SEJARAH MATEMATIKA :
KARYA ILMUAN MUSLIM DALAM SEJARAH MATEMATIKA

Abstrak

This paper presents a discussion of the contribution of Muslim scientists in the development of modern science. It was widely known at that time that in the golden age many competent scientists emerged in their respective fields. Such as science, philosophy, astronomy, literature, medicine, mathematics and so on. Their knowledge or knowledge is very valuable, especially for the development of modern knowledge in the next period. And so is the value of their knowledge and what is offered by them, that it is not uncommon for scientists who come later to call them the father of science in their respective fields. However, in this paper, not all Muslim scientists are discussed, but only a few Muslim scientists are discussed in this article, such as: Al Karaji, Al Samaw'al, Ibn Al Haytam, Omar Kayyam, Abu Al Wafa, Nasir Al Din Al Tusi, and Al Biruni. Their contribution is so great in the development of modern science and is widely recognized by scientists both in the east and especially the west.

Discussion: Islam, works, modern, contributions

A. Introduction

The world is developing and changing very quickly thanks to scientists who have created, created and sparked something new to be used by all people in this world so that it has been used until now.In the world of science and knowledge, especially in modern times, it is very real and has great value for the development of world civilization today. In the past, for example, we had Muslim scientists who were very reliable in the field of science.

This means, long before western scientists discovered theories and science, Muslim scientists had found them in the past, only because of historical distortions, then the findings of these Muslim scientists did not reach us, because they were plagiarized and claimed by western scientists in the future as a result their findings. What is quite encouraging for us and of course as a valuable lesson for us is that apart from being well-known experts and inventors in the field of science and knowledge, Muslim scientists are

also very proficient in religious knowledge. In the various studies they do, it is almost unforgettable that their studies and research are given a spiritual touch and spirit.

So that this kind of model produces science that is environmentally friendly, has high usefulness and is not empty of moral and ethical values. Because if science is completely empty of spiritual values and a moral touch, it will only lead to endless calamities as we have seen recently, where science should be a prosperity for human civilization, it will turn into a source of world catastrophe, nuclear sophistication. , atomic bombs, and the like, because they are not accompanied by a spiritual, ethical, humanitarian spirit, their use becomes a curse and a prolonged disaster for mankind.

In a book, challenge in one superworld, who said honestly that the west " owe so much' (owe a lot to Islam). So this once again indicates the qualifications of past Islamic scientists. However, several decades now, many of us do not know Islamic scientists in the history of science in the past so that the claims of the western world seem to be general knowledge that has penetrated the thinking horizon of Muslims. Muslim figures who have incised gold ink in world civilization.

B. Problem Formulation

Some of the central topics in this paper will be discussed, such as biographies and works of Al Karaji, Al Samaw'al, Ibn Al Haytam, Omar Kayyam, Abu Al Wafa, Nasir Al Din Al Tusi, and Al Biruni

C. Discussion

1. Al Karaji

a. Biography

Abu bakr Muhammad al karaji bin al hasan adalah Muslim mathematician's real name al karaji. Little is known about life al-Karajī other than that he worked in Baghdad around the year 1000 and wrote many mathematical works as well as works on engineering topics (hydrology and hydraulics). In the first decade of the 11th century, he composed a major work on algebra entitled al-Fahrī (The Extraordinary).

The aim of al-Fahrī, and algebra in general according to al-Karajī, is "the determination of the unknown starting with the known."1 In pursuit of this goal, he made use of all the arithmetic techniques, then turned them into techniques for dealing with the unknown. He began by making a systematic study of exponential algebra.

Although earlier writers, including Diophantus, had assumed that the unknown ability was greater than the third, al-Karajī was the first to fully understand that this ability could be expanded infinitely. In fact, he developed a method of

1 Franz Woepcke, *Extrait du Fakhr'i, trait´e d'alg`ebre par Abo`u Bekr Mohammed ben Alha¸can al-Karkh¯ i* (Paris: L'imprimerie Imp´eriale, 1853)

naming various abilities x^n and their reciprocals $\frac{1}{x^n}$. Each ability is defined recursively as x times the previous ability. It follows that there is an infinite sequence of passages,

$$1 : x = x : x^2 = x^2 : x^3 = \ldots\ldots,$$

This also applies to the opposite situation,

$$\frac{1}{x} : \frac{1}{x^2} = \frac{1}{x^2} : \frac{1}{x^3} = \frac{1}{x^3} : \frac{1}{x^4} = \ldots\ldots,$$

