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Thabit Ibn Qurra : History and The Influence to Detemine The Time of Praying Fardhu

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Abstract. The application of mathematical history for overcoming with life's problems are reflection to build more advanced civilizations than previous civilizations, because by studying history a nation can do an evaluation of the past mistakes. In addition, mathematical history gives wide basic understanding against the mathematical consepts for giving a solution against the problems. Not only about the ideal world held by the Platonist. As example, in the golden age of islam, the scientist at that moment developed knowledge especially mathematics with the principal to solve the problems with in daily life. The one of them is Thabit ibn qurra. Thabit ibn qurra used the principal of geometry to decide motion of the sun. The method used was by means of a shadow that produced by sunlight. So, the muslim can pray fardhu on time. This research is meant to reconstruct the method was used by Thabit ibn qurrah, so that the mathematics especially, the topic of geometry is no longer a matter that cannot be expressed in real or real terms. So that, the young generations, especially muslim will realize that learn the mathematics is invaluable in this life. Not only for them self but also to give benefits for a lot of people. The result is the young generations will have the spirit to learn it. The method was used in this research is the study of literature, which mean to study the relevant previous researches and conclude based on the data obtained. The result of this research Thabit's discovery of influences on prayer time determination.

Keywords: Thabit Ibn Qurra, History, Geometry.

Running title: Detemine The Time of Praying Fardhu.

INTRODUCTION

Astronomical phenomenon is an interesting discussion for human civilization. History records, astronomical phenomena have occurred since the beginning of civilization. Many civilizations have paid great attention to astronomical phenomena, for example, the civilizations of Greece, Islam, China and India. One of the reasons for great attention is the many benefits that can be obtained from astronomical phenomena, including calculating calendar time, calculating the time of a full day, and determining the direction of the wind.

One of the astronomical phenomena that is getting intense attention is the sun and the earth. One of the causes is due to the movement of the sun and the movement of the earth which causes day and night. The theories of the sun and earth underwent violent changes. In the first theory, humans consider the earth as its center and the sun surrounds it or what is often known as geocentric. The second theory contradicts the first theory, namely that humans assume that the earth is orbiting the sun or what is known as heliocentric.

One of the civilizations that uses geocentric theory is Islamic civilization. Islamic civilization has paid great attention to astronomical phenomena. Because Islamic civilization requires astronomical phenomena related to the sun to calculate prayer times. In calculating prayer times, Muslims depend on the location or position of the sun when it is in the sky. So we need a way to know the time of the sun at a certain position. Thabit ibn Qurra was one of the scientists who translated Ptolemy's book Al-magest and then perfected it.

MATERIALS AND METHODS

The method used is literate study, where this method examines previous studies that are related and concludes based on the data obtained. The literature selection process can be done in 4 ways according to Taylor. Among them are : (1) *Organize*, by organizing the literature reviewed according to the problem, (2) *Synthesize*, namely uniting the results of organizing literature in to one unified whole, (3) *Identify*, namely identifying problems or issues that are considered very important in the literature to beanalyzed, (4) *Formulate*, namely formulating questions or curiosity to be used as further research.

RESULTS AND DISCUSSIONS

A. The History of Thabit Ibn Qurra

Thabit ibn qurra was born in Harran in 826 AD. He is one of the scholars who lived during the Islamic golden era. He is also an expert in matemathics, mechanics, astronomy, astrology, and many other fields that he mastered. Throughout his life, he had a lot of influence on the benefit of Muslims, especially in the field of early reformer of the pteomaic system, a founder of statics, and the length of the sidereal year. Many things from his ideas and findings were later developed by the next generation of scientists, namely: Banu Musa, Archimedes, Apollinous, Nicomachus, and Euclid. Where later this will be the forerunner to the development of modern science that we can learn to date.

B. Ide triginometri Thabit Ibn Qurra

Thabit ibn qurra begins his idea with an axiom. Neugebauer compared Thabit's ideas with Ptolemy, where Thabit tended to use recurring facts while Ptolemy used a suitable definition (3,264). On the basis of his astronomical

doctrine, Ptolemy discovered three things: the slope of the sun's path is equal to: 23;51,20° (4.I.12), the length of tropical year is 365;⟦14,48⟧^d(4.III.1), and the velocity at which the star moves from the east (1° per century) if counted from spring ekuinoks (4.VII.2-3).

