 2001)
on Pati's Coordinate

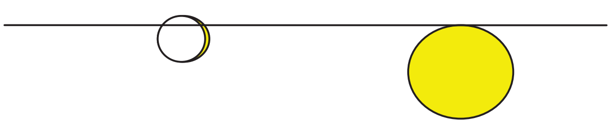
No	Bulan	Data Bulan dan Matahari
1	Muharam	Conjunction = November 25, 2011 at 1:10 p.m. Sunset = 17:36:48 Moonset = 17:44:02 Illumination = 0.71%, Alt = 1° 7 '41.6 "
2	Safar	Conjunction = December 25, 2011 at 01:07 Sunset = 17:51:40 Moonset = 18:25:51 Illumination = 0.69%, Alt = 6° 57 '54.3 "
3	Rabiul Awal	Conjunction = January 23, 2012 at 2:40 p.m. Sunset = 18:01:32 Moonset = 17:57:52 Illumination = 0.15%,

		Alt = -0° 55 '52.8 "(crescent has not been realized because the 3rd parameter is not fulfilled)
4	Rabius Thani	Conjunction = February 22, 2012 at 5:35 Sunset = 17:57:58 Moonset = 18:06:03 Illumination = 0.47% Alt = 1° 27 '36.9 "
5	Jumadil Awal	Conjunction = March 25, 2012 at 21:37 Sunset = 17:44:58 Moonset = 17:25:13 Illumination = 0.19% Alt = -5° 33 '26.7 "(crescent has not been realized because the 3rd parameter is not fulfilled)
6	Jumadil Akhir	Conjunction = April 21, 2012 at 2:18 p.m. Sunset = 17:31:17 Moonset = 17:27:36 Illumination = 0.07% Alt: -0° 55 '43.8 "(crescent has not been realized because the 3rd parameter is not fulfilled)
7	Rajab	Conjunction = May 21, 2012 at 6:47 Sunset = 17:25:13 Moonset = 17:41:22 Illumination = 0.18% Alt: 3° 1 ’20.1”
8	Syaban	Conjunction = June 19, 2012 at 10:02 p.m. Sunset = 17:28:11 Moonset = 17:15:45 Illumination = 0.06% Alt: -3° 34 '44.5 "(crescent has not been realized because the 3rd parameter is not fulfilled)
9	Ramadan	Conjunction = July 19, 2012 at 11:24 Sunset = 17:34:30 Moonset = 17:42:21 Illumination = 0.21% Alt: 1° 20 '6.7 "
10	Shawal	Conjunction = August 17, 2012 at 10:55 p.m. Sunset = 17:36:35 Moonset = 17:16:24 Illumination = 0.25% Alt: -5° 35 '4.9 "(crescent has not been realized because the 3rd parameter is not fulfilled)
11	Zulkaidah	Conjunction = September 16, 2012 at 9:11 Sunset = 17:33:18 Moonset = 17:41:53

		Illumination = 0.31% Alt: 1° 32 '25.7 "
12	Zulhijah	Conjunction = October 15, 2012 at 7:03 p.m. Sunset = 17:29:45 Moon setting = 17:18:06 Illumination = 0.07% Alt: -3° 33 '16.4 "(crescent has not been realized because the 3rd parameter is not fulfilled).

Based on the concept of *Wujūdul Hilāl*, the beginning of the fasting of 1433 H coincided with the Friday of July 20, 2012, because the hilal was formed with illumination of 0.21% even though its height was 1°20'6.7". Based on the postulate above, no matter how small the illumination of the Moon after conjunction before sunset, the actually crescent has been formed, because there must be sunlight reflected from the Moon to the Earth, even though the Moon's illumination cannot be seen empirically by observers on the Earth's surface. The following is an illustration of the basic concept of the crescent in the tradition of *Wujūdul Hilāl.*

Figure 2
The Basic Concept of the Crescent in the
Wujūdul Hilāl Tradition



IV. CRESCENT VISIBILITY THEORITIZATION

A. Variables that Influence the Crescent Visibility

Astronomers disagreed about variables that affect the visibility of the crescent. There were at least six variables used to measure the level of crescent visibility, i.e.:

1. Moon Age
   Moon Age is the period calculated from the time of conjunction to the sunset on the day of conjunction or the days thereafter. This variable is expressed in units of time ie hours, minutes and seconds.
2. Altitude
   Altitude is the position of the midpoint of the Moon measured by the observer horizon. Altitude variables are expressed in units of degrees, minutes and seconds.
3. Elongation
   Elongation is the distance of the Moon and Sun measured from the point of departure expressed in units of degrees, minutes and seconds.
4. Lag Time
   Lag time is the difference in time between moonset and sunset. This variable time unit is expressed in hours, minutes and seconds.
5. Crescent width
   This variable size is expressed in units of minutes and seconds (arcs).
6. Illumination
   Illumination is the moon's lighting phase which is expressed in units of %. This unit is a logical consequence of the meaning of illumination as a result of a comparison between the surface of the Moon which is glowing with its entire surface.