Once these powers were understood, al-Karajī was able to establish general procedures for adding, subtracting, and multiplying monomials and polynomials. However, in division, he only used monomials as divisors, partly because he could not incorporate the rule of negative numbers into his theory and partly because of his means of verbal symbols. Similarly, although he developed an algorithm to calculate the square root of a polynomial, it only holds true under limited circumstances.

b. Creation

Al-Karaji also wrote a number of other works. Unfortunately, some important works were lost. Among al-Karaji's works that have attracted the attention of many people are four books on mathematics and hydraulic machines, namely

1. Al-Fakhri fil-Jabr wal-Muqabala (about algebra),
2. Al-Badi’ fil-Hisab (about arithmetic)
3. Al-Kafi fil-Hisab (about arithmetic),
4. Inbat al-Miyah al-Khafiya.

2. Al Samaw’al

a. Biography

Al Samaw'al bin Yahya Al-Maghribi is the original pest of Muslim mathematicians, astronomers, doctors, namely Al Samaw'al. Al-Samaw'al was born in Baghdad to well-educated Jewish parents. The father was actually a Hebrew poet.

Apart from giving him a religious education, they also encouraged him to study medicine and mathematics. Since the House of Wisdom was no longer in Baghdad, he had to study mathematics independently and because of this, he traveled to various other parts of the Middle East. He wrote his major mathematical work Al-Bāhir fi'l-jabr, which means "diamond in algebra" when he was only nineteen years old.

Then his interest turned to medicine, and he became a successful doctor as well as a writer of medical texts. The only surviving one is entitled "The Companion's Promenade in the Garden of Love". Contains a treatise on sexology and a collection of erotic stories.

When he was about forty years old, he decided to convert to Islam. To prove the sincerity of his conversion to the world, he wrote an autobiography in 1167 stating his arguments against Judaism, a work which became famous as a source of Islamic polemic against the Jews..

b. **Creation**

However, especially as a mathematician, al-Samaw'al deserves a place in the history of science. His surviving book on algebra, Al-bāhir (“The Dazzling”), written when he was nineteen, is a remarkable development of the work of his predecessors. In it al-Samaw'al unifies the rules of algebra formulated by, in particular, al-Karajī and, to a lesser extent, Ibn Aslam and other writers. including al-Sijz, Ibn al-Haytham. Qusta ibn Lūqā, and aḷ-Harīrī.2

Al-Bahir's treatise consists of four books: (1) premise, multiplication, division and square root, (2) infinity root, (3) irrational distance, and (4) problem classification. Al-Samawal's predecessors had already begun to develop what historians today call the "arithmetisation of algebra". Even Al-Samawal was the first to give this development an accurate picture when he wrote that:

After writing al-Bahir, Al-Samawal traveled to many countries such as Iraq, Syria, Kohistan (mountain areas in Pakistan and Afghanistan) and Azerbaijan (northwest of Iran). We know from his own writings that he was in Maraghah in Azerbaijan on November 8, 1163, because on that date Al-Samawal made a commitment to the Islamic faith. This decision was not taken without much thought by Al-Samawal. He has put a lot of effort into testing the validity of the claims made by the major religions and he reports that on November 8, 1163 he decided that Islam was the most satisfactory. He wrote works of rebuttal of Christians and Jews. Most of Al-Samawal's works have been lost, but he is reported to have written 85 books or articles.

3. Ibn Al Haytam

a. Biography

Al-Hasan bin al-Haitsam is one of the leading Muslim scientists and has a fairly high achievement among scientists in the field of science. However, it is rather vexed that he did not get his due; his name was buried and did not get the position he deserved even though he had advantages and quite great skills

2 Adel Anbouba (1970). "Al-Samaw'al, Ibn Yaḥyā Al-Maghrib" . Kamus Biografi Ilmiah . New York: Putra Charles Scribner . ISBN 978-0-684-10114-9.

that were not understood by historians of Islamic civilization and writers of history books.

Therefore, he was wronged twice; was wronged by the Muslim generation themselves, and what was worse he was persecuted by Western scientists and historians who had robbed him of his intellectual property, because his name was changed to theirs. As such, he has been placed at a disproportionate place among scientists throughout history.

