International Beginnings Of Qamerî Months And Hijrî Calendar Unity Congress

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SIGHTING OF CRESCENT BY COMMUNICATED TRADITION AND MENTAL PROOFS

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INTERNATIONAL HIJRI CALENDAR UNION CONGRESS
28-30 MAY 2016

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1. OBJECTIVE

The purpose of our presentation is to explain how to determine the new Hijrî Lunar Month in line with the commands of our religion and with the light of astronomical knowledge.

2. MONTHS OF FASTING, HAJJ AND SACRIFICE (adha) ARE DETERMINED BY "NASS" (âyât-i karimas and hadîth-i sherîfs)

It was clearly narrated that the first days of lunar months – especially Ramadan and Dhu'lhijja months- to be determined by sighting the crescent.

a. Ayat-i karimas and Hadîth-i Sherîfs about observation of crescent:

- **"They are asking you about crescents, say that they are the mîqats (time signals) for humans and Hajj"** (Sura-i Baqara, 189th âyet-i kerîma). Mustafa Sabri Effendi has shown this âyet-i kerîma as a proof for this issue.

- In a hadîth-i-sherîf quoted in **Marâqil-falâh,** it is declared: **"When you see the Moon, start fasting! When you see her again, stop fasting!"**

- **"Don't fast unless you see the crescent: don't perform 'iyd unless you see it, either. If your horizon is clouded, use your evaluation"** (Bukhari, Muslim, Nesai, Darimi, Muwatta-i Imam-i Malik, Musned-i Ahmed bin Hanbel).

- **"Fast on the condition of sighting the Moon and make 'iyd on the condition of consecutive sighting. If the sky is cloudy, complete (the month of) Sha'bân up to thirty"** (Bukhârî, Muslim,Tirmizî, Nesâî, Dârimî, Musned-i Ahmed bin Hanbel).

- It is stated as follows on the two hundred and eighty-ninth page of the first volume of (**Ibni Âbidîn)**, in the section on how to find the direction of qibla: "Scholars said that we should not trust calendars in learning the first day of Ramadân-i-sherîf. For, the fast becomes fard after the new moon is seen in the sky. Our Prophet 'sall-Allâhu 'alaihi wa sallam' stated: **'Begin to fast when you see the new moon!'** On the other hand, the appearing of the new moon depends on calculation, not on seeing it; calculation is valid, and the new moon appears on the night indicated by calculation. Yet it may be seen on the following night instead of that night, and it is necessary to begin the fast on the night it is seen, not on the night it must appear (according to the calculation). Such is the commandment of Islam."

b. There is no permission for ijtihad in Nass [i.e. âyat-i karimas and hadîth-i sherîfs]

As is seen, after the clear commandments of ayat-i karîmas and hadîth-i sherifs there is no permission for ijtihad in this issue as is written in the 14th article of Majalla. Because this article states: "There is no permission for ijtihad where there is Nass."

Furthermore, it is written in **(Tabyin-ul-haqaiq)** by Othman bin Ali Zaylai as annotation to the work **(Kanz)** and in **(I'ânet-ut-tabilin)** of Abu Bakr Shata, that there is ijmâ' (unanimity) in certainty of Ramadân that it must be determined by sighting the crescent or by completing the month of Sha'bân to 30 days.

c. It is certain with communicated and mental proofs that the time of crescent cannot be calculated.

Islamic Scholars, Islamic Astronomy Experts and Modern Astronomy Organizations and Experts have all clearly stated in their various works that the sighting of crescent would never be possible by calculations but only by observation.

- According to this command, the month of Ramadân begins when the waxing moon (the new crescent) is first sighted. In **(Ibni Âbidîn)'**s discussion of the qibla and in the books **(Ashî'at-ullama'ât)** and **(Ni'mat-i islâm),** the authors 'rahmatullâhi ta'âlâ 'alaihim ajma'în' note that starting to fast by referring to a calendar prepared beforehand or by calculation before seeing the new crescent is not permissible.

