



Islamic Center of Boston, Wayland

**WILL HENCEFORTH BE FOLLOWING THE
RECOMMENDATIONS OF**

THE FIQH COUNCIL OF NORTH AMERICA

REGARDING THE ADOPTION OF AN

ASTRONOMICALLY CALCULATED ISLAMIC CALENDAR

**DETAILED INFORMATION ABOUT THIS DECISION AND
A CALENDAR FOR THE NEXT FIVE YEARS ARE
PROVIDED IN THIS DOCUMENT.**

September 7th, 2007

RAMADAN AND EID ANNOUNCEMENT BY THE FIQH COUNCIL OF NORTH AMERICA (REVISED)

09- 5-07 15:21

The Fiqh Council of North America in its meeting in Herndon, Virginia on July 31-August 1, 2007 noted with satisfaction the recent Fatwa of its counterpart in Europe “the European Council for Fatwa and Research” related to the permissibility of the use of calculation method for determining the beginning of Lunar months including the months of Ramadan and Shawwal.

The position of ECFR is very similar to the position of FCNA adopted last year on June 10, 2006, with a minor difference. FCNA adopted the position that the conjunction should occur before noon at Greenwich time. ECFR has adopted Makkah al-Mukarram as a conventional point and took the position that the conjunction must take place before sunset in Makkah and moon must set after sunset in Makkah.

FCNA after careful discussion has revised its position and has adopted the Fatwa of ECFR. This revised position will change only a few dates in the Fiqh Council’s Five year calendar; but it will bring greater harmony and unity among the Muslims communities in the West.

On the basis of this new position the dates of Ramadan and Eidul Fitr for this year are as follows:

1st of Ramadan will be on Thursday, September 13, 2007

1st of Shawwal will be on Saturday, October 13, 2007

Ramadan 1428 AH:

The astronomical New Moon is on Tuesday, September 11, 2007 at 12:44 Universal Time (3:44 pm Makkah time). Sunset at Makkah on September 11 is 6:28 pm local time, while moonset at Makkah is at 6:24 pm local time (4 minutes before sunset). This does not meet the new criteria adopted by Fiqh Council of North America (FCNA) and European Council of Fatwa and Research (ECFR). On Wednesday, September 12, 2007, sunset at Makkah is 6:27 pm local time, while moonset is at 6:55 pm local time. Therefore, first day of Ramadan is Thursday, September 13, insha'Allah.

Eid ul-Fitr 1428 AH:

The astronomical New Moon is on Thursday, October 11, 2007, at 5:00 Universal Time (8:00 am Makkah time). Sunset at Makkah on October 11 is 6:00 pm local time, while moonset at Makkah is at 5:59 pm local time (1 minute before sunset). This does not meet the new criteria adopted by FCNA and ECFR. On Friday, October 12, 2007, sunset at Makkah is 5:59 pm local time, while moonset is at 6:32 pm local time. Therefore, first day of Shawwal, i.e., Eid ul-Fitr is Saturday, October 13, insha'Allah.

The Fiqh Council of North America

The Fiqh Council of North America is an association of Muslims who interpret Islamic law within the United States. The 18 members of the Council are Muslims who issue religious rulings, resolve disputes, and answer questions relating to the Islamic faith. As outlined in its by-laws, the Council's primary objectives include:

" To consider, from a Shari'ah perspective, and offer advice on specific undertakings, transactions, contracts, projects, or proposals, guaranteeing thereby that the dealings of American Muslims fall within the parameters of what is permitted by the Shari'ah." .

They regularly receive numerous inquiries from Muslims all over the continent and respond to them with studied opinions on issues of concern. The Council meets in face-to-face meetings as necessary, and more frequently via telephone conferences. Its members speak at various Muslim conferences and address issues of concern to Muslims in North America. The Fiqh Council of North America acts as Shari'ah Consultant to Amana Mutual Funds Trust.

