



Geneology of Astronomy Science In Java



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Abstract

This research will trace the process of transmission of falak science in Java from its inception to its current development: the geneology and the process of transmitting astronomy and developed pattern in Java. This research is a qualitative descriptive study with a historical approach. The steps taken are collecting data from the object under study (heuristic), verifying or criticizing the source, and making conclusions and interpreting existing authentic data. The analytical method used is descriptive analysis. The results showed that at the beginning of its development, the science of astronomy was studied and developed by Syekh Abdurrahman bin Aḥmad al-Miṣrī al-Batawī who was then taught to Habib Uṣmān al-Batawī, Syekh Abdul Ḥamīd al-Dumairī al-Batawī, and KH. Ahmad Dahlan al-Samāranī. From here the science of astronomy developed and gave birth to a number of works including Taḏkirah al-Ikhwān, and Bulūgh al-Waṭār. The development of astronomy is then carried out through educational institutions both formal and informal. For formal education through tertiary institutions and informal through Islamic boarding schools.

Keywords: *Astronomy, Geneology, Transmission, Development.*

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Abstrak

Penelitian ini menelusuri proses transmisi keilmuan falak di Jawa dari awal hingga perkembangannya saat ini: yaitu geneology dan proses penyebaran serta perkembangannya di Jawa. Penelitian ini merupakan penelitian deskriptif kualitatif



dengan pendekatan historis. Langkah yang dilakukan adalah mengumpulkan data dari obyek yang diteliti (*heuristic*), melakukan verifikasi atau kritik sumber, dan melakukan kesimpulan serta interpretasi atas data autentik yang ada. Metode analisis yang digunakan adalah deskriptif analisis. Hasil penelitian menunjukkan bahwa pada awal perkembangannya, ilmu falak dipelajari dan dikembangkan Syekh Abdurrahman bin Ahmad al-Misri al-Batawi yang kemudian diajarkan Habib Usmān al-Batawi, Syekh Abdul Hamid al-Dumairi al-Batawi, dan KH. Ahmad Dahlan al-Samāranī. Dari sini ilmu falak berkembang dan melahirkan sejumlah karya di antaranya Kitab Tazkirah al-Ikhwan, dan Bulugh al-Watār. Perkembangan ilmu falak selanjutnya dilakukan melalui lembaga pendidikan baik formal maupun informal. Untuk pendidikan formal melalui perguruan tinggi dan informal melalui pondok pesantren dan komunitas/lembaga kajian ilmu falak.

Kata Kunci: Astronomy, Geneologi, Penyebaran. Perkembangan.

A. INTRODUCTION

The history of the development of astronomy in the archipelago is interesting to be examined and studied in more depth. Especially in Java, scientific study of astronomy is inseparable from the network of Indonesian ulama and Haramain. Along with the return of young scholars to Nusantara of Mecca in the early 20th century AD, astronomy increasingly growing in the country. They not only brought scientific notes on tafsir, hadith, fiqh, tauhid, and Sufism, but also the science of astronomy that they got from Mecca (Khazin, 2004, p. 30). According Azyumardi Azra, the scholars *Jawi* derived from the Malay-Indonesian acquire knowledge of scholars cosmopolitan centered in Mecca and Medina, played a decisive role in the spread of ideas. They carried out scientific transmissions in the archipelago which influenced historical travel in the country (Azra, 1995, p. 79).

A number of studies on the history of astronomy have been carried out. Among them are: First, Arwin Juli Rakhmadi Butar-Butar (2019) explains in this article that the form of a global explanation of the history of astronomy in a long span and only reaches the archaeological figures of the archipelago in the early days. Second, Jayusman (2017) wrote an article that from the beginning the Arab community had been interested in observing and studying the circulation of celestial bodies. Third, Alimuddin (2016) explain an his article that the Arabian Islamic civilization (Islam) emerged and was born, in addition to other civilizations. Indian civilization was the strongest in its influence on Islam (Arabic). Fourth, Susiknan Azhari (2008) wrote an article entitled “*The Development of Islamic Astronomy Studies in Malay Realm*”. Although this paper reveals the history of astronomy in the archipelago to the contemporary era, it is only a glimpse to capture the position of astronomy in the archipelago related to developments in Malay, especially in Malaysia.