B. Theorizing the Crescent Visibility and its Database

The database used by astronomers in formulating the theory of crescent visibility, can be categorized into two databases. First is the database based on the results of observations that they do by themselves. Second, the database based on the observations of others.

In addition, the theory of crescent visibility was based on data from observations with the naked eye or telescope. Thus, the crescent visiblity category was based on the two observation models, for example, what is done by Odeh and ICOP. Odeh categorized the crescent visibility into five categories: 1) impossible to see, 2) impossible to see with the naked eye, 3) only a telescope might look, 4) it might be visible to the eye but easily with a telescope, and 5) easily visible to the naked eye.

The theoritization of the crescent visiblity has developed recently by taking an observation database with CCD imaging telescope, where the crescent image is captured and processed with personal computer software. CCD imaging telescopes have proven successful in detecting the crescent shortly after conjunction. If the database of crescent visibility is based on observations with CCD imaging telescopes, there will be a new category of crescent visibility, namely the crescent visibility of CCD imaging telescopes.

From the aspect of Shari'a, the sighting of the crescent with CCD imaging telescopes has not yet received its legality, so that it cannot be accepted by the practitioners of crescent sighting. It is time for Fiqh scholars responding to increasingly advanced observation technology and more accurate in detecting the crescent. They must answer whether the visibility of the cfrescent with CCD imaging telescope technology can be accepted by Fiqh. The author is preparing a discussion of this issue from Fiqh perspective in a separate book.

V. MOON CONDITIONS OF THE SIGHTED CRESCENT TESTIMONY IN THE BOOK OF IBN JUBAYR AL-ANDALŪSY BETWEEN 578 AH - 581 AH

The condition of the Moon of the sighted crescent testimony of the ibn Jubayr in his Riḥlah can be distinguished based on the 4 Hijri years, namely: 1) 578 AH which consists of Shawwal, Zulkaidah and Zulhijah. 2) 579 AH consists of 12 full months from Muharam to Zulhijah, 3) 580 AH consists of 12 full months from Muharam to Zulhijah, and 4) 581 AH which consists of only one month namely Muharam[45].

The following is a tabulation of the Moon condition data for each of the beginning of the lunar month above.

A. The Moon Condition of the Sighted Crescent Testimony for Year 578 AH (1183 AD)

Ibn Jubayr began to travel from Andalusia in Shawwal 578 AH. Thus, during 578 AH, the report of the sighted crescent written by Ibn Jubayr consisted of Shawwal while he was in Andalusia, Zulkaidah while he was near the Ibiza islands and Zulhijah while he was in Alexandria. The following table shows the data on the Moon condition for the three lunar months.

Table 2
Moon Conditions of the Sighted Crescent Testimony During 578 AH (1183 AD)

No	Month of Hijri	Time of the Sighted Crescent Testimony	Location (Coordinate)	Moon-Sun Data at the Beginning of Hijri Lunar Month
1	Shawwal	Wednesday	Spain	Conjunction: Tuesday,

45 See ibn Jubayr, *ar-Rihlah.*

		night/ January 27	Granada (37.18° N 3.60° W)	1/25/1183 at 6:40 p.m. Rukyat day: on Wednesday, 1/26/1183 Sunset: 18:41 Moonset: 19:44 Age: 24.02 hours Illumination: 1.71% Altitude: 9.85° Elongation: 14°55´19´´ (Positive observation)
2	Dhu al- Qa'dah	Suterday night/ February 26	Spain Yabisah (Ibiza) (38.98° N 1,43° E)	ISTIKMAL Conjunction: Thursday, 2/24/1183 at 4:17 a.m. Rukyat Day: on Thursday, 2/24/1183 Sunset: 18:46 Moonset: 19:19 Age: 14.48 hours Illumination: 0.75% Altitude: 5.26° Elongation: 9°53´48.3´´ (Negative observation)
3	Dhu al- Hijjah	Saturday night/ March 27	Egypt Iskandaria Alexandria (31.13° N 29.55° E)	Conjunction: Friday, 3/25/1183 at 2:12 p.m. Rukyat Day: on Friday, 3/25/1183 Sunset: 18:18 Moonset: 18:22 Age: 4.10 hours Illumination: 0.21% Altitude: 0.47° Elongation: 5°11´26.4´´ (Negative observation) on Saturday, 3/26/1183 Sunset: 18:19 Moonset: 7:30 p.m. Age: 28.11 hours Illumination: 2.08% Altitude: 13°43´40.4´´ Elongation:

				16°30′22.4′′ (Positive observation)

B. The Moon Condition of the Sighted Crescent Testimony for Year 579 AH (1183 AD/1184 AD)

Starting the year 579 AH, in the month of Muharam, ibn Jubayr was in Cairo. Then, he traveled to Mecca in the month of Jumada Thani. The following table contains data on the Moon condition for 12 months during the year.