The current members of the Council are:

Dr. Muzammil H. Siddiqi (Chairman)
Dr. Ahmad Shleibak
Dr. Akbar Muhammad
Dr. Deina Abdulkadir
Shaikh Hassan Qazwini
Dr. Ihsan Bagby
Dr. Jamal Badawi
Dr. Muhammad Adam Sheikh
Shaikh Muhammad Al-Hanooti
Shaikh Muhammad Nur Abdallah
Dr. Salah Soltan
Dr. Taha Jabir Alalwani
Shaikh Yahya Hindi
Shaikhah Zainab Alwani
Dr. Zulfiqar Ali Shah
Dr. Mukhtar Maghraoui
Dr. Nazih Hammad

The Fiqh Council of North America traces its origins back to the Religious Affairs Committee of the then Muslim Students Association of the United States and Canada in the early 1960s. This Religious Affairs Committee evolved into the Fiqh Committee of the Islamic Society of North America (ISNA) after the founding of ISNA in 1980. As the needs of the Muslim community and the complexity of the issues they faced grew, the Fiqh Council was transformed into the Fiqh Council of North America in 1986. The Council continues to an affiliate of ISNA, advising and educating its members and officials on matters related to the application of Shari'ah in their individual and collective lives in the North American environment.

Fiqh Council of North America - Announcement (Aug 6, 2006)

A special conference on Hilal Sighting was organized by the Fiqh Council of North America (FCNA) on 10 June 2006, in Virginia, attended by a number of jurists, Imams, astronomers and other concerned Muslims. A number of research papers dealing with the juridical and astronomical aspects of the topic were presented and discussed. After further teleconferences and communications among the members and astronomical consultants, the following is concluded:

The Fiqh Council of North America after careful research, deliberations and discussion has adopted a new position regarding the determination of the beginning of the Islamic lunar months. This position is based primarily on the following Fiqhi premises:

1. Sighting the Hilal (ru'yah) is not an act of 'ibadah in itself; it is rather a means to know with certainty about the beginning of the new month related to Islamic 'Ibadat.
2. Ru'yah as a means was indicated and used by the Prophet -peace be upon him- because he himself said that the Ummah at that time was not literate and did not know how to write or to calculate (complicated astronomical data).
3. Some classical jurists refused to allow calculations in this matter because in their time astronomy and astrology were not quite distinct sciences. Jurists were suspicious that astronomical predictions may not be based on exact science but on whims, conjectures, superstition etc.
4. During the last century an increasing number of Muslim jurists indicated that calculations could be used to negate erroneous reports of crescent sighting. Some jurists were of the opinion that calculations could also be used as a positive method to determine the new Islamic lunar months.
5. There are now many Muslim astronomers who have been working for many years to develop a global lunar Islamic calendar. Fiqh Council particularly appreciates the efforts of its consultants Dr. Imad ad-Dean Ahmad, Dr. Khalid Shaukat, Dr. Muhib Durrani and Dr. Ahmad Salamah.
6. **Dr. Salah Soltan** and **Dr. Zulfiqar Ali Shah** also presented scholarly papers to give thorough evidence from Fiqh Perspective that the use of calculations is not against the Sunnah of the Prophet -peace be upon him.

The Fiqh Council of North America considered the following factors in making its decision:

1. Use of calculations in determining the Islamic dates is not against the Sunnah.
2. Reliable astronomical methods are now available to provide a sound basis for the determination of the Islamic dates of Ramadan and the two Eids.
3. Shari'ah is based on ease and considers the convenience of people.
4. Announcement of Islamic dates ahead of time will reduce a lot of hardship, chaos and confusion that happen every year at the time of the beginning of Ramadan and the two Eids.
5. Announcement of Islamic dates will help Muslims to plan their activities, to take day off from their work, students can take day off from their schools and many other benefits will result from this.
6. Announcement of these dates will also remove unnecessary financial burdens from the Muslim community in North America.
7. Muslim of America will become more united in their celebrations.
8. Muslims of America can also work to have their Islamic holidays officially recognized.
9. The Muslim community of North America will lead a way towards **the development of a unified global Islamic calendar for the whole Muslim world.**
10. The Fiqh Council will continue working with the Imams and scholars of the communities to develop a consensus in this matter. It is, however, hoped that whether some of us agree or disagree with this position, we shall all recognize the validity of ikhtilaf in this issue and that the Ummah should be united in brotherhood despite any legitimate fiqhi differences.