- Again **(Ibni Âbidîn)** declares, (…Determination of beginning of Ramadân is not to be based on astronomical calculations, because, the start of Ramadân-i sherîf happens with sighting of the crescent in the sky. The hadîth-i sherîf declares, **(Begin fasting upon sighting the crescent!)**. The birth of crescent can be found by calculation. The time of ijtimâ' (conjunction) is highly accurate. However, the crescent can be seen the second evening as well as the evening following the conjunction. It has been ordered that the beginning of Ramadân must be based on ru'yet (sighting), not by the birth of moon (conjunction).) However, the beginning of Ramadân cannot be based on the calendars (almanacs), because they give the time of conjunction based on calculation, and not the time of sighting of the crescent.

- It is written in **(Fatâwâ-i-Hindiyya)** as well that it is not permissible to begin (fasting in) Ramadân or (to stop fasting in order to celebrate the) 'Iyd by (taking the) calendar or calculation (as a guide). When the crescent is seen in a city at the thirtieth night of Sha'bân, it becomes necessary to start fasting all over the world. The crescent seen during the day belongs to the night to come.

- It is wâjib-i-kifâya to look for the new crescent on the thirtieth of the month of Sha'bân at the time of sunset and to go to the Qâdî and inform him as soon as they see the new moon. Taqiy-y-ud-dîn Muhammad ibni Daqîq states that the new moon can never be sighted before one or two days after the **ijtimâ'i neyyireyn = conjunction.**

- It is written in the book **(Majmû'a-i Zuhdiyya)**: "A person who sees the new moon of the month of Shawwâl cannot break his fast. For, in cloudy weather, it is necessary for two men or one man and two women to give the testimony of having seen the new moon of Shawwâl. If the sky is clear, it is necessary for many people to witness the moons of Ramadân and Shawwâl."

- It is stated in **(Qâdî-Khân)**: "If the new moon sets after the Shafaq, (night prayer,) it belongs to the second night (of the new month); if it sets before the Shafâq, it belongs to the first night.

- Elmalili Hamdi Effendi states in his article in the 22nd volume of (**Sebil-ur-Rashad)** magazine, "Since the Shari'at has tied up the start of fasting not to astronomic rules but to observation, it has not considered calculations at this point."

- Again Elmalili Hamdi Effendi states in the same article, "Tiding of the start of fasting to observation of the crescent and the cause of this observation to the start of the fasting have been declared free from any doubt. Saying observation, on the other hand, should be understood as sighting the crescent of the month since the month itself would not be able to be observed.

  The hadith-i sherif, "**Don't fast unless you see the crescent: don't perform 'Iyd unless you see it, either. If your horizon is clouded, use your evaluation"** is an evidence for showing that the 'observation' mentioned in the âyet means observation of the crescent and that the main reason for the case is observation without any doubt. According to this âyet-i kerîma and this hadith-i sherif it is not possible to determine the sighting of the moon with the calculation of the moon.

- Fatin Gokmen Effendi, Chairman of Observatory and committee preacher of Dar-ul-funun, writes in his article in the 22nd volume of **(Sebil-ur-Rashad)** magazine, "Unanimity of men of Shari'at stated that if the seeing of crescent of Ramadan and crescent of 'Iyd-al-Adha is not possible, the previous month has to be completed to 30 days. Their evidence for this is the hadith-i sherif which purports, **"Perform fasting when you see the crescent and perform the 'Iyd when you see it again; if the crescent is unseen because of cloud or similar things, then use your evaluation."** Majority of men of Shari'a have interpreted the evaluation to adding the previous month up to 30 days. The reason leading them to this interpretation is the mentioning of **"Perform fasting for 30 days", "Complete the month Sha'bân to 30 days", "Add up to 30 days"** in the places of **"use your evaluation"** in other hadith-i sherifs declared for the same matter.

- "Although I do not put forward the decisions of the committe of astronomers as the only evidence for the official (canonical) proof, I consider it as more legal not to suffice with two witnesses contradicting the decision of the committee of astronomers." That is, the two witnesses' reporting sighting before the calculated time is not valid. Because, the computation (of the time of conjunction is accurate), the crescent cannot be sighted before conjunction.