Tabel 3
Moon Conditions of the Sighted Crescent Testimony During 579 AH (1183 AD/1184 AD)

No	Month of Hijri	Time of the Sighted Crescent Testimony	Location (Coordinate)	Moon-Sun Data at the Beginning of Hijri Lunar Month
1	Muharram	Monday night/ April 26	Egypt Cairo (30.03° N 31.15° E)	Conjunction: Saturday, 4/23/1183, at 11:16 p.m. Rukyat Day: on Sunday, 4/24/1183 Sunset: 18:31 Moonset: 19:14 Age: 19.26 hours Illumination: 0.88% Altitude: 7.92° Elongation: 10°42′36.6′′ (Negative observation) on Monday, 4/25/1183 Sunset: 18:32 Moonset: 20:19 Age: 43.27 hours Illumination: 4.08% Altitude: 20°31′40.7′′ Elongation: 23°15′23.6′′ (Positive observation)

2	Safar	Tuesday night/ May 25	Egypt Qous City (30.03° N 31.15° E)	Conjunction: Monday, 5/23/1183 at 9:19 a.m. Rukyat Day: on Monday, 5/23/1183 Sunset: 18:50 Moonset: 19:06 Age: 9.51 hours Illumination: 0.18% Altitude: 2.63° Elongation: 4°51´57.6´´ (Negative observation) on Tuesday, 5/24/1183 Sunset: 18:51 Moonset: 20:07 Age: 33.52 hours Illumination: 2.21% Altitude: 14°1´20.2´´ Elongation: 4°51´ 57.6´´ (Positive observation)
3	Rabi' I	Thursday night/ June 24	Aidzab (22.33° N 36.48 ° E)	Conjunction: Tuesday, 6/6/1183, 9:00 p.m. Rukyat Day: on Wednesday, 6/22/1183 Sunset: 18:21 Moonset: 19:06 Age: 21.35 hours Illumination: 0.86% Altitude: 8.53° Elongation: 10°34´45.5´´ (Negative observation) on Thursday, 6/23/1183 Sunset: 18:21 Moonset: 19:55 Age: 45.35 hours Illumination: 3.66% Altitude: 18.93° Elongation: 21°57´10.1´´ (Positive observation)
4	Rabi' II	Friday night/ July 23	Jeddah (21.30° N 39.10° E)	Conjunction: Thursday, 7/21/1183, 11:34 Rukyat Day: on Thursday, 7/21/1183

				Sunset: 19:05 Moonset: 19:24 Age: 7.53 hours Illumination: 0.21% Altitude: 3.57° Elongation: 5°14′52.6′′ (Negative observation) on Friday, 7/22/1183 Sunset: 19:04 Moonset: 20:05 Age: 31.52 hours Illumination: 1.77% Altitude: 12°34′59.1′′ Elongation: 15°14′1.5′′ (Positive observation)
5	Jumada I	Sunday night/ August 22	Mecca (21.43° N 39.83° E)	Conjunction: Saturday, 8/20/1183, at 2:54 a.m. Rukyat Day: on Saturday, 8/20/1183 Sunset: 18:41 Moonset: 19:14 Age: 15.79 hours Illumination: 0.58% Altitude: 6.8° Elongation: 8°41′52.6′′ (Negative observation) on Sunday, 8/21/1183 Sunset: 18:40 Moonset: 19:47 Age: 39.77 hours Illumination: 2.65% Altitude: 14°29′59.1′′ Elongation: 18°39′1.5′′ (Positive observation)
6	Jumada II	Tuesday night/ September 21	Mecca (21.43° N 39.83° E)	Conjunction: Sunday, 9/18/1183, at 7:40 p.m. Rukyat Day: on Monday, 9/19/1183 Sunset: 18:13 Moonset: 18:53 Age: 22.55 hours Illumination: 0.94% Altitude: 8.28°

				Elongation: 11°4′39.9′′ (Negative Observation) on Tuesday, 9/20/1183 Sunset: 18:12 Moonset: 19:25 Age: 46.54 hours Illumination: 3.51% Altitude: 15°21′59.1′′ Elongation: 21°29′58.5′′ (Positive observation)
7	Rajab	Wednesday night/ October 20	Mecca (21.43° N 39.83° E)	Conjunction: Tuesday, 10/18/1183, at 1:09 p.m. Rukyat Day: on Tuesday, 10/18/1183 Sunset: 17:47 Moonset: 5:59 p.m. Age: 4.63 hours Illumination: 0.11% Altitude: 1.97° Elongation: 3°41′16.7′′ (Negative observation) on Wednesday, 10/19/1183 Sunset: 17:46 Moonset: 18:35 Age: 28.62 hours Illumination: 1.40% Altitude: 9°21′59.9′′ Elongation: 13°30′53′′ (Positive observation)
8	Sha'ban	Friday night (supposed to be Sunday night)/ November 19	Mecca (21.43° N 39.83° E)	Conjunction: Saturday, 11/17/1183, 6:19 a.m. Rukyat Day: on Saturday, 11/17/1183 Sunset: 17:34 Moonset: 17:54 Age: 11.26 hours Illumination: 0.23% Altitude: 3.06° Elongation: 5°28′9.4′′ (Negative observation) on Sunday, 11/18/1183