A number of studies by the experts above, no one has specifically written about the scientific genealogy of astronomy in Java, up to its applicable development in one complete writing. Discussions on the history of the development of astronomy always depart from the early days of Islamic civilization even before Islam to the contemporary era in general. At first the Nusantara’s scholars doing pilgrimage and then continued studying at Haramain (Mecca and Medina). Although the Nusantara’s scholars that

explore the science of the Middle East is quite a lot, but only some of them are pleasing deepen or at least learn and has a work in the field of astronomy, both in the aspects of practical and theoretical (Butar-Butar, 2017, p. 187). This is where writings on the geneology of astronomy in Java find its vital elan in a more specific context of study. Based on the description above, this study wishes to examine two things, namely: First, the geneology of astronomy in Java; second, the process of transmitting astronomy and developed pattern in Java. It is expected that this study can probe further roots of scientific astronomy developed in Java and also can determine the transmission process and the development patern.

Research which aims to solve the above problems is a qualitative descriptive study. Therefore, the data presentation and analysis do not use quantitative figures. Qualitative research is a research process that aims to collect, describe, and analyze descriptive data in the form of: writings, expressions and observed human behavior. Qualitative research has several unique characteristics, namely an emphasis on the naturalistics setting, inductive, flexible, direct experience, indepth, process, grasping meaning, wholeness, active participation from participants and interpretation. The approach used in this research is a historical approach.

B. DISCUSSION

1. Genealogy Scientific Falak in Java

The history of astronomy in Java started of arrival scholar astronomy Betawi, namely Syekh Abdurrahman al-Misri (d. 1847) who came to the land of Java, in 1773, on his return to learn of Mecca along with Syekh Muhammad Arsyad Al-Banjari, Syekh Abdul Wahab Al-Bugisi, and Syekh Abdus Shomad al-Falimbani. Their journey from Mecca via Singapore then transit in Betawi. Syekh Abdurrahman bin Aḥmad al-Miṣrī al-Batawī stayed in Betawi while the other scholars returned to their hometowns (Pramasto & Firnando, 2020). He was the son-in-law of Syekh Junaid al-Batawī (d. 1840) and was the grandfather of Sayid Uṣmān (mufti Batawī). It was from al-Miṣrī that Sayid Uṣmān (d. 1914) then developed the science of astronomy because since he was 3 years old Sayid Uṣmān was raised by al-Miṣrī until Sayid Usman was 18 years old. At that time, Sayyid Uṣmān studied directly with al-Miṣrī.

Sayyid Uṣmān then continued to study in Mecca and studied from Syekh Zaini Daḥlān, the mufti of Mecca. Then he carried out scientific rihlah to various countries (Rahmah, 2018, p. 207). After returning to Batawī (1862), Sayyid Uṣmān was active in preaching and became an advisor to the Dutch Government in Batavia. He later wrote a book *Iqāz al-Niyām biḥī Māyata'allaqu al-Ahillah wa al-Siyām* printed in 1321 AH/1903 AD (Noupal, 2012, p. 1374). According to Muhyiddin Khazin (2004, p. 31), this book is not included in the book of astronomy, but only related to astronomy because it contains several legal discussions on fasting, reckoning, and rukyat. The science of astronomy that he teaches is the calculation of conjungtion with the Batavia or Jakarta epoch. Among the traces of Sayyid Uṣmān's falak expertise is the establishment of a center for the study of astronomi and rukyatul hilal at the Al-Musyari`in Tower, Basmol, West Jakarta, which was then continued by one of his students, Syekh Madjid, one of the six Betawi leading scholars.

The Sayyid Uṣmān, in addition, a student of al-Miṣrī was Syekh Abdul Ḥamīd al-Dumairi al-Batawī who then teaches astronomy to own son namely Syekh Muhammad Mansūr bin Abdul Ḥamīd al-Dumairi al-Batawī or more known as Syekh Mansūr

Jembatan Lima (d. 1967). As well as his father, Syekh Mansūr also studied astronomy from Syekh Mukhtār at-Ṭarīd and Syekh Muḥtaba. Syekh Mansūr later wrote the book *Sullam al-Nayyirain* (published in 1925) which is then taught to his disciples. Among them are KH. Mohammad Muhadjrin Amsar al-Dary, founder of Lajnah Falakiyah, Cakung, East Jakarta. In addition, the book *Sullam an-Nayyiraian* was studied by students of astronomi and became a reference in a number of Islamic boarding school.