His real name is Abu Al-Hassan bin Al-Haitsam. He is known as Al-Basri. He was born in 354 H (965 AD) in the city of Basra, Iraq. He died in 430 H (1039 AD) in Kaherah. He first studied science in Basra, then in Baghdad. In Baghdad, he studied sciences related to the Arab world and religion. In addition, he also studied mathematics, astronomy, doctorate, and philosophy. At the age of 30, he visited Egypt at the invitation of the Caliph of the Fatimid dynasty, Al-Hakim Biamrillah.

He spent most of his time in Kaherah. It was in this city that he carried out many studies related to his field and wrote many books. He lived life in Kaherah in a simple and humble state, where he only lived in a room near the gate of the Al-Azhar Mosque.

He spent most of his time in Kaherah. It was in this city that he carried out many studies related to his field and wrote many books. He lived life in Kaherah in a simple and humble state, where he only lived in a room near the gate of the Al-Azhar Mosque.

ibn al-Haytham, known in Europe as Alhazen and one of the most influential Islamic scholars, was born in Basra, now in Iraq, but spent most of his life in Egypt after he was visited by the caliph al-Hakim to work on a project to control the Nile. Although the project never came to fruition, ibn al-Haytham did produce in Egypt his most important scientific work, Optics, in seven books. Optics was trans- translated into Latin in the early thirteenth century and studied and commented on in Europe for several centuries thereafter.

Ibn al-Haytham's fame as a mathematician lies primarily in his treatment of the "Alhazen problem"—to find the point or points on some reflecting surface where light from one of the two points outside the surface is reflected onto the other. In all five books of Optics, he attempts to solve problems for various surfaces—spherical, cylindrical, and conical, concave and convex. While not entirely successful, his act of praise shows he is in complete control of both—basic and advanced geometry from Greece. in the final years of his life, ibn al-

Haytham made a living by copying annually, among others, Euclid's Elements, Apollonius's Conics, and Ptolemy's Almagest.3

b. **Creation**

Ibn al-Haitsam lived in the time of three great scientists, namely Al-Karkhi, Al-Biruni, and Ibn Sina. This is indeed a 'special' event, where at one time or age there were four prominent Muslim scientists. In particular, Ibn al-Haitham stands out in several areas such as the following:

- Mathematics; which includes arithmetic, algebra, geometry, and trigonometry.
- Natural science; especially the science of optics which he himself called the science of "al-manazhir".
- Astronomy or astronomy.

Some Arabic records mention that Ibn Haitsam was the first to encounter the camera. This record is in fact too exaggerated and violates the scientific trust and will be disputed by Ibnul Haitsam if he is still alive. What is true is that this leading scientist was the inventor of the idea and who did so that eventually discovered how to make a camera.

There are 12 books by Ibnul Haitsam who are famous in optics. Among these books the most important is the Kitab Al-Manazhir which contains various important discoveries in the science of optics. This book was translated into Latin in 1572, and published in Basel, Switzerland, under the title Thesaurus Opticus (Complete Reference In Optics). This book was so great influence for the development of optical science in Europe. Among his other works in optical science are the following:

- Risalah Fi Al-Ain Wa Al-Abshar
- Risalah Fi Al-Maraya Al-Muhriqah Bi Ad-Dawa'ir
- Risalah Fi In'ithaf Adh-Dhau
- Risalah Fi Al-Maraya Al-Muhriqah Bi Al-Quthu
- Kitab Fin Al-Halah Wa Qaus Qazah

It should be noted that the books of Al-Hasan bin Al-Haitsam were used as the main reference in Europe in optics until the 17th century. An English scientist in mathematics and theology, and a lecturer at the University of Cambridge, Issac Barrow (1630-1677) gave lectures on Ibn Haitsam. When among the students at that time was Isaac Newton who later became a famous scientist in the West until the emergence of Einstein.