				Sunset: 17:34 Moonset: 18:41 Age: 35.26 hours Illumination: 2.32% Altitude: 11°59′42.5′′ Elongation: 17°25′10.6′′ (Positive observation)
9	Ramadan	Sunday night/ December 19	Mecca (21.43° N 39.83° E)	Conjunction: Friday, 12/16/1183, 9:57 p.m. Rukyat Day: on Saturday, 12/17/1183 Sunset: 17:42 Moonset: 18:23 Age: 19.74 hours Illumination: 0.88% Altitude: 6.91° Elongation: 10°43′1.7′′ (Negative observation) on Sunday, 12/18/1183 Sunset: 17:42 Moonset: 19:25 Age: 43.75 hours Illumination: 4.17% Altitude: 18°17′1.3′′ Elongation: 23°27′57.0′′ (Positive observation)
10	Shawwal	Monday night/ January 16	Mecca (21.43° N 39.83° E)	Conjunction: Sunday, 1/15/1184, 11:19 Rukyat Day: on Sunday, 1/15/1184 Sunset: 18:01 Moonset: 18:12 Age: 6.70 hours Illumination: 0.25% Altitude: 1.69 ° Elongation: 5°40′22.8′′ (Negative observation)on on Monday, 1/16/1184 Sunset: 18:01 Moonset: 19:18 Age: 30.71 hours Illumination: 2.44% Altitude: 14°41′28.0′′

				Elongation: 17°52′31.7′′ (Positive observation)
11	Dhu al-Qa'dah	Tuesday night/ February 14	Mecca (21.43° N 39.83° E)	Conjunction: Monday, 2/13/1184 at 10:19 p.m. Rukyat Day: on Tuesday, 2/14/1184 Sunset: 18:18 Moonset: 19:09 Age: 19.99 hours Illumination: 1.23% Altitude: 10.20 ° Elongation: 12°39′33.5′′ (Positive observation)
12	Dhu al-Hijjah	Wednesday night/ March 15	Mecca (21.43° N 39.83° E)	Conjunction: Wednesday, 3/14/1184 at 7:30 a.m. Rukyat Day: on Wednesday, 3/14/1184 Sunset: 18:29 Moonset: 18:56 Age: 10.99 hours Illumination: 0.46% Altitude: 5.20° Elongation: 7°41′13.0′′ (Positive observation)

C. The Moon Condition of the Sighted Crescent Testimony for Year 580 AH (1184 AD/1185 AD)

In 580 AH, Ibn Jubayr continued his journey until he arrived in Badar city in Muharram. At the end of 580 AH, Ibju Jubayr arrived in the city of Trapani, Sicillia. The following table contains data on the Moon condition for 12 months during the year.

Tabel 4
Moon Conditions of the Sighted Crescent
Testimony during 580 AH (1184 AD/1185 AD)

No	Month of Hijri	Time of the Sighted Crescent Testimony	Location (Coordinate)	Moon-Sun Data at the Beginning of Hijri Lunar Month
1	Muharram	Friday night/ April 14	Badr Saudi Arabia (23.78° N 28.78° E)	Conjunction: Thursday, 4/12/1184, at 3:38 p.m. Rukyat Day: on Thursday, 4/12/1184 Sunset: 18:46 Moonset: 6:49 Age: 3.13 hours Illumination: 0.07% Altitude: 0.26° Elongation: 3°5´33.9´´ (Negative Observation)on on Friday, 4/13/1184 Sunset: 18:46 Moonset: 19:56 Age: 27.14 hours Illumination: 1.94% Altitude: 13.98° Elongation: 15°56´0.7´´ (Positive Observation)
2	Safar	Sunday night/ May 14	Hillah Iraq (32.48° N 44.43° E)	Conjungtion: Friday, 5/11/1184, at 11:32 p.m. Rukyat Day: on Saturday, 5/12/1184 Sunset: 18:56 Moonset: 19:46 Age: 19.39 hours Illumination: 0.93% Altitude: 8.73° Elongation: 11°1´19.6´´ (Negative Observation) on Sunday, 5/13/1184

				Sunset: 18:56 Moonset: 20:56 Age: 43.40 hours Illumination: 4.53% Altitude: 21.51° Elongation: 24°28´20.4´´ (Positive Observation)
3	Rabi' I	Monday night/ June 12	Mosul Iraq (36.57° N 43.22° E)	Conjunction: Sunday, 6/10/1184 at 7:57 Rukyat day: on Sunday, 6/10/1184 Sunset: 19:28 Moonset: 20:01 Age: 11.52 hours Illumination: 0.36% Altitude: 5.05° Elongation: 6°49´56.9´´ (Negative observation) on Monday, 6/11/1184 Sunset: 19:29 Moonset: 21:01 Age: 35.53 hours Illumination: 2.88% Altitude: 15.23° Elongation: 19°27´8.5´´ (Positive observation)
4	Rabi' II	Tuesday night/ July 11	Damascus 33.30° N 36.29° E	Conjunction: Monday, 7/9/1184 at 4:39 p.m. Rukyat Day: on Monday, 7/9/1184 Sunset: 18:46 Moonset: 7:00 p.m. Age: 2.11 hours Illumination: 0.15% Altitude: 2.39° Elongation: 4°21´41.6´´ (Negative Observation) on Tuesday, 7/10/1184 Sunset: 18:45 Moonset: 19:46 Age: 26.10 hours Illumination: 1.53%