- In response to the letter of Religious Affairs Directorate dated 30.04.1963 and no: 12712 about determining the first day of Hijri Lunar Months, Istanbul Technical University sent a letter with an attachment prepared by Prof. Hamit Dilgan of Faculty of Architecture, Advanced Mathematics Department, which reads:

  "It is possible that even if all favorable observation conditions cited below are realized, it may not be possible to see the New Moon (crescent).
  …..
  In brief, it is important to differentiate between the possibility of observation of the crescent, and its being in sightable position."

  It is understood from this that the accurate determination of the first days of Hijri Lunar Months is possible only by sighting. The computation (in this case) is estimation. It is not definite.

- As a matter of fact, the Presidency of the Religious Affairs of Turkey has published the statement, "**In order to start of a Lunar Month, sighting the crescent is a must as per the order of Hadrat Prophet**" in the website given below:

  http://www2.diyanet.gov.tr/DinHizmetleriGenelMudurlugu/Sayfalar/Tanim.aspx (05.2016 21:00)

d. Necessary information communicated by Islamic Scholars and Islamic Astronomy experts about sighting of the crescent:

- At places where Ramadân and the month containing the days of 'Iyd cannot be determined by testimony of witnesses as prescribed by the Sharî'a, the first day of the month of Dhu'lhijja and hence the tenth day, that is, the first day of the 'Iyd of Adha are calculated. The first day of the 'Iyd is the day determined by this calculation. Or it is the next day. It cannot be the previous day. Because the New Moon cannot become visible before it appears in the sky.

- The Moon not only accompanies the Sun and the stars in their daily east-west motions, but also moves solo in a west-east direction around the Earth. This motion is faster than the Sun's (apparent) annual motion from west to east. The moon completes one revolution in 27 days plus 8 hours. Therefore, it completes its daily tour approximately fifty minutes plus 30 seconds after the stars. The Sun, on the other hand, completes its tour four minutes after (the stars). Consequently, the moon reaches the meridian later than the Sun did the previous day and sets 45 minutes after the Sun the first night. There is an angle of approximately five degrees between the plane of the lunar orbit and the ecliptic plane. Once each revolution, the Sun, the Earth and the Moon become aligned with one another, the Sun and the Moon are on the same side with respect to the Earth. This state of collinearity is called **Ijtimâ'i neyyireyn = Conjunction**. In this state the side of the Moon facing the Earth is unilluminated. We cannot see the Moon. This period of time is called **(Muhâq)** (Interlunar Period, Dark Moon, or Dark of the Moon). The length of the period of muhâq is not constant. It varies from twenty-eight hours

to seventy-two hours. The Ottoman calendars give a maximum of three days [72 hours]. The time of conjunction is exactly the middle of the period of muhâq. Scientific calendars provide monthly tables showing the variations in its length. Since the Earth revolves around the Sun, too, the duration of time between two conjunctions is 29 days and 13 hours. At the time of conjunction, the Sun and the Moon pass the meridian at the same time. The Moon can by no means be seen anywhere before the angle between the Sun and the Moon as seen from the Earth, which is termed **Beynûnet** (elongation), reaches eight degrees [approximately fourteen hours after the moment of conjunction]. When the angle becomes 18 [eighteen] degrees at the maximum, the Moon comes out of the state of invisibility and the New Moon (crescent) appears on the western horizon within the 45 minutes following sunset. However, due to the 57 minutes lunar parallax, when it comes to a position 5 degrees above the horizon, it can no longer be seen. After the Moon comes out of the state of invisibility, the new Moon can be observed in places situated on the same longitude as the location where the sunset is taking place. As for later hours, or, at night it can be observed after sunset in countries to the west of these places.

- The purpose for these calculations is not to determine the time when the lunar month begins, but to determine the (beginning of the) month when the New Moon (crescent) can be seen. Imâm-i-Subkî also said so. We should not believe people who falsify the Imâm's statement. The sighting of the Moon can be on the day given by the calendars (computed) or the next day but it cannot be a day before **(Commentaries of Tahtâwî and Shernblâlî)**.

- It is an act of worship to look for the new moon in the sky. As is seen, announcing the beginning of Ramadân-i-sherîf beforehand is an indication of not knowing Islam. Likewise, the first day of the 'Iyd of Qurbân [adha] is determined by observing the New Moon for the (beginning of the) month of Dhu'lhijja. The ninth day of the month of Dhu'lhijja, the 'Arafa Day, is the day found by calculation or calendar, or the following day. The hajj performed by those who climb the 'Arafât a day earlier is not valid. So none of them can be a hadji. It is wajib to observe the Ramadân crescent over the apparent horizon on the west when the sun sets on the 29th day of Sha'bân.