- Basic idea Thabit Ibn Qurra
  a. The sun's apsidal line rotates with a strong connection as it is with the spheres of a stationary star.
  b. Thabit Ibn Qurra reviews the pages that have been selected from *Almagest*.
  c. On the basis of old and new observations.
- Models and terms.

Everything that happens within the zone of the twelve zodiac signs is centered on the earth *T*.

	According with Ptolemy's teory	**According with Thabit's teory**
Velocity	Constant velocity with in 1°per century	So that the angle of presession : $\angle \Upsilon T * = P(t)$
Apsidal Line of The Sun	constant points of the longitude with apogee, $\lambda_A = \angle \Upsilon TA = 65;30°$	Rotating with the motionless stars, so : $\lambda_A = P(t) + \angle$*TA, where the final term is constant.
Formula	$a_m = \angle ACS = a_m(t_0) + \omega_a.(t\text{-}t_0)$	$a_m = \angle ACS = a_m(t_0) + \omega_a.(t\text{-}t_0)$
Revolusion Periods	One year tropical is equal to $360/\omega_a$	One year sidereal is equal to $360/\omega_a$
Apsidal longitude	$\lambda_m = \angle \Upsilon CS = \lambda_A + a_m$	$\lambda_m = \angle \Upsilon CS = \lambda_A + a_m$
Prosthaphairesis	Which increases uniformly with time	Where there is P(t), does not keep increasing steadily
	$p = p(a_m) = \angle CST$, negative for $0° < a_m < 180°$, positive for $180° < a_m < 360°$	$p = p(a_m) = \angle CST$, negative for $0° < a_m < 180°$, positive for $180° < a_m < 360°$
	$\lambda = \angle \Upsilon TS = \lambda_A + a_m + p(a_m).$	$\lambda = \angle \Upsilon TS = \lambda_A + a_m + p(a_m).$

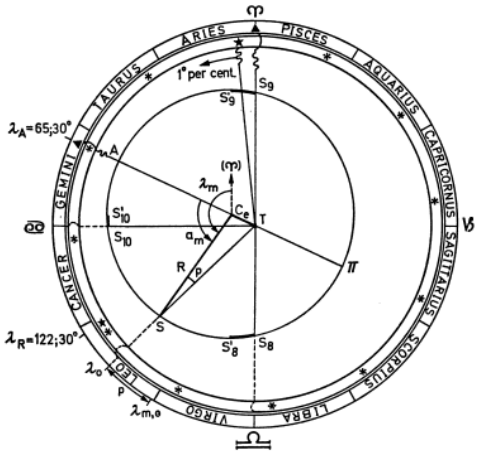

Figure 1. PTOLEuv's solar model. Eccentricity exaggerated. The stellar sphere has no real significance in PzOLEMY, but is shown for comparison with TiiAair's model. Its position corresponds to about A.D. 140.

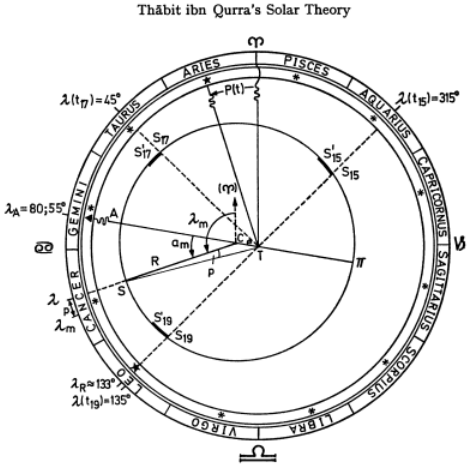

Figure 2. Thabit's solar model. Eccentricity exaggerated. Position of stellar sphere and of solar apogee shown for about A.D 830.

Thabit's proof of the movement of the sun.