				Altitude: 10.95° Elongation: 14°8′57.0′′ (Positive Observation)
5	Jumada I	Thursday night/ August 10	Damascus 33.30° N 36.29° E	Conjunction: Wednesday, 8/8/1184 at 4:24 Rukyat Day: on Wednesday, 8/9/1184 Sunset: 18:22 Moonset: 18:57 Age: 13.98 hours Illumination: 0.54% Altitude: 6.33° Elongation: 4°21′41.6′′ (Negative Observation) on Thursday, 8/10/1184 Sunset: 18:45 Moonset: 19: 46 Age: 26.10 hours Illumination: 1.53% Altitude: 10.95° Elongation: 14°8′57.0′′ (Positive Observation)
6	Jumada II	Saturday night/ September 9	Damascus 33.30° N 36.29° E	Conjunction: Thursday, 9/6/1184 at 6:49 p.m. Rukyat Day: on Friday, 9/7/1184 Sunset: 17:44 Moonset: 18:22 Age: 22.91 hours Illumination: 0.97% Altitude: 7.10° Elongation: 11°15′21.0′′ (Negative Observation) on Saturday, 9/8/1184 Sunset: 17:43 Moonset: 18:43 Age: 46.89 hours Illumination: 3.59% Altitude: 12.18° Elongation: 21°45′9.7′′ (Positive Observation)

7	Rajab	Monday night/ October 9	Damascus 33.30° N 36.29° E	Conjunction: Saturday, 10/6/1184 at 12:01 Rukyat Day: on Saturday, 10/6/1184 Sunset: 17:04 Moonset: 17:16 Age: 5.06 hours Illumination: 0.09% Altitude: 1.6° Elongation: 3°20´15.8´´ (Negative Observation) on Monday, 10/8/1184 Sunset: 17:02 Moonset: 18:10 Age: 53.02 hours Illumination: 4.29% Altitude: 11.43° Elongation: 23°48´15.8´´ (Positive Observation)
8	Sha'ban	Wednesday night/ November 8	Damascus 33.30° N 36.29° E	The month of Rajab was fulfilled, because it was cloudy Conjunction: Monday, 11/5/1184 at 7:03 a.m. Rukyat Day: on Monday, 11/5/1184 Sunset: 16:34 Moonset: 16:43 Age: 9.50 hours Illumination: 0.14% Altitude: 0.87° Elongation: 4°15´36.8´´ (Negative Observation) on Tuesday, 11/6/1184 Sunset: 16:33 Moonset: 17:18 Age: 33.49 hours Illumination: 1.77% Altitude: 6.6° Elongation: 15°11´46.8´´

				(Negative Observation)
9	Ramadan	Thursday night/ December 7th	Calabria Sicillia 38.92° N 16.6° E	Conjunction: Wednesday, 12/5/1184 at 1:09 a.m. Rukyat Day: on Wednesday, 12/5/1184 Sunset: 16:28 Moonset: 16:40 Age: 15.32 hours Illumination: 0.47% Altitude: 0.95° Elongation: 7°48′27.5′′ (Negative Observation) on Thursday, 12/6/1184 Sunset: 16:28 Moonset: 17:32 Age: 39.32 hours Illumination: 2.73% Altitude: 7.75° Elongation: 18°56′43.0′′ (Positive Observation)
10	Shawwal	Friday night/ January 5	Trapani Sicillia 38.01° N 12.51° E	Conjunction: Thursday, 1/3/1185 at 6:27 p.m. Rukyat Day: on Friday, 1/4/1185 Sunset: 17:09 Moonset: 5:49 Age: 22.70 hours Illumination: 1.16% Altitude: 5.34° Elongation: 12°16′19.1′′ (Positive Observation)
11	Dhu al-Qa'dah	Sunday night/ February 4	Trapani Sicillia 38.01° N 12.51° E	Conjunction: Saturday, 2/2/1185 at 9:01 Rukyat Day: on Saturday, 2/2/1185 Sunset: 17:40 Moonset: 17:51 Age: 8.66 hours Illumination: 0.55%

				Altitude: 1.28° Elongation: 6° 41´32.2´´ (Negative Observation) on Sunday, 2/3/1185 Sunset: 17:41 Moonset: 19:02 Age: 32.68 hours Illumination: 2.47% Altitude: 13.18° Elongation: 17°59´8.4´´ (Positive Observation)
12	Dhu al-Hijjah	Tuesday night/ March 6. Corrected to be Monday night/ March 5, because on the third day, the crescent already looked big	Trapani Sicillia 38.01° N 12.51° E	Dhu al-Qa'dah was fulfilled because of the cloud Conjunction: Sunday, 3/3/1185 at 8:52 p.m. Rukyat Day: on Monday, 3/4/1185 Sunset: 18:11 Moonset: 19:04 Age: 21.32 hours Illumination: 1.17% Altitude: 9.27° Elongation: 12°21´54.3´´ (Negative Observation) on Tuesday, 3/5/1185 Sunset: 18:12 Moonset: 20:17 Age: 45.34 hours Illumination: 4.96% Altitude: 22.68° Elongation: 25°38´11.4´´ (Negative Observation)

D. The Moon Condition of the Sighted Crescent Testimony for Year 581 AH (1185 AD)

Entering Muharram 581 AH, Ibn Jubayr was in Sardinia to continue his journey back to Andalusia. The following table shows the data on the condition of the Moon at the beginning of the month of Muharram 581 AH.