The following is the decision by Fiqh Council of North America:

1. It is decided to use astronomical calculation to determine the beginning of the Islamic lunar months with the consideration of the sightability of the crescent anywhere on the globe.
2. To determine a lunar Islamic calendar, a conventional point of reference must be used. The International Date Line (IDL) or the Greenwich Mean Time (GMT) may be used.
3. The new Islamic Lunar month begins at sunset of the day when the conjunction occurs before 12:00 Noon GMT. If the conjunction occurs after 12:00 UT, then the month begins at sunset of the next day.

Brief Explanation:

A. Discussion of a number of research papers led to the conclusion that the use of calculation both in negation as well as affirmation of the beginning of the new Islamic Lunar months has a firm basis in the Qur'an and Sunnah as well as in the opinion of some classical and contemporary jurists. For more details please see the website of ISNA at <http://www.isna.net/>

B. The new moon (i.e. time of conjunction) is when the Moon passes between the Earth and the Sun closest to the Sun-Earth line. This time of conjunction is precisely predictable by astronomical calculation.

C. The conjunction before 12:00 Noon GMT would give enough time to the new moon to be visible (weather permitting) somewhere on the globe before the end of the night in North America.

Why 12:00 GMT

Primary reason is that when it is 12:00 noon GMT, it is 0:00 at International Dateline (IDL) [180:00 Longitude]. So, when sunset time comes at IDL around 6:00 to 6:30 pm, it will be 18 plus hours after conjunction, and the moon is considered sightable at the IDL or before, when its age has become more than 18 hours (in some cases by telescope only).

Secondary reason is that by choosing 12:00 noon GMT, it is also good for Global Islamic Calendar, because when it is 12:00 noon GMT, it is 0:00 at IDL. If the conjunction has occurred before that time, then the month can begin at the IDL when it is 0:00 at IDL, meaning a new day has started. This condition will not be true if we choose any other time. Also, the sightability consideration would be affected if any other time is chosen.

Explaining the Fiqh Council Position

September 12, 2006

The decision of the Fiqh Council of North America about using astronomical calculations to affirm the month of Ramadan is appreciated by many as well as being hotly debated and misunderstood by some others. We would like to explain our position for those who have some misgivings.

The Fiqh Council is not negating any Sunnah of the beloved Prophet (PBUH). We are saying that the actual sighting with the naked eyes is not required. If the moon is born and enough time has passed after conjunction to make the moon visible then we accept it whether the moon is sighted by the naked eyes or not. This is the reason why we have maintained that if the new Moon was born at 12:00 Noon GMT (or 3:00 PM in Makkah), this Moon will be around 12 to 18 hours of age by the time it reaches the North American Mat'l'a upto IDL (International Date Line). The Fiqh Council is not going with the birth of the new Moon only; it is rather going with the possibility of its sighting somewhere within the Western Hemisphere.

The Fiqh Council maintains that actual sighting is not the objective but a means to establish the objective. The objective is to start the month of Ramadan with certainty. That is why Muslims used to sight the new Moon on the 29th day of Ramadan and not on the 30th day of Ramadan. The Ahadith requiring actual moon sighting are not generic. They are restricted as they require the sighting only on the 29th day of Sha'aban or Ramadan and not on the 30th day. No jurist has ever required sighting the new Moon on the 30th of Sha'aban or 30th of Ramadan because the certainty is already achieved that the new Moon is there. If someone argues that Muslims do not sight the new Moon on the 30th day because the Prophet (PBUH) said, "Complete 30 days in case of obscurities." It will be argued that the Ahadith put the condition of completing 30 days in case of cloudy weather. What if it is not cloudy on the 29th day of the month? Are the Muslims required to sight the Moon on 30th of that month? The answer is "No". Therefore, all the Muslim jurists agree upon the fact that sighting the new Moon is a means and not the objective of the month of Ramadan.

Currently, the actual sighting method is causing a lot of difficulties for Muslims all over the world. Different countries are claiming sighting on different dates and starting the month of Ramadan and celebrating Eid on different days. In the West Muslims face more problems due to starting Ramadan at different timings and celebrating Eids on different days. The trouble is so great that even the family members are divided on the issue and young Muslims are utterly confused about this aspect of Islamic community. The issue of Moon sighting is causing problem of discord among Muslims and is a bone of contention all over the Muslim world. Therefore the argument that the Prophet (PBUH) adopted this method for the sake of making things easy for the Muslim is no more valid. This method has been playing havoc among the Muslim especially in the West for decades and is one of the main sources of disunity and rift within the Muslim community..