In 1901, a scholar of astronomy published a book entitled *Tazkirah al-Ikhwān fī Ba'di Tawārikh wa al-'Amāl li al-Falākiyah bi Samāranī*. The author of this book is Syekh Ahmad Dahlan al-Samāranī at-Tirmīsī (d.1911). Besides the book, in 1903, Syekh Ahmad Dahlan also wrote the books of *Natījah al-Miqāt* and *Bulūgh al-Waṭār*. Scientific geneology Syekh Ahmad Dahlan came from his teacher that Syekh Sholeh Darat. Syekh Ahmad Dahlan developed astronomy in Semarang with his teacher and father-in-law. Besides studying with Syekh Sholeh Darat, Syekh Ahmad Dahlan also studied astronomy from al-Miṣrī. At a time when studying in Cairo, Syekh Ahmad Dahlan also met two great Nusantara's Scholars Syekh Jamil Djambek and Syekh Ṭahir Jalaluddin Ahmad Al-Azharī and specifically examine book of *al-Maṭlā' al-Sa'id fī Hisāb al-Kawākib alā al-Rasyd al-Jadīd*, a master book of astronomy written by Syekh Husein Zaid al-Miṣrī from the early 19th century. *Al-Maṭlā' as-Sa'id* book carred by Syekh Ṭahir al-Azharī Djalaluddin. This is based on information from Syekh Ahmad Dahlan bin Abdullah al-Samāranī at-Tirmīsī (d. 1911). In his *Bulūgh al-Waṭār*, he said that naturally came from Syekh Jamil Djambek and Syekh Ṭahir Djamaluddin who studied directly from Syekh Husein Zaid Al-Miṣrī (Butar-Butar, 2017, p. 5).

The book *Tazkirat* (completed in 1901) contains the calculation of conjunction and a solar eclipse with the mabda' of Semarang city. The book *Natījat* contain the use rubū' mujayyab (traditional calculating tool designed to the shape of a quarter circle to forming right angle) in the initial determination prayer time and Qibla direction. This book summarizes the thought of her teachers, such as Syekh Abdurrahman bin Aḥmad al-Miṣrī, Syekh Muḥammad bin Yusūf al-Makkī, to KH. Saleh Darat in Semarang Centra Java. In 1930 this book in give commentary or commented by Syekh Ihsan Jampes Kediri (d. 1952) in his book *Taṣrīḥ al-Ibārat*. Meanwhile, the book *Tazkirat* contains the calculation of conjunction and eclipse with mabda' (calculation basis) of Semarang city, using the hakiki takribi method. Among them are KH. Abdul Jalil Hamid Kudus (d. 1974) in his book, *Fath al-Ra'ūf al-Mannān*; KH. Mohammad Wardan, a cleric expert on the Muhammadiyah organization in his book, *Hisab Haqiqi*; and KH. Yunus Abdulloh Kediri, author of the book *Risālat al-Qamarain*.

In 1930, published the book *Badi'ah al-Miṣāl fī-Hisāb al-Sinin wa al-Ḥilāl*. This book was written by KH. Muhammad Maksum bin Ali Al-Maskumambangi al-Jawi (d. 1933), founder of the Seblak Islamic Boarding School Jombang. By using the epoch Jombang, data used astronomical book *Badi'ah al-Miṣāl* same as the data used in the book of *al-Maṭlā'*. This book has used the spherical triangle formula, although the solution used the Rubu' Mujayyab. This book uses the hakiki tahqiqi system (Khazin, 2004, p. 33). Beside the book *Badi'ah*, KH. Maksum Ali also wrote the book *Durūs al-Falākiyah*. KH. Maksum Ali then developed at the Seblak Islamic Boarding School Jombang and was continued by KH. Mahfudz Anwar. Even now, Ma'had Aly has been founded, who studies astronomy in depth. The book *Durūs* is also one of the curricula in the Buntet Islamic Boarding School Cirebon. Even the Islamic University of Malang made this book a mandatory teaching material in astronomy.

Syekh Zubair Umar al-Jailani, in 1354 AH/1935 AD, wrote the book *al-Khulāṣah al-Wafiyah fī al-Falak Bi jāwī al-Gharitmiyyah*. Syekh Zubair Umar al-Jailani carried out scientific rihlah to Mecca and Cairo. So that it was not an exaggeration if his thoughts in his book were the result of an embodiment of Egyptian (Middle Eastern) rukyah reckoning, including from the book *al-Maṭla' al-Sa'īd fī Ḥisāb al-Kawākib alā Rasydī al-Jadīd* by Ḥusain Zaid al-Miṣra and the book *al-Manāḥij al-Ḥamīdiyyah* by Abdul Hamid Mursī Ghais al-Falākī al-Syāfi'ī (Izzuddin, 2003, p. 183).