Tabel 5
Moon Conditions of the Sighted Crescent Testimony for Muharram 581 AH

No	Month of Hijri	Time of the Sighted Crescent Testimony	Location (Coordinate)	Moon-Sun Data at the Beginning of Hijri Lunar Month
1	Muharam	Wednesday night/ April 4	Sardinia 40.00° N 9.00° E	Dhu al-Hijjah was fulfilled because it was cloudy Conjunction: Tuesday, 4/2/1185 at 6:30 Rukyat Day: on Tuesday, 4/2/1185 Sunset: 18:55 Moonset: 19:26 Age: 12.43 hours Illumination: 0.41% Altitude: 4.92° Elongation: 7°18′40.2′′ (Negative observation)

E. The Sighted Crescent Testimony in The Book of Ibn Jubayr: A Refiew from Fiqh Perspective and The Crescent Visibility Theory

1. Fiqh Perspective

Fiqh perspective is a review on the crescent sighting report validity based on the normative conditions, whether a sighted crescent testimony is acceptable or not. The number of days in one month is not less than 29 days or not more than 30 days. The Prophet said:

حَدَّثَنَا أَبُو بَكْرِ بْنُ أَبِى شَيْبَةَ حَدَّثَنَا أَبُو أُسَامَةَ حَدَّثَنَا عُبَيْدُ اللَّهِ عَنْ نَافِعٍ عَنِ ابْنِ عُمَرَ رضى الله عنهما أَنَّ رَسُولَ اللَّهِ -ﷺ- ذَكَرَ رَمَضَانَ فَضَرَبَ بِيَدَيْهِ فَقَالَ «الشَّهْرُ هَكَذَا وَهَكَذَا وَهَكَذَا - ثُمَّ عَقَدَ إِبْهَامَهُ فِى الثَّالِثَةِ - فَصُومُوا لِرُؤْيَتِهِ وَأَفْطِرُوا لِرُؤْيَتِهِ فَإِنْ أُغْمِىَ عَلَيْكُمْ فَاقْدِرُوا لَهُ ثَلاَثِينَ»[46]

"Abu Bakr ibn Abi Shaybah told us, Abu Usama Obeidullah told us, from Nafi, from Ibn Omar, may Allah be pleased with them, that the Messenger of Allah (peace be upon him) said about Ramadan and he hit his hands and said: "month is so and so and so (and then he held his thumb in the third), do fasting for see it (the crescent) and broke fasting for see it (the crescent). If it (the crescent) is clouded over you, set it to 30 days".

The Prophet's tradition above has explained normatively, that the number of days in one month is not more than 30 days and not less than 29 days. The following table contains the number of days from 27 months from year 579 AH till 581 AH in the book of ibn Jubayr.

Tabel 6
The Number of Days for 27 Months of 578 AH - 580 AH in the Book of ibn Jubayr

No	Year	Lunar Month	Beginning of the month	Number of days
1	578	Shawwal	27/1/1183	30
2	578	Dhu al-Qa'dah	26/2/1183	29
3	578	Dhu al-Hijjah	27/3/1183	30

46 *Hadis*, Muslim Ibn al-Hajjaj, *Sahih Muslim*, Kairo, Dar Ihya al-Kutub al-Araiyah, 1374 H, Juz 7, p. 33.

4	579	Muharram	26/4/1183	29
5	579	Safar	25/5/1183	30
6	579	Rabi' I	24/6/1183	29
7	579	Rabi' II	23/7/1183	30
8	579	Jumada I	22/8/1183	30
9	579	Jumada II	21/9/1183	29
10	579	Rajab	20/10/1183	30
11	579	Sha'ban	19/11/1183	30
12	579	Ramadan	19/12/1183	28
13	579	Shawwal	16/1/1184	29
14	579	Dhu al-Qa'dah	14/2/1184	29
15	579	Dhu al-Hijjah	15/3/1184	30
16	580	Muharram	14/4/1184	30
17	580	Safar	14/5/1184	29
18	580	Rabi' I	12/6/1184	29
19	580	Rabi' II	11/7/1184	30
20	580	Jumada I	10/8/1184	30
21	580	Jumada II	9/9/1184	30
22	580	Rajab	9/10/1184	30
23	580	Sha'ban	8/11/1184	29
24	580	Ramadan	7/12/1184	29
25	580	Shawwal	5/1/1885	30
26	580	Dhu al-Qa'dah	4/2/1185	29
27	580	Dhu al-Hijjah	5/3/1185	30

From a Fiqh perspective, 27 times in the determination of the beginning of the lunar month reported by ibn Jubayr, there is 1 determination that was not in accordance with the above provisions, namely the determination of the beginning of Ramadan 579 AH. That is because the number of days of Ramadan 579 AH is only 28 days. The cause of Ramadan 579 AH amounted to 28 days is a typical error in determining the beginning of the lunar month with normative crescent sighting.