- When an 'âdil person, that is, a person who does not commit grave sins, having Ahl-as-sunna belief, sees the crescent in a cloudy weather, he informs the judge or the governor. If he [judge or governor] accepts, Ramadân starts at all places. At places where there is no judge or governor, the Ramadân starts when a Muslim sights the crescent.

- The words of a bid'at holder, a fâsiq are not acceptable. In a clear weather, a lot of people must report. If the crescent is not observed, the month Sha'bân is considered thirty days and the next day becomes Ramadân. Ramadân does not start with calculation or astronomical calculations.

- It is stated in **(Bahr), (Hindiyya)** and **(Qâdi-Khân),** "If a prisoner in dâr-ul-harb fasts for one month without knowing the beginning of Ramadân, he might have started fasting one day earlier, on the second day or on exact day. In the first case, he will have started one day before Ramadân starts and made 'Iyd on

the last day of Ramadân. In the second case, he will not have fasted on the first day of Ramadân and he will have fasted on the ’Iyd as his last day of fasting. In both cases, he will have fasted for twenty-eight days of Ramadân and he will have to make two days of qadâ after the ’Iyd. On another possibility as the third case, it is doubtful that all thirty days of his fasting match the real time of Ramadân. For the fasting on the doubtful days will not be sahih, he has to make two days of qadâ.” It is understood from this that those who start fasting not by seeing the crescent but by calendars which are prepared earlier, must make two days of qadã after the ’Iyd. It is, for instance, said, “How is it made up fasting two days as qadâ after Ramadân? There is no such thing in any book.” It is wrong to say this is not written in books. For Ramadân would start by sighting the crescent in every place at that time. There was no need to fast two days as qadâ. Today, however, the month of Ramadân is being started at the time when the New Moon is beforehand calculated to be sighted. Therefore, the beginning of Ramadân is out of keeping with the ahkâm-i-islâmiyya (rules of Islam). This misapplication should be rectified by fasting for two days with the intention of qadâ after ’Iyd of Ramadân is written in Tahtâwî’s annotation to (Shernblâlî’s commentary to) **(Marâq-il-falâh)**. If one begins fasting without sighting the New Moon (crescent) indicating the beginning of Ramadân and then if the New Moon (crescent) is observed on the twenty-ninth night, which will mean (that the following day is the beginning of the following month, Shawwâl, the first day of which is at the same time the first day of) ’Iyd, qadâ for one day is performed, (that is, one fasts one day again), after the ’Iyd, if the month of Sha’bân is known to have begun upon the observation of the New Moon. On the other hand, it is written in (the celebrated books) **(Hindiyya)** and **(Qâdi-Khân)** that, if the month of Sha’bân is not known to have begun upon the observation of the new moon, one makes qadâ for two days, (that is, one fasts for two days with the intention of qadâ.)

- **(Ibni Âbidîn)** “rahima-hullahu ta’âlâ declares in his work **(Radd-ul-mukhtar),** “It is wâjib-i kifâya for all wise and bâligh (at the age of puberty) to look for the crescent, that is, the new moon in the sky in the beginning of the month of Ramadân. It is also wâjib to inform the qâdi, that is, the judge when they see [the crescent]. It becomes fard for all Muslims [in all countries] to fast that day when the qâdi accepts and announces [the beginning of Ramadân]. In cloudy weather, the word of one ’âdil Muslim is accepted. A lot of people have to have reported in clear weather. At places without a Qâdî or a Muslim governor, Ramadân begins when an ’âdil person says he has seen the new moon and those who hear this, have to start fasting**. It is not permissible to start Ramadân with calendar, with calculation. There is no value of their calculation to start the Ramadân even if they are ’âdil.** The fasting for Ramadân does not start with the report of them about the rising day of the Ramadân crescent.