In the next stage, the books of astronomy by ulama in Java, apart from making *al-Maṭla' al-Sa'īd* and *al-Manāḥij al-Ḥamīdiyyah* as their main references, also refer to the work of Indonesian scholars before them. Among the works produced is the *Almanac Menara Kudus* by KH. Turaichan Adjhuri (d. 1999), *Nūr al-Anwār* by KH. Noor Ahmad SS from Jepara, Central Java (d. 2012), *al-Maksūf* by Kyai Ahmad Soleh Mahmud Jauhari from Cirebon, and *Ittifāq Żāt al-Bain* by KH. Muhammad Zubair Abdul Karim from Gresik East Java (Jayusman, 2017, p. 58). In additional, there is also the Book of *Faṭḥ ar-Rauf al-Mannān li 'Amāli al-Kusūf bi Zaij al-Daḥlān* written by Syekh Abdul Jalil bin Abdul Hamid from Kudus (Butar-Butar, 2019, p. 136).

The development of astronomy cannot be separated from the role of Saadoe'ddin Djambek (d. 1977). He is a teacher and expert in BHR (Badan Hisab Rukyat), the son of the great scholar Syekh Muhammad Djamil Djambek (d. 1277) from Minangkabau. He gave a lecture on Falak science as a non-permanent lecturer at the Syari'ah Faculty of IAIN Sunan Kalijaga Yogyakarta (1959-1961). As an expert in Falak science, he wrote extensively on the science of Hisab. Among his works are: (1) *Waktu dan Djadwal Penjelasan Populer Mengenai Perjalanan Bumi, Bulan dan Matahari* (published in 1952), (2) *Almanak Djamiliyah* (published in 1953), (3) *Perbandingan Tarich* (published in 1968), (4) *Pedoman Waktu Sholat Sepanjang Masa* (published in 1974), (5) *Sholat dan Puasa di Daerah Kutub* (published in 1974), and (6) *Hisab Awal bulan Qamariyah* (published in 1976). The book *Hisab Awal Bulan Qamariyah* by Saadoe'din Djambek contains a method of calculating the beginning of the month using Nautical Almanac data. The calculation uses spherical triangles measuring formulas that are resolved using a logarithmic list (Khazin, 2004, 38). Sa'adoeddin Djambek's scientific network was continued by his students. Among his students were Abdul Rachim and A. Mustadjib. Abdul Rachim's works include *Ilmu Falak* which was printed in 1983 and *Perhitungan Awal Bulan dan Gerhana Matahari sistem Newcomb*.

Then came the astronomer who wrote a book entitled *Hisab Urfi dan Hakiki* written by KRT. Wardan Diponingrat (d. 1991). He is the initiator of the concept of the *wujūd al-hilāl*. His full name is Kyai Kanjeng Raden Penghulu Muhammad Wardan Diponingrat. He is a student of KH. Siraj Dahlan, son of KH. Ahmad Dahlan, founder of the Muhammadiyah organization (Azhari, 2008, p. 157). Some of his works are in the field of astronomy: *Umdah al-Ḥasīb*, *Kitab Ilmu Falak dan Hisab*, as well as *Hisab Urfi dan Hakiki*. Apart from writing books, he has also written several articles on astronomy (Suwarno, 2007, p. 9). The book of *Hisab Urfi dan Hakiki* is generally the same as the book of *Khulāṣah al-Wafiyah* by Syekh Zubair al-Jailani. That is, the astronomical data used are the same as the data in *Kitab al-Maṭla' al-Said*, but using the Yogyakarta epoch.

The description above, it can be seen that the scholar who first brought astronomy to Java was Syekh Abdurrahman al-Miṣrī. While the scholars who first wrote the book of falak were Syekh Ahmad Daḥlān, then followed by Sayyid Uṣmān, and Guru Manṣūr (KH. Muhammad Manṣūr al-Dumairi al-Batawī), as well as other Javanese scholars. Even KH. Ahmad Daḥlān al-Samāranī is a scholar who first wrote the book of

falak, both related to the hakiki taqribi system and the hakiki tahkiki system. Those, although the scholar who first taught falak in Java was Syekh Abdurrahman al-Miṣrī, the one who wrote in book form was KH. Ahmad Daḥlān.