The typical error above can be understood through the following illustration. When on the night of Sha'ban 30th, the crescent was very possible to be sighted by naked eye, but it was unsuccessful due to the cloudiness, so the month of Sha'ban was fulfilled to 30 days. Meanwhile, the condition of the new moon on the 29th night of Ramadan can be seen clearly, so the next day comes on the 1st of Shawwal (if the Ramadan crescent is seen on the night of 30th Sha'ban, then actually the 29th night of Ramadan is the 30th night of Ramadan). If so, then the age of Ramadan must be 28 days. This thing happened at the time of Ali ibn Abi Talib, and it also happened in Saudi Arabia. That is all because of the weakness of the use of purely normative rukyat in determining the fasting of Ramadan and Eid al-Fitr.

It is interesting, that the existence of the age of the lunar month, amounting to 30 days repeated 4 times in a row. This may occur considering the sighting was done normatively without regard to the theories of crescent visibility. Even so, there was no any gain from the perspective of Fiqh for ibn Jubayr's sighting report in his Rihlah in general.

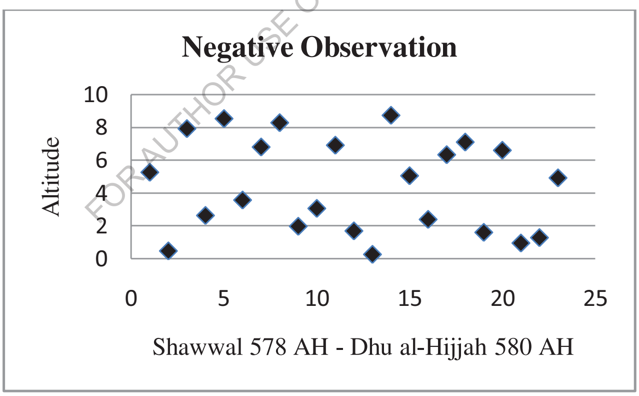
2. **Astronomical perspective**

This discussion of the sighted crescent testimony in this section can be divided into three categories, namely a) the negative observastion, b) the positive observation, and c) the crescent sighting on 1 day after conjunction.

a. The Negative Observation

The negative observation is a failed observation of sighting the crescent on the observation day. Astronomically, the observation day is the time that observation should take place, which is the day of the conjunction of the Moon and the Sun. Based on data on the condition of the Moon and the Sun in the previous section it can be said that the number of negative observations was very large. The following picture shows the distribution of negative observations in the book of ibn Jubayr.

Figure 3
Scatter Plots for theh Negative
Observation form 578 AH - 580 AH



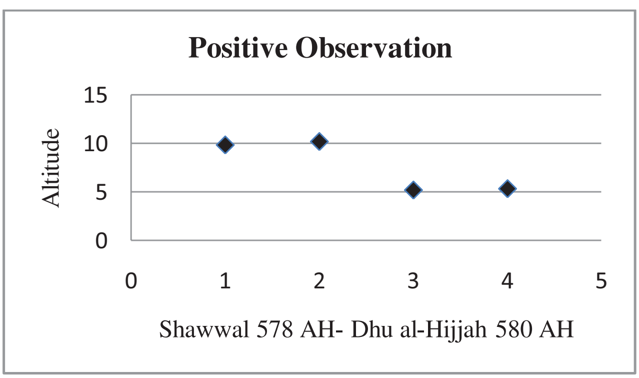
From the picture above, it can be said that there were 23 negative observations. There were 7 observations from 23 negative observations that were not in accordance with any theory of visibility, even MABIMS visibility theory where the altitude requirements for crescent are at least 2°. The remaining 16 negative observations had exceeded the MABIMS criteria. Even quite a few crescents with altitudes above 6° to 9° were included in the negative observation testimony, which reached 9 testimonies.

Based on the above data, it can be concluded that the visibility of crescent with the naked eye as practiced in the ibn Jubayr era in the 6th century AH showed that the crescent with an altitude of 9° is not necessarily observed.

b. **The Positive Observation**

The positive observation is observation that succeeds in sighting the crescent on the day of conjunction. Based on the data in the previous sub-chapter, it was known that positive observations only occured in four months, namely Shawwal 578 AH, Dhu al-Qa'dah and Dhu al-Hijjah 579 AH, and Shawwal 580 AH. The following picture shows the distribution of positive observastion.