- Imâm-i Subki “rahima-hullahu ta’âlâ”, one of Shafi’î scholars, says, “If there is somebody claiming to have seen the crescent on the night of the thirtieth of Sha’bân but if it is informed one night after according to the time determined by calculation, in this case, the calculation is to be believed. For the one determined by calculation is definite. It is impossible to be seen before it rises.”

[Beginning of Ramadân by seeing the crescent can be one day after the day found by calculation. But it can't be one day before.]

- Shams-ul-aimmah Halwânî "rahima-hullahu ta'âlâ" declared, "Beginning of the month of Ramadân becomes by seeing the crescent. It doesn't become by rising of the crescent. Since the calculation determines the night when the crescent rises, the beginning of the month of Ramadân cannot be understood with calculation. **When Ramadân begins at one place** upon two 'âdil Muslims' saying "we have seen the crescent" or with the judge of the qâdi, **it becomes necessary to begin fasting in all parts of the world. The times for hajj, qurbân [sacrifice] and prayer times are not so. When times for these are determined according to one place will not necessitate being the same at other places, as well."** [In other words, these three are local.]

3. INFO AT USNO (U.S. NAVAL OBSERVATORY) WEBSITE ABOUT OBSERVATION OF CRESCENT

USNO is a deep-rooted organization operating in scientific activities in the USA. Its main duty is to provide information to the US Maritime Force and Ministry of Defense about positioning, timing and navigation. USNO has also been operating the Main Time system which is providing sharp time data for GPS satellite systems that is operated by the American Air Forces.

https://en.wikipedia.org/wiki/United_States_Naval_Observatory

The original English text of the explanation of observation of crescent in the website of USNO has been attached to this letter and the link to the site is below:

http://aa.usno.navy.mil/faq/docs/crescent.php (2016-05-25 22:52)

The first sentence of the information on the website of USNO regarding the observation of crescent reads as:

"Although the date and time of each New Moon can be computed exactly, the visibility of the lunar crescent as a function of the Moon's "age"—the time counted from New Moon—depends upon many factors and cannot be predicted with certainty."

4. THE HEBREW CALENDAR

Bukhârî narrates from İbn 'Abbâs the following hadîth-i sharîf. "When Rasûlullâh honored Madîna, upon finding the Jews fasting, and asking, (What fasting is this?) and getting the reply (This is a pious day. This is the day on which the banî İsrâîl was redeemed from the wickedness of the pharoah, their enemy. Hadrat-i Mûsâ performed fast on this day for thanksgiving), Resûlullah, declared (We have more right with Mûsâ than you do), and performed fast, and he ordered his As-hâb also to do so." Al Bîrûnî reports that the abovementioned day was the tenth of the Tashrî (Tishrei) month of the Hebrew calendar.

That is to say that, at present time also, the Jews determine on the basis of ru'yet and observers (witnesses), the beginnings of the months in their special "Lunar" (designed according with the orbiting of the Moon) calendar. They record,

the (results of) observations, together with the names of the locations, dates, times and observers, and publish and use them. This calendar is the “Hebrew Calendar”, which is also callled the Mûsavî and Yahûdî Calendar. Please see the following link for details.

(https://tr.wikipedia.org/wiki/%C4%B0brani_takvimi)

For example, it has been reported that the crescent of the 2nd Biblical month, was observed on 2016 May 7, at the locations cited below, by the persons cited, and May 8th was taken as the beginning day of the month. This coincides with the month “Sha’bân” of our Hijrî Qamerî calendar as determined by ru’yet. They all coincide with the ru’yet based beginnings of the Hijrî Qamerî months, because the advent of every month was determined by ru’yet. The following link displays the sightability map for every month, which they published prior to observations.

http://renewedmoon.com/ (2016-05-26 00:20)

Bali, Indonesia [Ahmad Adji (6:24pm/UCT+8)]
Poriyallit, Israel [Rebecca Biderman (7:47pm/UCT+2)]
Jerusalem, Israel [Devorah Gordon (7:49**pm**/UCT+2)]

The crescent of the 1st Biblical month (which coincides with the month Rajab) was sighted on 2016 April 8, from at the locations and by the persons cited below, and April 9 was taken as the first day of the month in the calendar they use.

http://renewedmoon.com/archived-reports/archive.htm?d=2016-2017-01 (2016-05-26 00:23)