The astronomical calculations especially about the birth of the new Moon are absolutely precise. They can be adopted as a means of affirming the new month to avoid the problems connected with actual sighting with the naked eyes. Here we are referring to the astronomical calculations to prove the possibility of sighting and not the birth of the new Moon in an effort to try to fulfill the Sunnah in letter and in spirit. These astronomical calculations are already being used in acts of Islamic worship such as directions of Qiblah, five daily prayers, Imsak and Iftar timings, the acts of worship which are more significant and frequent than sighting the crescent. The Qura'nic verses and the Prophetic commandments clearly indicate some means to accomplish the aspired

objectives. For instance, The Qur'an connects the Imsak timings with the white and black thread at the dawn time. Presently we go by our watches based upon the astronomical calculations. The Hadith connects the Iftar timings with seeing the night coming from the East. Currently we break fast without sighting the night coming from the East but by our watches. The Qur'an and Ahadith connect the five daily prayers timings with the shadow and movement of the Sun. According to the Ahadith Angel Jibreel himself taught the Prophet (PBUH) timings of these prayers and connected them with the shadow of the Sun. The entire Ummah somehow goes by the astronomical timings of the watches and not with the letter of the Qur'an and Hadith texts. There is a consensus among the Muslim jurists that these means are permitted to determine the Salah, Imsak and Iftar timings and nobody makes fuss about them being against the Sunnah or against the crystal clear texts of the Qur'an. It is strange that some Muslims are stuck on the text of Moon sighting and not about the other texts which are more frequent and authentic. The Qur'an and Hadith texts are religious texts and must be respected without exceptions.

We also know that the Prophet (PBUH) himself affirmed the new month by just counting the 29 days and without sighting the new Moon, as the Ahadith in al-Bukhari, al-Muslim and all other authentic sources report. Eight of the known Companions of the Prophet (PBUH) including his beloved wife A'ishah, her sister Asma', Caliph U'mar, his son Abdullah bin U'mar, Abu Hurayrah, Anas, 'Amr bin al-A'as and others (May Allah be Pleased with them) used to start the month of Ramadan if the horizon was obscured on the 29th days of Sha'aban without completing the 30 days of Sha'aban (see more details in my paper on ISNA.net). They used to just count 29 days of the month of Sha'aban and start the month of Ramadan without actually sighting the new Moon or completing the 30 days of Sha'aban. Many Successors followed them in this and a whole school of Islamic Fiqh, the Hanbali school, is based upon this position in the matters of affirming the month of Ramadan in case of obscurities. That is why Muttirrif Ibn al-Shakheer, the known Taba'ee, refers his opinion of permitting use of astronomical calculations to Abdullah bin U'mar and not himself. The issue of calculations was discussed even in the first century of Hijra and has been discussed throughout Islamic history. The majority of the Classical jurists rejected the use of calculations because the calculations were not precise in their times. The calculations were usually connected with astrology and magic. Moreover, due to lack of high speed internet, telephone and other means of communication, each locality used to go by its local sighting and the Ummah did not suffer because of going with the actual sighting the way we are suffering in our times. The Fiqh Council is trying to save the Ummah this enormous wrangling and bickering while trying to stick to the letter and the spirit of the Sunnah as much as possible. We believe that our position of possibility of sighting is more precise than the actual visibility requirements. The calculations about the possibility of sighting are more precise than the calculations about the actual visibility. In reality there is no science that can give us precise visibility calculations. No astronomer has ever claimed that there is such a thing called science of accurate or authentic visibility. Even the Muslim astronomers disagree between themselves about the true criterions of the actual visibility because the visibility depends upon many variable factors. These factors are not predictable or are not 100% sure. That is why those who follow actual sighting are confused for years as to which astronomer to follow and which and how many witnesses to accept..