The thinking of KH. Ahmad Daḥlān al-Samāranī was developed by his students who later had different organizational affiliations, namely the Muhammadiyah and Nahdlatul Ulama organizations. As is known, one of KH. Ahmad Daḥlān al-Samāranī is Muhammad Darwis who later became known and popular in Indonesia as KH. Ahmad Daḥlān. From here the scientific gathering of NU and Muhammadiyah figures through the path of Syekh Abdurrahman al-Miṣrī, Syekh Jamil Djambek and Syekh Ṭāhir Jalaluddin al-Azharī.

The historical facts above, it can be seen that the transmission of astronomy in Java was developed through celestial books with various classification variants based on the accuracy of the calculations. If based on the classification method of hisab, since the beginning of writing the book of falak in Java, it can be said that books written in the early days were classified as the hakiki taqribi method and the hakiki tahkiki method. So, in the context of the development of astronomy in Java, it cannot be judged that the early days were the hakiki taqribi method which later developed into the hakiki tahkiki method, but these two methods actually existed since the beginning of their development in Java. This is at the same time to ward off that the hakiki tahkiki method is part of the contact between celestial science and technology, because before there was contact with contemporary technology actually the hakiki tahkiki method already existed.

Viewed from the book written, the hakiki taqribi method and the hakiki tahkiki method were introduced almost simultaneously in 1901, KH. Ahmad Daḥlān al-Samāranī has written a book of the hakiki taqribi method, namely the book *Taḥkīrah al-Ikhwān* and in 1903 wrote the hakiki tahkiki method, namely the book of *Bulūgh al-Waṭār*. Then book *Sulam al-Nayyirain* by Syekh Muhammad Mansūr al-Batawī in 1925 while on the other side KH. Makshum Ali wrote the *Durūs al-Falākiyah* and *Badī'ah al-Miṣāl* in 1931 (Salam, 2010, p. 4).

The next development, although appears astronomy books with contemporary of hakiki tahkiki method, the book of *Sulam al-Nayyirain* until now still taught and reference. Once again, this cannot be separated from the spirit of maintaining scientific continuity coherently as well as in the context of preserving the scientific treasures of the past to the present. The emergence of the astronomi book with the category of the hakiki tahkiki method and contemporary method does not necessarily "eliminate" the existence of the astronomi book with the hakiki taqribi method.

One of the writers of contemporary astronomy is KH. Ghazali, son of KH. Muhammad Fathullah Lambulan Madura. He is a student of Syekh Yasin al-Fadani. KH. Ahmad Ghazali wrote a lot of falak books, namely *Irsyād al-Murīd ilā Ma'rifah Ilm al-Falāk alā al-Rasyd al-Jadīd* (2015), *Jāmi 'al-Adillah ilā Ma'rifah Simti al-Qiblah* (2017), *Infā' al-Waṣīlah ilā Ma'rifah al-Auqāt al-Syar'iyyah wa Simti al-Qiblah* (2015), *Al-Durr al-Anīq fī Ma'rifah al-Hilāl wa al-Kusufain bi al-Tadqīq* (2016), *Faiḥ al-Karīm al-Rauf fī Hisāb al-Sinīn wa al-Khusūf wa Al-Kusūf* (2015), *Ṣamrah al-Fikr fī Hisāb Auqāt al-Ṣalah wa Al-Ahillah wa Khusūf al-Qomar* (2017), and *Bughyah al-Rafīq fī Hisāb al-Ahillah wa al-Kusūfain alā Al-Tahqīq* (2017). The book of astronomy written by KH.

Ahmad Ghozali is included in the categories of hisab hakiki tahkiki and hisab hakiki tadqiqi (contemporary).

The development of science books on falak was also carried out by Banten scholars. This is as done by KH. Suhaimi, leader of the Jauharotun Naqiyah Islamic Boarding School, Cibeber Cilegon, Banten. He wrote falak books, including: *al-Rubu 'al-Mujayyab fī al-A'māl Jaibiyah* (this book is a summary of the book *Durūs al-Falākiyah*), *Ilm al-Ḥisāb Juz al-Awwal*, *Ilm al-Ḥisāb Juz al-Ṣānī*, *Ringkasan Ilmu Falak dengan Microsoft Excel*, *Ilm al-Falāk li Al-Mubtadi*, *Tashīl al-Murīd fī Ma'rifah al-Ḥisāb al-Falākiyah alā Rasyd al-Jadīd bi computer calculator tool*. Pesantren Jauharotun Naqiyah Cibeber Cilegon, Banten, also made the Bany Latif Calendar which is used in the community of the city of Cilegon and alumni as a determinant of the beginning of the Hijri month. Then KH. Suhaimi has a student namely KH. Ahmad Ghozali Cibeber who compiled the book *Fath al-Laṭīf Rohīm* which is used until now. This book is the main book used in the Al-Jauharotun Naqiyah Islamic Boarding School.