Gambar 4
Scatter Plots for the Positive Observation
form 578 AH – 580 H



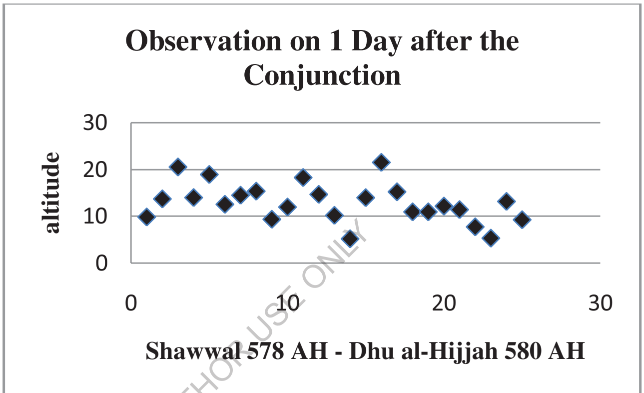
The picture above shows that the minimum altitude of the crescent in the testimony of positive observation in ibn Jubayr's report was 5°. Thus, it can be said that the crescent with an altitude of less than 5° had never been reported could be sighted. The negative observation data in Figure 3 shows that there were 11 crescents with altitude more than 5° reported could not be sighted.

Based on the above facts, it can be said that the altitude of a crescent to be sighted in ibn Jubayr's report was at least 5°. This certainly becomes the basis for reviewing the visibility theory of MABIMS which determines the minimum limit altitude of the crescent to be sighted is 2°. Astronomically, this parameter is indeed worth reviewing, considering that thousands of observations with the naked eye had never mentioned the existence of crescent with altitude of at least 2°. It seems that the minimum 2° altitude was based on claims of normative observations that have existed in Indonesia, and they were accepted as one of the data for theorization of crescent visibility in Indonesia.

c. **The Observation on 1 Day after Conjunction**

From ibn Jubayr's testimony reports in the previous sub-chapter, it can be said that most positive observations were for the high-altitude crescents. This is because the observation was carried out on 1 day after the conjunction had occured. The figure 5 below shows the positive observation data on 1 day after the conjunction.

Figure 5
The Scatter Plot for the Positive Observation on 1 Day after the Conjunction Occurred from 578 AH - 580 AH



The picture above shows that there were 21 positive observations on 1 day after conjunction occurred. The crescent condition on positive observation as shown in the figure 5 above shows that negative observations often occur on astronomically recommended observation days, namely the day of conjunction. There were 21 lunar months that were determined based on positive observations on 1 day after the conjunction had occurred from 27 lunar months reported by Ibn Jubayr.

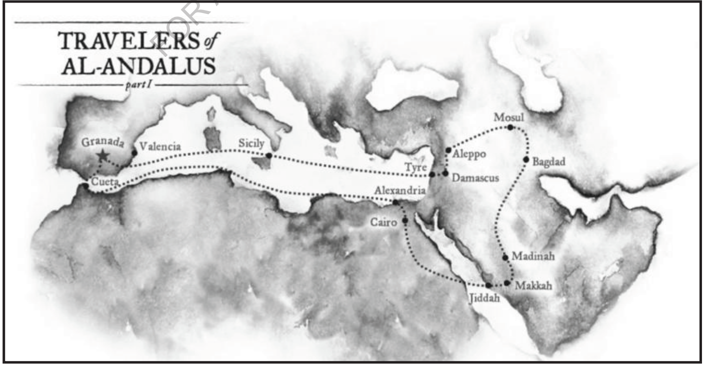
Astronomically, based on the number of such observations, it can be concluded that the crescent observation practiced in that era, as Ibn

Jubayr's travel report is the practice of normative observation. The practice of observation was not guided by the scientific theory of crescent visibility. When the crescent observation for the determination of the beginning of the lunar month failed (negative), then the previous lunar month will be fulfilled. The problem that arises later is that the 29th of a lunar month is essentially the 1st day of the next lunar month.

d. **Ibn Jubayr's Journey on The Map**

The following picture shows the cities and places that Ibn Jubayr traveled through on his journey from Andalusia to Mecca and returned to Andalusia in 3 years from 578 AH to 581 AH.

Figure 6
Road Map of Rihlah ibn Jubayr from
578 AH to 581 AH[47]



47 https://www.aramcoworld.com/en-US/Articles/October-2016/Travelers-of-Al-Andalus-The-Travel-Writer-Ibn-Jubayr

BAB V CLOSING REMARKS

From the discussion in the previous chapter, it can be concluded:

1. There were four categories of sighted crescent testimonies on the observation report in the book ar-Riḥlah by ibn Jubayr al-Andalūsy in the light of astronomical perspective, i.e:
   a. Most of the sighted crescent testimonies were of the crescents that their altitude was above the modern criteria of the crescent visibility theory, but they had not been sighted by naked eye.
   b. The least minimum altitude of the sighted crescent testimony by naked eye was 5°.
   c. Most of the sighted crescent testimonies were of the crescents that sighted by naked eye on 1 day after the day of conjunction.
2. In the astronomical perspective, the sighted crescent testimonies reported by ibn Jubayr in his Rihlah was a normative observation practice, in which the theory of crescent visibility was not used as an observation guideline. This is because at that time, the theory of crescent visibility had not yet developed. Meanwhile, in Fiqh perspective, the sighted crescent testimonies in the report of ibn Jubayr generally had met with minimum normative standards.

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