We feel comfortable that our new position of possibility of sighting is more precise and can help the Ummah unite in the long run, Insha'Allah. Moreover, the Fiqh Council is not imposing its decision upon anyone. It is our opinion based upon the solid Islamic principles but people have choices. We encourage every Muslim to follow the majority decision in their local area Masajid and celebrate Eid with their local communities. Muslims must show unity during the month of Ramadan and at the occasions of Eid at least locally if not nationally or internationally. That is the true spirit of Islam.

Calculation for Crescent: A Reliable Method to Meet the Objective of Shari'ah

By Dr. Muzammil H. Siddiqi

هو الذي جعل الشمس ضياء والقمر نورا وقدره منازل لتعلموا عدد السنين والحساب ما خلق الله ذلك إلا بالحق يفصل الآيات لقوم يعلمون {يونس 5}

It is He Who made the Sun to be a shining glory and the Moon to be a light (of beauty), and measured out stages for her; that you might know the number of years and the count (of time). Nowise did Allah create this but in truth and righteousness. (Thus) does He explain His Signs in detail, for those who understand. (Yunus 10:5)

الشمس والقمر بحسبان {الرحمن 5}

The Sun and the Moon follow courses (exactly) computed. (Al-Rahman 55:5)

On Jumada al-'Ula 14, 1427, A.H. (June 10, 2006 A.D.), the Fiqh Council of approved the use of astronomical calculations in determining the beginning and end of the Islamic lunar months. The birth of the new Moon, followed by a calculated amount of movement of the new Moon above the horizon, will be used to determine when the Crescent Moon will become sightable. Sightability of the Crescent anywhere in the world, as opposed to actual reports of local physical

In order to understand Fiqh Council's decision, let us understand the following points:

1. Allah subhanahu wa ta'ala has created the Sun and Moon and both of them move according to precise and pre-defined patterns. Knowledge of these patterns help people calculate time, days and years, as mentioned in Surah Yunus, ayah 5. This pattern is not only for Ramadan, but it is for all time periods throughout the year.
2. Allah subhanahu wa ta'ala tells us that we should pray our daily Salat and begin and end our fasts based on the movement of the sun.

أقم الصلاة لدلوك الشمس إلى غسق الليل وقرآن الفجر إن قرآن الفجر كان مشهودا {الإسراء 78}
Establish regular prayers -with the sun's decline till the darkness of the night, and the morning prayer and reading: for the prayer and reading in the morning carry their testimony. (Al-Isra' 17:78)

....وكلوا واشربوا حتى يتبين لكم الخيط الأبيض من الخيط الأسود من الفجر ثم أتموا الصيام إلى الليل (البقرة 187)

.... and eat and drink, until the white thread of dawn appear to you distinct from its black thread; then complete your fast Till the night appears.... (Al-Baqarah 2:187)

Allah also told us that we should establish the months of Ramadan and Hajj by the Crescent Moons. He says,

يسألونك عن الأهلة قل هي مواقيت للناس والحج (البقرة 189)

They ask thee concerning the New Moons. Say: They are but signs to mark fixed periods of time in (the affairs of) men, and for Pilgrimage.(Al-Baqarah 2:187)

3. The Prophet –peace be upon him- in explaining these rules told us how to observe the movements of the sun to establish the timings of daily Salat and the beginning and

ending of the daily fasts. Similarly he told us how to begin and end the month of Ramadan.

4. For centuries Muslims observed the movement of the sun according to the Sunnah. They observed the movement of the sun by their naked eyes every day for their five daily prayers. When clocks were invented, Muslims changed this method and started used calculated movements of the sun. They did so even though there are no Ayah or Hadith that provide for using calculated time or timetables for Salat. They established the timings of daily Salat and developed perpetual Salat timetables that can be used throughout the year. Now, instead of physically watching movements of the sun, we can follow a timetable that is based on the calculations of the movements of the sun. Timetables sometime differ on the basis of the Fiqh of prayer times. Some Muslims have determined that Fajr should start when the sun is 18 degree below the horizon; others have determined that Fajr time should start when the sun is 15 degree below the horizon. Some calculate Maghrib time when the sun disk descends the horizon and others calculate Maghrib time at when the red twilight disappears. Similar are the differences in the beginning and ending times of fasts. However, no one disputes the use of calculated time itself and preparing timetables Salat as bid'ah (innovations) or forbidden in Islam.
5. The Prophet –peace be upon him- told us that we should see the Crescent to begin and end the month of Ramadan. He said,