The fundamental difference between Ptolemy and Thabit's theory lies in the movement of the sun. Ptolemy argued that the movement of the sun was constant over a century. Meanwhile, according to thabit, the movement of the sun is always changing. In his proof, Thabit used mathematics as the basis.

The acceleration and deceleration of the Ecliptic movement corresponds to the location of the movement found in Eccentric. Thabit re-examine the problem by reviewing in book III in The Almagest relating to the movement of the sun in its eccentric orb: Ptolemy said that the sun has a circular path equation on its orb. He stated that the apparent movement occurs the slowest when the sun is in apogee and the fastest when the sun is in perigee.

Using geometry, thabit shows that it is true for common problems. He considered the problem with the existing theory: Given an eccentric ABC with center D,

through circular motion it becomes the star or center of the epicycle. From Earth E, one of these displacements occurs in the ecliptic A'B'C ', and this actual movement is moving irregularly.

Given the arc equation in eccentric: GF on both sides of the apogee A, HI on both sides of perigee C, BK adjacent to A, LM adjacent to C. The corresponding motion is observed in the ecliptic in arcs G'F', H'I', B'K', L'M '. So Thabit proves geometrically from Euclid's element that, G'F '<B'K' <L'M '<H'I'. So he concludes: Thus, the movement of the ecliptic is very slow when it is at point A and the fastest at point C. the movement when it is near point A is slower than at points farther from point A.

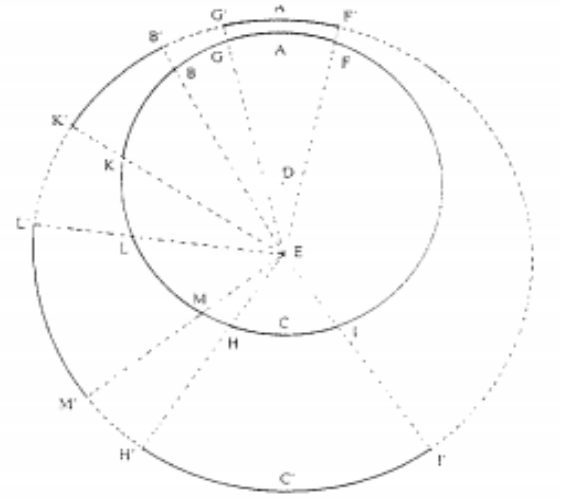

Figure. 1

From this we can see that Thabit is talking about the speed of a movement going to the apogee and perigee. After this first theory,Thabit proved the second theory : Given an eccentric ABC with center D and the ecliptic with center E, point B and F eccentric where the distance to apogee A in real movement is a quarter circle and given two points H and I on the eccentric. In accordance with H 'and I' on the ecliptic, for example, the angle of IEB is the same as the angle of HEB.

e *HEB*.

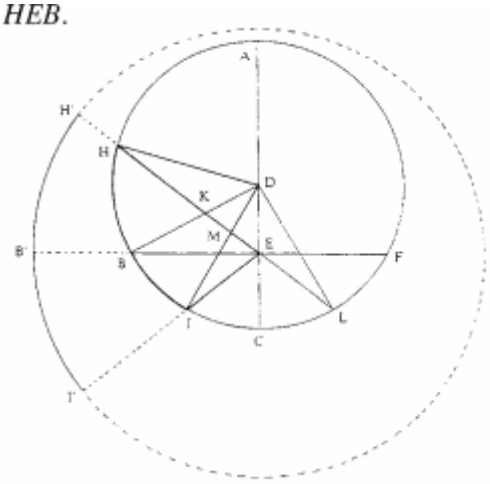

Figure 2.

Here Thabit proves geometrically that the HDI angle equals the HEI angle, so that the sum of the two angular movements on the arcs HB and BI is equal to the sum of the arc movements H'B 'and B'I'. And the same result will be obtained using the analogy of arcs around point F. And Thabit summed up the following:

The closer the moving motion is to point B or point F, and each time someone takes a point opposite to point B or point F, the two arcs which are similar apparet motion on the ecliptic, and the amount is the same as in the real motion. Points B and F are two points which directly resemble two points of a real motion.