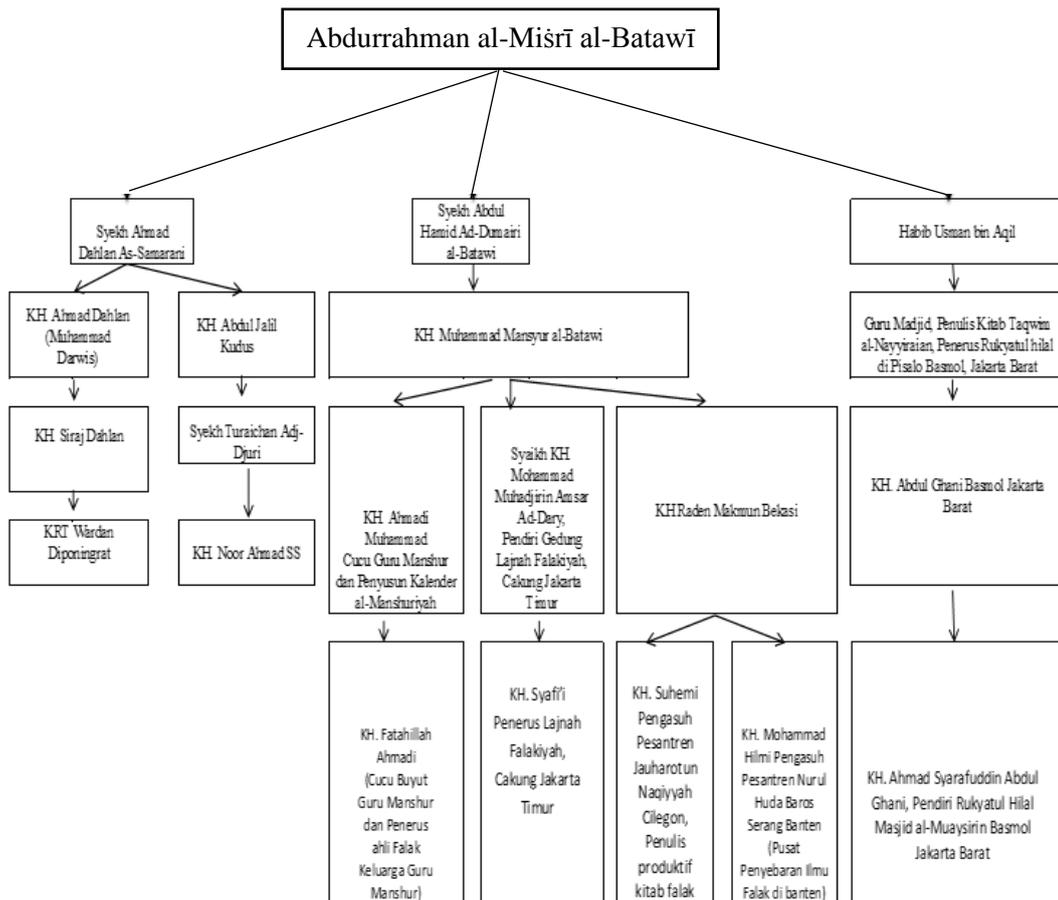
2. Patterns of Spatial Science Transmission in Java

Astronomical transmission patterns are carried out through the development of sources, educational institutions and the astronomy community, as well as the development of observation devices. At each stage, it has different characteristics. For example, every astronomer character must interact with other astronomers which has its own meaning if the interaction is carried out by other people. According to Bulmer, as written by Rusdiana and Utari, every human action has a value that is in that action and the astronomy community, and the development of observation equipment (Rusdiana & Utari, 2019, p. 107).