Darwin &Perth, Australia [ShabbirAhmed (approx. 6:45pm/UCT+9:30)]
Colombo, Sri Lanka [Nimal Road Mosque (approx. 6:19pm/UCT+5:30)]
Gothenburg, Sweden [MiltonAbili (21:15)]

5. OBSERVATION OF THE RAJAB-1437 CRESCENT

From time to time, our Hay’at (committee) arranges ru’yet-i hilâl (crescent sighting) observations. For instance, for the sighting of the crescent of Rajab month of the year 1437, an observation application was arranged on the evenings of April the 7th and 8th, but, contrary to the Turkish calendars, neither in Turkey nor anywhere on Earth, no crescent could be sighted on Thursday, April 7. Another observation was arranged on Friday, April 8, and the crescent was sighted and photographed. According to the observation, the month of Rajab of the year 1437 started on April 8, 2016. The digital photographs and the video record can be viewed in the link below.

http://www.turktakvim.com/index.php?link=html/rasadlar/rasadlar.html

6. CONCLUSIONS AND PROPOSALS

It has been proven by both scientific and Islamic evidences that it is necessary to determine the first days of the Qamerî Months by sighting of the Moon (Qamer) based on naked-eye observations.

It is evident by “Nass” that sighting of the Moon is necessary for determining the first days of Ramadân and ’Iyd months. It is not permissible to do ijtihâd on matters about which there is Nass.

The fact that the sighting time of the Moon for determining the first days of these and all the other Qamerî months cannot be computed, is explicitly stated in the relevant USNO website.

Since the naked-eye Moon sightings are taken as basis for determining the beginnings of the Qamerî months, it is necessary to act in accordance with the days determined by observations, and not the days given in calendars based on the computations of the New Moon crescent.

In brief, the beginnings of the Qamerî months should be determined by observations.

Furthermore, the relevant practice on this matter in Muslim countries, since ‘Asr-i Sa’âdet, is evidently known based on traditional and scientific documents.

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CRESCENT MOON VISIBILITY

Although the date and time of each New Moon can be computed exactly, the visibility of the lunar crescent as a function of the Moon's "age"—the time counted from New Moon—depends upon many factors and cannot be predicted with certainty. During the first two days after New Moon, the young crescent Moon appears very low in the western sky after sunset, must be viewed through bright twilight, and sets shortly after sunset. The sighting of the lunar crescent within one day of New Moon is usually difficult. The crescent at this time is quite thin, has a low surface brightness, and can easily be lost in the twilight. Generally, the lunar crescent will become visible to suitably-located, experienced observers with good sky conditions about one day after New Moon. However, the time that the crescent actually becomes visible varies quite a bit from one month to another. Naked-eye sightings as early as 15.5 hours after New Moon have been reliably reported while observers with telescopes have made reliable reports as early as 12.1 hours after New Moon. Because these observations are exceptional, crescent sightings this early in the lunar month should not be expected as the norm.

The visibility of the young lunar crescent depends on sky conditions and the location, experience, and preparation of the observer. Generally, low-latitude and high-altitude observers who know exactly where and when to look will be favored. For observers at mid-northern latitudes, months near the spring equinox are also favored, because the ecliptic makes a relatively steep angle to the western horizon during these months. The steep angle means the Moon's altitude will be greater just after sunset.

Ignoring local conditions for the moment and visualizing the problem from outside the Earth's atmosphere, the size and brightness of the lunar crescent depend on only one astronomical quantity: the *elongation* of the Moon from the Sun, which is the apparent angular distance between their centers. For this reason, the elongation has also been called the *arc of light*. If the value of the elongation at any instant is known, the width of the crescent can be computed.