سمعت أبا هريرة رضي الله عنه يقول قال النبي صلى الله عليه وسلم أو قال قال أبو القاسم صلى الله عليه وسلم صوموا لرؤيته وأفطروا لرؤيته فإن غبي عليكم فأكملوا عدة شعبان ثلاثين (البخارى 1776)

“Fast with sighting it (Moon) and break the fast with sighting it. Complete 30 days of Sha’aban if it is cloudy.” (Al-Bukhari 1776)

He –peace be upon him- also said,

عن نافع عن عبد الله بن عمر رضي الله عنهما أن رسول الله صلى الله عليه وسلم ذكر رمضان فقال لا تصوموا حتى تروا الهلال ولا تفطروا حتى تروه فإن غم عليكم فاقدروا له (البخارى 1773)

“Do not fast until you see the Crescent and do not break the fast until you see it. Estimate about it in case it is cloudy.” (Al-Bukhari 1773)

6. The Prophet –peace be upon him- wanted that Muslims should make sure that the month has begun before they start their ‘Ibadah of fasting so that they be united in their observance of this act of worship together. He also told us that we should make sure that this month has ended so that we may have our celebration of Eid together.
7. The Prophet –peace be upon him- also said in this context:
حدثنا سعيد بن عمرو أنه سمع ابن عمر رضي الله عنهما عن النبي صلى الله عليه وسلم أنه قال إنا أمة أمية لا نكتب ولا نحسب الشهر هكذا وهكذا يعني مرة تسعة وعشرين ومرة ثلاثين (البخارى 1780)

“We are an unlettered people; we do not know how to write and how to calculate. The month is thus and thus, meaning either 29 days or 30 days.” (Al-Bukhari 1780)

The Prophet –peace be upon him- was fully aware of the condition of his people at that time and he gave them the instructions according to their capacity. He gave them a method that was easy and simple so that they could start and end their ‘Ibadah with confidence that it is in the month of Ramadan.

8. Muslims in general continued sighting the Crescent to begin and end their month of Ramadan and celebrate Eid. It is reported that among the great Tabi’in Mutarrif ibn Shikhhir held the opinion that calculations of Crescent can be used for Ramadan.

Imam Taqiuddin al-Subki a great Shafi'i jurist even said that calculation were more reliable than eye sighting. When Muslims learned writing and calculations and became more knowledgeable about the Moon and its various phases, more voices were raised to rely on the calculations of the Crescent instead of its physical sighting. Most jurists did not accept calculations because they were not sure whether the calculations were correct or could be trusted. With the development of astronomical sciences in the last one hundred years more and more voices are being raised by jurists in support of calculations. One of the famous Muhaddith Shaikh Ahmad Muhammad Shakir wrote a long article emphasizing that calculation is the most appropriate method of determining the lunar months and it is permissible.

9. The objective of the Shari'ah is that Muslims begin and end the month of Ramadan with assurance and be united in the observance of these blessed times. The objective of the Shari'ah is not that Muslims merely conduct Moon sightings or remain uncertain about their time of 'Ibadah until the last minute. The astronomical sciences are highly advanced today and more reliable methods are available to know the beginning of the lunar months. On the basis of the principles of the Shari'ah just as the timetable for Salat and Siyam are prepared, it is possible to prepare the calendars for the lunar months and for the beginning and end of Ramadan. This knowledge is now easily available and can be used.
10. The Fiqh Council of North America has given us a method that fulfills the basic requirement of the Shari'ah. This method is based on two principles:
 - a. The new Moon is born. This means that the conjunction must have taken place.
 - b. The new Moon has become the Hilal. Enough time has passed to make this Moon sightable.

By scientific calculations we know very accurately and definitely when the conjunction has taken place and the new Moon is on the way to become Hilal. It becomes Hilal when it is above the Horizon and has moved to certain degrees of altitude to receive the light of the sun. By scientific knowledge we then know that the Hilal has appeared and it is sightable. Whether people see it or not depends on many factors. Actual sighting is, however, not required when we know definitely that the Crescent is there.