a) Source Development

Some source side, the development of astronomy through: *first*, writing Arabic book of astronomi by scholar astronomer archipelago. The book written is a theory developed from existing books of astronomy, which is the main reference, as explained above. *Second*, through astronomy books in Indonesian written by experts so that they are easy to understand. It is well known that the book of astronomy is difficult to understand and for beginners it will be hampered in understanding it. Therefore, many astronomers developed by writing books on practical astronomy in Indonesian. To mention among them is in the book entitled: *Ilmu Falak dan Hisab* and *Hisab 'Ufri dan Hakiki*. These two books are by KRT. Wardan Diponegoro, a leader of the Yogyakarta Palace, was published in 1957 (Alimuddin, 2016, p. 190). Then Ahmad Izzuddin wrote a book entitled *Fiqh Hisab Ru'yah di Indonesia (2003)*; The Ministry of Religion Affair of the Republic of Indonesia published a book entitled *Ilmu Falak Praktik (2013)*; Muhyiddin Khazin wrote a book entitled *Ilmu Falak dalam Teori dan Praktik (2004)*; Susiknan Azhari wrote a book entitled *Ilmu Falak; Perjumpaan Islam dan Sains Modern (2007)*; and Slamet Hambali wrote a book entitled *Ilmu Falak; Penentuan Waktu Shalat dan Arah Kiblat (2013)*.

Development of sources in the form of the book of falak science, it can be seen that the chain of falak science in Java, including through the scientific chain of Syekh Abdurrahman al-Mishri. The following is the scientific chain of Syekh Abdurrahman al-Miṣrī al-Batawī:



Third, Through the development of astronomy application *software* based on modern algorithms compiled by experts such as *Winhisab* by Taufik (1998). Taufik and his son prepared *Winhisab Version 2.0*, the licensing rights currently at *Hisab and Rukyat Authority* under Ministry of Religion Affair of Republic of Indonesia. In addition to the *Winhisab software version 2.0*, there was also *Mawaqit* by the one of ICMI branch In Netherlands (1993). This software was later refined by Kholik into the 2002 version of *Mawaqitt*. Other programs are: *Program Falakiyah Najmi* by Nuril Fuad (1995), *Program Astinfo* by the Department of Astronomy-ITB (1996), *Program Badiah al-Mitsal* (2000), and *Program Ahillah* (Khazin, 2004, p. 39). There is also software developed by Rukyatul Hilal Indonesia (RHI), namely *Starrynight Pro Plus version 6.32*; *Hisab Falak Version 1.1*. ©Ir. Aminuddin EKS (Amana Co) from Gresik, *Shollu Version 3.08.2* ©Ebta Setiawan are the masterpiece of an IT-practitioner from Yogyakarta, and *Muzakkin Falak Software Collecions* from RHI Lamongan.

b) Development of Educational and Community Institutions

The transmission of astronomy is carried out through the development of educational institutions both formal and informal and through a number of communities/institutions for astronomy activists. According to Ahmad Izzuddin, from its initial development until now, the development of astronomy in Java cannot be separated from the world of Pesantren, namely the role of Islamic boarding school in the process of transmitting astronomy knowledge to its students (Izzuddin, 2003, p. 68).

A number of Islamic boarding schools that have become centers for the study of astronomy are: a) Lirboyo Islamic boarding school Kediri develop science of astronomy by studying *Sulam al-Nayyiraiian*. The study of astronomy at Lirboyo's Islamic of boarding school more intense done by inserting the astronomy lessons into Hidayatul Mubtadi'iin Madrasah curriculum. In fact, astronomy is one of the subjects tested as a graduation requirement at the Aliyah level. b) Another Islamic boarding school is Seblak Jombang. The founder of this Islamic boarding school is KH. Ma'shum Ali, compiler of the *Durūs al-Falākiyah* Book. To preserve and develop astronomy, starting in the year academic 2007-2008, founded Ma'had Aly Al-Mahfouz, a college-level institution Strata-1 department of astronomy. c). Tasywiqut Tullab Salafiyah (TBS) Islamic boarding school Kudus, Central Java. In TBS is a Islamic boarding school that teaches astronomy from KH. Turaichan Adjhuri, who among the alumni is KH. Noor Ahmad SS. compiled the Book of *Nūr al-Anwār*. From here it is hoped that the scientific genealogy of Falak KH. Turaichan can be traced and other scholars of astronomy, including KH. Noor Ahmad SS. In this Pesantren there is also Ma'had 'Aly specifically for astronomy. d) Buntet Islamic Boarding School Cirebon, West Java. In this Islamic boarding school, the science of astronomy is taught to MANU Putra by using the *Dūrus al-Falākiyah* so that the scientific genealogy of astronomy at the Pesantren will be traced based on the books taught.