In addition to the field of optics, Ibn Haitsam is also an expert in the field of astronomy, here are the names of the books written by Ibn Haistam in the field of Astronomy:At-Tanbih Ala Ma Fi Ar-Rashdi Min Al-Ghalath

3 Victor J. Katz, *A History of MATHEMATICS An Introduction Third Edition*, (Mexico City Munich Paris Cape Town Hong Kong Montreal)

- Irtifa' Al-Kawakib
- Maqalah Fi Ab'ad Al-Ajram As-Samawiyyah wa Iqdar I'zhamiha wa Ghairiha
- Kitab Fi Hai'ati Al-Alam
- Risalah Fi Asy-Syafaq

Ibn Haitsam was also very skilled in mathematics, following his work in mathematics:AL-Jami' Fi Ushul Al-Hisab

- Ilal Al-Hisab Al-Hindi
- Ta'liq Ala Ilm Al-Jabar
- Al-Mukhtashar Fi Ilm Al-Handasah
- Tarbi' Ad-Da'irah
- Al-Asykal Al-Hilaliyah

Ibn Haitsam's contributions to science and philosophy were numerous. That's why Ibn Haitsam is known as a person who is poor in terms of material but rich in knowledge. Some of his views and opinions are still relevant today.

4. Omar Kayyam

a. Biography

Umar Khyayyam was born in Persia (Iran) on 18 May 1048 AD (born between 1038 and 1048) with the full name Ghiyath A-Din Abu'l-Fath Umar ibn Ibrahim Al-Nisaburi A-Khayyami Linguistically, Khayyam means 'tent maker'. The name was used, because the father named Ibrahim was a tent maker. Khayyam's hometown is called Nishapur. he lived during the reign of the Seljuk dynasty of the 11th century AD. Khayyam spent his childhood in the city of Balkh (now northern Afghanistan). he was a great poet, philosopher, Sufi, astronomer, and the famous mathematician from Persia (Iran).

l-Khayy¯am (1048-1131) was born in Nishapur, Iran, in 1048 shortly after the area was conquered by the Seljuk Turks. he was able for most of his life to enjoy the support of the Seljuk rulers. In fact, he spent many years at the observatory in Isfahan at the head of a group working to reform the calendar.

On several occasions, when rulers replaced rulers, he fell out of favor, but he was eventually able to garner enough support to write many mathematical and astronomical works, as well as poetry and philosophical works. In fact, he is famous in the West for the collection of poems known as the Rubaiyat. In the preface to his great algebra work, he complains how difficult it has been for him to work, but then thanks the authorities for providing him with the necessary support.

In the city of Balkh (now northern Afghanistan). There Khayyam studied with a famous scientist, Sheikh Muhammad Mansuri. Khayyam also studied at a prominent teacher in the Khurasan region named Imam Mowaffaq. At that

time, Khurasan became the capital of the Seljuk empire.

Not surprisingly, at that time Khurasan competed with Cairo and Baghdad to become the center of Islamic civilization and the world. The Seljuk Turks ruled over Mesopotamia, Syria, Palestine and most of Iran. In the uncertain political situation, at that time, it was not easy for Khayyam to study. In that era, each dynasty competed to expand its territory.

Khayyam studied philosophy at Nishapur. A friend of his wrote that Umar Khayyam was a student who was gifted with sharp intelligence and very high natural powers. According to a well-known legend, when studying with Imam Mowaffaq, Khayyam was very close to Nizam-ul-Mulk (born: 1018 AD) who became an official in the Seljuk Empire and Hassan-i-Sabah (born:1034 AD) who became the leader Hashshashin (Nizar Ismaili) sect. These three are often called the 'Three Companions. When Nizam-ul-Mulk became ruler, Hassan-i-Sabah and Khayyam came to him. If Hassan-i-Sabah asks for a position in the government. To his friend, Khayyam only asked for a place to live, study knowledge and worship. It is said that Khayyam received a pension which annually reached 1,200 mithkals of gold.

However, the validity of the legend is doubted by a number of scientists such as Foroughi and Aghaeipour. According to them, it is impossible for Khayyam and Nizam-ul-Mulk to be friends at school, because they are 30 years apart in age. Moreover, the three people lived in three different places. Possibly, the story of the friendship of the three people appeared, because all three of them were famous figures. Khayyam is famous for his great knowledge and poetry, while Hassan-i-Sabah is famous as a rebel soldier and Nizam-ul-Mulk is famous for his power and the rules and laws he controls. So no wonder, if at that time a legend emerged about the friendship of the three prominent figures.

b. Creation

There is no doubt that Umar Khayyam was a great philosopher, mathematician and astronomer. He wrote in Arabic more than ten books on philosophy, astronomy, and mathematics. One of his famous books, **al-Jibr**, is the greatest contribution to science.