The elongation as a function of the Moon's age depends on several factors:

1. **The Moon's elongation at New Moon.** The elongation of the Moon at New Moon is not necessarily 0. The Moon's center may pass directly in front of the Sun at New Moon (when a solar eclipse will occur) or it may be as much as five degrees to the north or south of the Sun. That is, the Moon can *start* the month with an elongation ranging from zero to five degrees. A minor complicating factor involves the definition of New Moon in the almanacs. Astronomical New Moon is defined to occur when the Sun and Moon have the same geocentric ecliptic longitude, which may not occur precisely when the Sun and Moon are closest together in the sky.
2. **The speed of the Moon in its orbit.** The Moon's orbit is elliptical, and its speed is greatest when it is near perigee (closest to the Earth), least near apogee (furthest from the Earth). The change in speed is caused by conservation of angular momentum; the same principle causes a spinning ice skater to speed up when she pulls her arms inward. If perigee occurs near New Moon, the Moon will appear to be moving away from the Sun in the sky at a greater than average rate.
3. **The distance of the Moon:** Because of its elliptical orbit, the distance of the Moon varies. Even if the Moon moved with a constant speed, its angular motion as viewed from the Earth would be greater when the Moon is near perigee. Similarly, a nearby automobile appears to be moving quicker than a more distant one, even if they are actually moving at the same speed.
4. **The observer's location (parallax).** If the observer is located in the tropics such that the one-day-old-Moon is observed just before it sets, its elongation as seen by the observer will be about a degree less than that seen by a fictitious observer at the center of the Earth, which is the position used for most almanac calculations. Similarly, if you look at a foreground object with one eye closed and then close that eye and open the other, the object makes an apparent jump against the background. The change in the observed elongation is less for observers at middle or high latitudes; however, other geometric factors are less favorable for these observers.

Factors (2) and (3) are linked by Kepler's second law, which predicts that the angular speed of the Moon as seen from the Earth will vary by about 22%. The combined effect of the first three factors gives geocentric elongation of the Moon from the Sun at an age of one day can vary between about 10 and 15 degrees. The last factor can subtract about a degree for an observer at the equator.

This large range of possible elongations in the one-day-old Moon is critical. At this time the width of the crescent is increasing with the square of the elongation, and the surface brightness of the crescent is also rapidly increasing. The apparent area of the crescent also increases inversely with the square of the distance to the Moon. Some of the earliest reliable sightings of the crescent occur near elongations of around 10 degrees. Simply specifying the age or elongation of the Moon cannot tell the whole story. But the elongation is a more reliable parameter to use *as a starting point* in assessing the lunar crescent visibility at any given date and time.

The prediction of the first sighting of the early crescent Moon is an interesting problem because it simultaneously involves a number of highly non-linear effects. Stated in less technical language, many things are changing very rapidly. Effects to be considered are the geometry of the Sun, Moon, and natural horizon; the width and surface brightness of the crescent; the absorption of moonlight and the scattering of sunlight in the Earth's atmosphere; and the physiology of human vision. This problem has a rich literature. Some modern astronomical references are:

- Caldwell, J.A.R. & Laney, C.D. 2001, "First Visibility of the Lunar Crescent",*African Skies*, No. 5, pp. 15–23
- Doggett, L. E. & Schaefer, B. E. 1994, "Lunar Crescent Visibility," *Icarus*, Vol. 107, pp. 388–403.
- Fatoohi, L.J., Stephenson, F.R., & Al-Dargazelli, S.S. 1998, "The Danjon Limit of First Visibility of the Lunar Crescent," *The Observatory*, Vol. 118, pp. 65–72
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- Schaefer, B. E. 1988, "Visibility of the Lunar Crescent," *Quarterly Journal of the Royal Astronomical Society*, Vol. 29, pp. 511–523
- Schaefer, B. E., Ahmad, I. A., & Doggett, L. E. 1993, "Records for Young Moon Sightings," *Quarterly Journal of the Royal Astronomical Society*, Vol. 34, pp. 53–56

Her Majesty's Nautical Almanac Office computes and distributes predictions of lunar crescent visibility. The *Astronomical Calendar* by Guy Ottewell includes good diagrams of the positions of young and old Moons during the year (drawn for the eastern U.S.) and an explanation of the factors affecting their visibility.

Related information on these web pages includes:

- Phases of the Moon and Percent of the Moon Illuminated (definitions) in **FAQ**
- Dates of Primary Phases of the Moon in **Data Services**
- Fraction of the Moon Illuminated in **Data Services**
- What the Moon Looks Like Today in **Data Services**
- Complete Sun and Moon Data for One Day in **Data Services**
- Sun or Moon Rise/Set Table for One Year in **Data Services**
- The Islamic Calendar in **FAQ**