As for the development of astronomy through the Islamic College of Religion, especially spearheaded by UIN Walisongo Semarang by opening a science study program for both the S.1, S.2 (master program) and the astronomy concentration for the S.3 level (doctoral program), as college religion or community college else, developing astronomy through the Faculty of Sharia or Islamic Faculty by Astronomi Sciences study program. Apart from Islamic boarding schools and tertiary institutions, the development of astronomy is also carried out through the Falak Science Study Institute, an institution that specifically studies and develops astronomy in the practical realm with various findings of contemporary astronomy applications and tools. These institutions are based on organizations, communities, and educational institutions in public universities. Such institutions are:

Fisrt, the institution that is based organizations among which are: first, the Lembaga Falakiyah Nahdlatul Ulama. This institution becomes a reference for NU residents in determining worship, especially during the beginning of Ramadan, the beginning of Shawwal, and 10 Dzulhijjah. This institution has also formulated a calendar and is actively conducting training in astronomy. Second, Majelis Tarjih dan Tajdid Muhammadiyah Association. Like the Lembaga Falakiyah NU, this institution becomes a reference for Muhammadiyah members especially during the beginning of Ramadan, the beginning of Shawwal, and 10 Dzulhijjah. The two institutions are sometimes different, so the time for fasting Ramadan and Eid al-Fitr and Eid al-Adha are sometimes different.

Second, Base on education institutions (community college), among which is the Pusat Studi Astronomi (PSA) Ahmad Dahlan University (UAD) Yogyakarta; Forum Kajian Astronomi "Zenith" ITB Bandung; and Himpunan Mahasiswa Astronomi (HIMASTRON) ITB Bandung. *Third*, Community-based, including Rukyat Hilal Indonesia (RHI) , Jogja Astro Club (JAC), CASA Club Astronomy Assalam , the Jakarta

Amateur Astronomy Association (HAAJ), the Independent Hisab Rukyat Institute (LHRI) Semarang), and the Surabaya Al Falakiyah Foundation .

Apart from the above institutions, there is also one institution established by the Ministry of Religion, namely the Badan Hisab Rukyat (BHR). The BHR, which was established on August 16, 1972, contains astronomical experts from representatives of community organizations, Islamic boarding schools and universities. BHR's task is to provide input to the Minister of Religion in determining one Ramadan, Shawwal, and Dzulhijjah through the itsbat session. This agency was also established at the Provincial and Regency/City Ministry of Religious Affairs offices.

c) Equipment development

The development of astronomy is also carried out through the development of astronomical tools, including: a) equipment for determining the direction of the Qibla. a) Mizwala, this tool also be called stick *istiwa'* because the base of this tool is equipped with a circle radius and a center point is stick *istiwa'* (*genomon*); b) Istiwaaini created by KH. Drs. Slamet Hambali, astronomy expert at UIN Walisongo Semarang. It is called Istiwaini because among the main components are two sticks *istiwa'*. The first 'stick' is at the circle of 0° , and the second stick' is at the center of the circle. This tool is the work of researchers designed to replace theodolites in terms of: a). Determine/check the Qibla direction, b). Determine/check *true north*, c). Calculate the sun's height, and d). Determine the time (Hambali, 2014, p. 5).

The development of Astronomy in Indonesia can also be seen with the birth of 8 observatories, of which 6 are in Java, although the number is still far from the USA, Japan and India.(Junaidi, 2017, pp. 56–57). The existence of an observatory is of particular value to the development of astronomy. This is because the development of astronomy has entered the existing institutions. The existence of an observatory in an institution, of course, is a step forward considering the area outside Java, even in Indonesia the problem of astronomy has been studied scientifically for a long time (Sumi et al., 2010, pp. 1642–1643). This condition is something that cannot be avoided in this modern era where the development of science and technology has greeted all parts of life, including astronomy (Mufid, 2019, pp. 72–73).

C. Conclusion

The beginning of the development of astronomy in Java was marked by the teaching of astronomy by Syekh Abdurahman al-Miṣrī who came to Batawī in 1847. Then the falak books afterwards were written by falak scholars in Arabic and Indonesian. Based on astronomical data, the books of astronomy written by Javanese scholars have actually taken data from the Kitab al-Maṭlā 'al-Said by Syekh Husain Zaid al-Miṣrī. The pattern of transmission and development of astronomy in Java is carried out through writing books, teaching in educational institutions, and developing applications and equipment. From this, it can be seen that from the development of sources in the form of astronomy books, they were successfully developed with contemporary astronomical data which were then technically developed with software and applications. The development of astronomy in Java is also due to the role of educational institutions and communities formed by the astronomical scientific community and religious organizations.

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