In this book he demonstrates his science and authenticity. The famous algebra writer, al-Khuarizmi, did not exhibit the qualities that Umar Khayyam displayed in solving problems in algebra and geometry. In 1857, Woepeke edited and translated Umar Khayyam's book, **al-Jibr**. His book on geometry, which is an improvement on Euclid's book on the same subject, shows his scientific and originality (as someone who is skilled in the field of science).

It is true that the algebraist who was influenced by al-Khwarizmi was Umar al-Khayyam who developed algebra further so that this knowledge could be named Al-Khayyam. If al-Khwarizmi was more focused on quadratic (fourfold), then Umar Al-Khayyam prioritized cubic equations and degree equations, for example:

1. $X^3 + bx^2 = cx + d$
2. $X^2 + cx = bx + d$
3. $X^3 + d = bx^2 + cx$

This method is called geometric analysis.

he was able to solve problems of third and fourth power equations through the tory of intersecting conics, the highest success of the Arabs in algebra and the highest success ever achieved by modern mathematicians in solving fifth-order equations. and so on from any universal method.

But apart from that Umar Khayyam is better known for his beautiful quatrain, Ruba'iya. He is a great poet. His beautiful poems have touched the hearts of Eastern and Western poets. Writers and poets of his day could not give him the recognition he deserved, but six centuries later a great Western poet, Fitzgerald, bravely sang Umar Khayyam's song, and he translated many of his verses.

It is difficult to determine the number of poems and verse written by Umar Khayyam, but the number of Ruba'iyat or quatrains is over 1200. Many claim to be the creators of this composition, but no one is sure who actually wrote it. However, they recognized him as Ruba'iyat-i Umar Khayyam.

Umar Khayyam was undoubtedly a mystical poet, monotheistic writer, and a rational and argumentative poet. He was opposed by orthodox clerics and hostile to all institutionalized religious rules. For him religious institutions mean nothing. Sufism was unimportant and an excessive love of religion was something he despised. He adheres to a natural religion and uses a human and natural approach. His Ruba'iya rhymes are for those who are pure and simple in heart. He is a forgiving person for all his mistakes and his sympathy is from the bottom of his heart.

However, behind all that he is an optimist and not a pessimist. To him beauty, the truth of life, and prosperity have a special appeal. He has a human side. He believes in the transfer of spirits which is contrary to the fundamental beliefs of Islam. Therefore, orthodox Muslims never accepted him as an Islamic poet

5. Abu Al Wafa

a. Biography

Abu al-Wafa (940-998) Born in Buzjan, in the Khorasan region of what is now Iran, Muhammad Abu al Wafa al-Buzjani lived during the Islamic

Buyid dynasty in western Iran and Iraq. The culmination of this dynasty was during the reign of 'Adud ad Dawlah, who supported a number of mathematicians at his court in Baghdad. His son Sharaf ad Dawlah continued his father's policies, and Abu al-Wafa was employed in designing and building an observatory. His book What Is Required of Arithmetic Science for Scribes and Entrepreneurs provides an introduction to a variety of practical mathematical ideas, including measurement, taxes, units of money, and payments to soldiers.

Interestingly, this is actually the only book in medieval Islam where negative numbers appear, in the context of debt. But Abu al-Wafa's main contribution was in the simplification and expansion of spherical trigonometry which Islamic scientists had learned from Greek sources. Among his other achievements, he was responsible for the earliest proof of the rule of four quantities, which later became the basis for developing the basic ideas of spherical trigonometry.

He was also the first to discover and prove the law of the sphere of sines and the law of tangents. Abu al-Wafa' then presented one of the erroneous methods of the craftsmen, “so that right may be distinguished from wrong and one who looks into this subject will not make the mistake of accepting a wrong method. But this drawing he made is fantastic, and someone who has no experience in art or geometry might think it is true, but if he is told about it, he knows it is wrong." He goes on to note that the angle is correct, and that it looks like a fine construction. However, in reality, the side of the proposed large square is equal to the side of the smaller square plus half the diagonal. A quick calculation shows that, in effect, the square of $1 + \frac{\sqrt{2}}{2}$ not equal to 3.