So these two theories allowed Thabit to analyze mathematically, and this analysis allowed him to place two axes of symmetry the first in AC for real motion on the eccentric and the other in BF for real motion on the ecliptic when both are observed from point E.

Celestial Sphere : A Modeling From of The Universe

Although Ptolemy and Copernicus had different views on the central theory of the solar system, they modeled the universe as a sphere called the celestial sphere. The celestial sphere is a sphere with the observer's position or reference point as the center of the sphere and celestial objects as the object of observation located on the sphere's surface.

There are three kinds of celestial spherical, namely:

a. *Topocentric celestial sphere*

Topocentric celestial sphere is a celestial sphere that uses the earth's rotational motion as the main consideration and the actual position of the observer as the center of the ball. The actual position of the observer is expressed in terms of position coordinates, that is, in longitude and latitude.

b. *Geocentric celestial sphere*

Geocentric celestial sphere is *celestial sphere* which uses the earth's revolutionary motion as the main consideration and the earth itself as a whole is used as the center of the sphere.

c. *Heliocentric celestial sphere*

Heliocentric celestial sphere is *celestial sphere* which using the sun as a center sphere.

- Time duration calculations in a day by Ptolemy

$$\text{H in a day} = {}^{360}/_{\omega_a}, \text{which } \omega_a = 1° \text{ per century}$$
$$= {}^{360}/_{1°} = 360°$$
$$= 360 \text{ x } 4 \rightarrow \text{which } 1° = 4 \text{ minutes}$$
$$= 1440 \text{ minutes, because } 1 \text{ hour} = 60 \text{ minutes}$$
$$= \frac{1440}{60} = 24 \text{ hours}$$
$$\text{So that } 360° = 24 \text{ hours}$$

So that the calculations made by Ptolemy for the duration of time in a day are 24 hours.

- Time duration calculations in a day by Thabit Ibn Qurra

$$\lambda_A(t_{13}) = \lambda_A(t_0) + \omega_A \,.(t_{13}\text{-}t_0)$$
$$(80;55°) \quad 59;08° \quad 21;47°,$$
$$a_m(t_{13}) = a_m(t_0) + \omega_A \,.(t_{13}\text{-}t_0)$$
$$(277;55°) \quad 59;08° \quad \text{rev.} + 7;53°$$
$$\lambda_A(t_{13}) + P(a_m) + a_m(t_{13}) = 360°$$
$$(82;55°) \qquad 277;05°.$$

Because of $360° = 24$ hours, then the calculation of Thabit Ibn Qurra for the duration of the day is 24 hours.

C. Determination of The Prayer Times

1. Shubuh Prayer Time

The Fajr prayer time starts from the dawn of Sadiq until the sun rises. In Arabic terms, the meaning of Fajar does not refer to the rising of the sun. However, the definition of Dawn refers to the slightly bright white light that spreads across the eastern horizon just before the sun rises.

2. Dzuhur Prayer Time

The time for Dzuhur prayer starts from the time the sun leans to the west after being overhead or it is usually called the slide of the sun.

3. Ashar Prayer Time

The time for Asr Prayer begins when the length of the image of an object becomes as long as the length of the object itself.

4. Maghrib Prayer Time

Maghrib prayer time starts from the setting of the sun or the disappearance of all the sunsets and ends until the disappearance of the red clouds.

5. Isya' Prayer Time

Starting from the end of Maghrib time all night until early morning when dawn Sadiq rises. From this explanation, it can be concluded that the determination of prayer times cannot be separated from the movement of the sun.

From this explanation, it can be concluded that the determination of prayer times cannot be separated from the movement of the sun.

D. The Iinfluence on Prayer Time

In determining prayer times, the movement of the sun against the earth is taken into account. Including the location of the culmination, sunrise, and sunset. This is influenced by the angular velocity of the sun in motion. Meanwhile, Thabit argues that the movement of the sun is not always constant. This is different from Ptolemy who said that the sun's movement is constant 1 °. So it can be concluded that the results of research or corrections to Ptolemy's thabit research have an effect on determining prayer times.

CONCLUSIONS

From the results of the research we have presented it can be concluded that the discovery of Thabit Ibn Qurra's influence on the determination of prayer times.

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