Abu al-Wafa' finally presented a correct geometric construction, with proof that He bisected the square along its diagonal. Each is applied to one side of the third square. One of the corners of the triangle, which is half a right angle, is placed on one of the corners of the square and the hypotenuse of the triangle is on the side of the square. Then the right angles of the triangle are connected by straight lines. This becomes the side of the desired square. From each of the original triangles, the small triangle cut by this straight line is transferred to the "empty" triangle inside the square. To prove that this construction is correct, Abu al-Wafa' needs to prove that the triangle extending through the square is congruent with the "empty" triangle in the square. But this is followed by the congruence theorem of the sides of the angles of a triangle.

b. **Creation**

He has produced many books and scientific works covering many fields of science. However, not many of his works have been left to this day. A number of his works have been lost, while those that are still there have been modified.

His contributions in the form of scientific works include the book Ilm al-Hisab (Book of Practical Arithmetic), Al-Kitab Al-Kamil (Complete Book), and Kitab al-Handsa (Applied Geometry). Abul Wafa also published many of his writings in the scientific journals of Euclid, Diophantus and al-Khwarizmi, but unfortunately many have been lost. However, his contribution to the theory of trigonometry was very significant, especially the development of the tangent formula, the early discovery of the secant and cosecant formulas.

Therefore, a large number of trigomometric formulas cannot be separated from the name Abul Wafa. To monitor the stars from the observatory, Abul Wafa specifically built a wall quadrant. Unfortunately, the observatory did not last long. As soon as Sultan Sharaf ad-Dawlah died, the observatory was closed.

A number of great works have been produced by Abul Wafa during his dedication to the palace of the sultan of Buwaih. Some of the valuable books he wrote include; The book of fima Yahtaju Ilaihi al-Kuttab wa al-Ummal min 'Ilm al-Hisab is a book on arithmetic. Two copies of the book, unfortunately incomplete, are now in the libraries of Leiden, the Netherlands and Cairo, Egypt. He also wrote "Kitab al-Kamil".

In geometry, he wrote "Kitab fima Yahtaj Ilaih as-Suna' fi 'Amal al-Handasa". The book was written at the special request of the Caliph Baha 'ad Dawla. A copy is in the library of the Aya Sofya Mosque, Istanbul. Kitab al-Majesti is the most famous book by Abul Wafa of all the books he wrote. An incomplete copy is now stored in the National Library of Paris, France.

Unfortunately, his treatise on criticism of the thoughts of Euclid, Diophantus and Al-Khwarizmi has been destroyed and lost. Indeed, modern civilization is indebted to Abul Wafa. The results of his research and works inscribed in a series of books gave a very significant influence on the development of science, especially trigonometry and astronomy.

6. Nasir Al Din Al Tusi

a. Biography

Nasir al-Din Al-Tusi (1201-1274), from Tus in Iran, completed his formal education in Nishapur, Persia, which later became a major center of learning, and soon gained a great reputation as a scholar. However, the thirteenth century was a time of great upheaval in Islamic history. The only places of peace in Iran were forts which were controlled directly by the Isma'ili rulers.

Fortunately, Nasir al Din persuaded one of these rulers to allow him to work in such a fortress.

After the Mongol leader Hulagu defeated Isma'ilis in 1256, Nasir al-Din was able to shift his allegiance. He served Hulagu as a scientific adviser and obtained his approval to build an observatory in Maragha, a town about fifty miles south of Tabriz. It was here that Nasir al-Din spent the rest of his life as head of a large group of astronomers.

During that time, he calculated a new set of highly accurate astronomical tables and developed an astronomical model that Copernicus may have adapted to design his heliocentric system. About a century after al-Khayyami, another mathematician, Nasir al-Din al-Tusi (1201–1274) criticized the works of his predecessors in detail and then tried to prove the fifth postulate himself in his book written around 1250 entitled Al-risala al -shafiya'an al-shakk fi-l-khutut al mutawaziya (Discussion Dispelling Doubts about Parallel Lines).

He considered the same quadrilateral as al-Khayyami and also tried to derive the contradictions of the hypotheses of acute and obtuse angles. But in a manuscript probably written by his son Sadr al-Din in 1298, based on Nasir al-Din's later Thoughts on the subject, there is a new argument based on another hypothesis, also equivalent to Euclid's, that if the line GH is perpendicular to CD at H and inclined to AB at G, then the perpendicular drawn from AB to CD is greater than GH on the side where GH makes an obtuse angle with AB and less than GH on the other side.

b. **Creation**

Works in the field of Astronomy include:

- Al-Mutawassitah Bain Al-Handasa wal Haiʿʿa
- Kitab At-Tazkira fi alʿʿIlmal-haiʿʿa
- Tahzir Al-Majisti

In the fields of Arithmetic, geometry and trigonometry:

1) Al-Jabar wa Al-Muqabala
2) Al-Ushul Al-Maudua
3) Tahrir AL-Ushul

7. **Al Biruni**

a. Biography

Al-Biruni (973-1055), Al-Biruni was born in Khwarizm, near what is now Biruni in Uzbekistan, and began scientific studies early on under the tutelage of Abu Nasr Mansur ibn 'Ir aq, a promi- the. Political strife in his homeland forced him to flee in 995, but two years later he returned to Kath, the main

city of Khwarizm, to observe a lunar eclipse. He had previously arranged that Abu'l-Wafa' would observe the same eclipse in Baghdad, so the time difference between the two events would allow him to calculate the difference in longitudes of the two places..

At Khwarizm it was conquered by Sultan Mahmud of Ghazna, in Afghanistan, who soon ruled a vast empire covering parts of northern India. Al-Biruni was taken to the sultan's palace, from where he traveled to India and where he wrote a major work on all aspects of Indian culture, including topics as varied as the caste system, Hindu religious philosophy, chess rules, sense of time, and calendar procedures. . Al-Biruni wrote more than 140 works, mostly in mathematics, astronomy and geography.

Al-Biruni further notes that "if we are given a shadow at a certain time, and we want to find the elevation of the sun for that time, we multiply the shadow by its equation and the gnomon by its equation. and we take the [square root] of the sum, and that will be the cosecant. Then we divide by the gnomon product by the total sine, and there comes out the Sine of the height. We find the corresponding arc in the Sine chart and the elevation of the sun appears at the time of the shadow." In modern notation, al-Birun i uses the relation

$$\sqrt{g^2 cot^2 \propto + g^2} = g \csc \propto \ (cot^2 \propto + 1 = csc^2 \propto)$$

and then the previous formula in the form $\frac{gR}{g} \csc \propto = Sin \propto$ to determine the Sine function based on a certain value of the radius R used. He then consulted the Sinnya table in reverse to determine . Al Biruni also provides rules that are equivalent to $tan^2 \propto + 1 = sec^2 \propto$ and $tan \propto = \frac{\sin \propto}{\cos \propto}$ and presents a table for tangents and cotangents where it uses the relationshipn $cot\ \alpha = tan(90° - a)$.

It may come as a surprise that with the wealth of trigonometric knowledge accumulated in his texts, al-Biruni only used it to deal with astronomical problems. To determine terrestrial altitudes and distances, he described nontrigonometric methods. For example, to determine the height of a tower at which its base is accessible, he suggests that, "if surveyed at a time when the elevation of the sun was equal to one-eighth of a revolution [45°], there

would be between the tip of the shadow and the vertical foot a distance equal to the [height]..”4

If the grounds are inaccessible, however, al Biruni describes a procedure similar to the Chinese and Indian procedures discussed in Chapters 7 and 8. Unlike his Indian and Chinese predecessors, however, he provides an in-text description of his reasons, using the same triangular idea.

b. Creation

Get to know Al-Biruni, a Phenomenal Scientist

Here is the scientist's work for the world:

- Astronomy

  "He has written treatises on astrolabe and formulated astronomical tables for Sultan Ma'sud,"explained Will Durant about Al-Biruni's contribution to astronomy. In addition, Al-Biruni has also been instrumental in writing a treatise on the planisphere and the armillary sphere. Al-Biruni also emphasized that the earth is round.

  Al-Biruni was recorded as an astronomer who carried out experiments related to astronomical phenomena. He suspected that the Milky Way Galaxy (the Milky Way) was a constellation of a number of stars. In 1031 AD, he completed a very long astronomical encyclopedia entitled Kitab Al-Qanun Al Mas'udi.Astrologi

  He was the first scientist to distinguish the term astronomy from astrology. He did this in the 11th century AD. He also produced several important works in the field of astrology.

- Geography

  Al-Biruni also made a number of contributions to the development of Earth Sciences. For his role, he was named the 'Father of Geodesy'. He also made significant contributions to cartography, geography, geology and mineralogy.

- Cartography

  is the science of making maps or globes. At the age of 22, Al-Biruni had written an important work in cartography, namely a study of map-making projections.

4 Kennedy, Treatise on Shadows, p. 64. See also E. S. Kennedy, “An Overview of the History of Trigonometry,”
in Historical Topics for the Mathematics Classroom (Reston, VA: National Council of Teachers of Mathematics,
1989), 333–359.

- Geodesy and Geography

  At the age of 17, Al-Biruni was able to calculate the latitude of Kath Khawarzmi using the height of the sun. "Important contributions in geodesy and geography have been made by Al-Biruni. He has introduced the technique of measuring the earth and its distance using triangulation,"explained John J O'Connor and Edmund F Robertson in MacTutor History of Mathematics..
- Geology

  Al-Biruni has also produced works in the field of geology. One of them, he wrote about the geology of India.
- Mineralogy

  In his book entitled Kitab al-Jawahir or Book of Precious Stones, Al-Biruni describes various minerals. He classified each mineral according to color, odor, hardness, density, and weight.
- Science Method

  Al-Biruni also played a role in introducing the scientific method in every field he studied. One example, in Kitab al-Jamahirdia is classified as a very experimental scientist.
- Optics

  In the field of optics, Al-Biruni was among the first scientists with Ibn Al-Haitham to study and study optics. He was the first to discover that the speed of light is faster than the speed of sound.
- Anthropology

  In social science, Biruni lined up as the world's first anthropologist. He writes in detail comparative studies of human anthropology, religion, and culture in the Middle East, the Mediterranean, and South Asia. He is credited by a number of scientists for developing Islamic anthropology. He also developed a sophisticated methodology in anthropological studies.
- Experimental Psychology

  Al Biruni is noted as a pioneer of experimental psychology through the discovery of the concept of reaction time.
- History

  At the age of 27, he wrote a history book called Chronology. Unfortunately the book has now been lost. In the book he wrote Kitab fi Tahqiq ma li'l-Hind or Research on India, Al-Biruni has distinguished between the scientific method and the historical method.
- Indology

  He was the first scientist to study specifically about India to give birth to indology or the study of India.
- Mathematics

He made significant contributions to the development of mathematics, particularly in the fields of theory and practice of arithmetic, irrational numbers, ratio theory, geometry and others.

D. Conclusion

From the explanation and discussion above, it can be concluded that what was developed by them greatly influenced the development of modern science and was a breath of fresh air for the development of science and technology in the contemporary era as it is today. Many Western thinkers have adopted their mindset, so that not a few of them are oriented towards Muslim scientists. What is presented and presented by Muslim thinkers has been able to conjure up modern science as it develops in the world today, both in the West and in the East..

E. Bibliography

Anbouba, Adel (1970). "Al-Samaw'al, Ibn Yaḥyā Al-Maghrib" . Kamus Biografi Ilmiah . New York: Putra Charles Scribner . ISBN 978-0-684-10114-9.

Dalle, juhriyansyah, " Sumbangsih dan Pemikiran Matematika Ghiyat al-Din alias Omar Khayyam" , jurnal ilmiah darul ulum volume 6, nomer 11, Juli - Desember 2010

Dedikasi al karaji dalam bidang matematika dan mesin dilihat dari link : (https://www.google.com/amp/s/m.republika.co.id/amp/prndlq313) diakses pada tanggal 23 april 2022

Jailani, Imam Amrusi," *KONTRIBUSI ILMUWAN MUSLIM DALAM PERKEMBANGAN SAINS MODERN* ", JURNAL THEOLOGIA — Volume 29, Nomor 1, Juni 2018.

J. Katz ,Victor, *A History of MATHEMATICS An Introduction Third Edition*, (Mexico City Munich Paris Cape Town Hong Kong Montreal)

Karya al karaji diakses dari link (http://p2k.itbu.ac.id/ind/2-3064-2950/Al-Karaji_109468_itbu_p2k-itbu.html) diakses tanggal 27 april 2022

Karya ibnu haytam diakses dari link (https://www.google.com/amp/s/m.republika.co.id/amp/q8z4nf458) diakses pada tanggal 24 april 2022

Woepcke Franz, *Extrait du Fakhr'i, trait´e d'alg`ebre par Abo`u Bekr Mohammed ben Alha¸can al-Karkh¯ i* (Paris: L'imprimerie Imp´eriale, 1853)