11. Sighting of the Crescent has generated a lot of controversies and divisions in the Ummah today. In Muslim countries the official bodies make the decision. Some people differ but they have no choice except to follow the official decision. Countries where Muslim minorities live there is more division. In Western Europe and North America Moon sighting has become a much more divisive issue.
12. The new method of the Fiqh Council is based on the principles of the Shari'ah. It complies with the Sunnah of our beloved Prophet –peace be upon him- and it uses our growing and advanced scientific astronomical knowledge. By accepting this method we can unite ourselves and can take the benefit of knowing our important dates in advance. This is an important benefit and it will save us many difficulties that we and our young people go through every year during Ramadan and Eid.

We pray to Allah to keep us on the right path and help us to keep our minds open for ideas that are consistent with new knowledge without contradicting the basic principles of our deen. Amin.

Frequently Asked Questions

There are some frequently asked questions (FAQ). Following are the brief answers:

Q1. What about the Qur’anic ayah that says,

فمن شهد منكم الشهر فليصمه (لابقرة 185)

So every one of you who is present (at his home) during that month should spend it in fasting

(Al-Baqarah 2:185)

Does it not mean that one must see the Crescent?

A1. The word “shahida” does not always mean “to see.” It has four different meaning. It means:

- a) to see
- b) to be present
- c) to know
- d) to testify and announce

We cannot translate this ayah to mean “Whosoever see the month must fast,” because month is time and time cannot be seen. Secondly if Allah would have said that “whosoever see the Crescent must fast,” then fasting would be obligatory on only those who see the Moon. Most of the commentators of the Qur’an have taken it mean “to be present (residing at home, not traveling) during the month.

Q2. The Prophet –peace be upon him- said “Fast with its sighting...” and in another Hadith he is reported to have said that “Do not fast until you see it.” So how can you say that seeing the Crescent is not required?

A2. The same expression are used in the Qur’an for daily prayers “*Establish regular prayers with the declining of the sun till the darkness of night...*” (17:78) but we do not observe the decline of the sun or the darkness of the night. We rather use our watches. The same expression is also used for starting and ending our fast when Allah said, “*Eat and drink until the white thread is clear from the black thread and complete your fast until the night*” (2:187), but we use nowadays our watches to start and end our fasts. This shows that a mechanism can be used to calculate the movement of the sun. If this can be done for the sun, why cannot it be done for the Moon? Allah told us that both of them move according to set patterns and both of them are made to learn counting and to make calendar.

Q 3. By using calculation, you are going against the “majority of the Jurists (jumhur al-fuqaha)”.

A 3. Jumhur did not forbid the calculation because calculation in this matter was forbidden according to the Shari’ah. They forbade it because they believed that it was not a reliable method. They did not trust the astronomers and some of them thought that they use the same methods of superstition and conjectures that astrologers use. We know that this is not the case and astronomical science is now highly developed.

Q 4. Is this not a bid’ah i.e. innovation in religion?

A 4. No, this is not a “bid’ah.” The definition of “bid’ah” is الإحداث في الدين “introducing something new in religion.” It is not الإحداث للدين “introducing something new for the sake of religion.” We are not adding anything new in Islam; we are only using new knowledge to observe the rules of the Shari’ah. It is like using loudspeakers for the Salat. When loudspeakers

came and people wanted to use them, some people also objected that it was “bid’ah”; but now they are used universally.

Q 5. Is this not against the Sunnah?

A 5. It would have been against the Sunnah if we said that we should use solar calendar instead of lunar calendar or mix the solar and lunar calendars. It would have been against the Sunnah if we said that Ramadan should be in winter only or during summer holidays. We are strictly following the Sunnah; actually we can say that by using calculations we are using a more accurate method of following the Sunnah.

Q 6. Are you not dividing the Ummah by introducing this method?

A 6. People are divided because they cannot agree on one method of sighting the Crescent and there are always disputes about who saw it and where and how many witnesses there were, etc. This scientific method is intended to help people become more objective and accurate and, Insha’Allah, this will unite the Ummah.

Q 7. Watching the Moon is easy; calculations are difficult and you are making the Ummah dependant on the astronomers.

A 7. It is more difficult for people nowadays to watch for the Crescent. Most people prefer to know about it by making a telephone call or checking through the internet. Easy and difficult are relative terms. Things that were easy are now difficult and things that were difficult at one time are now easy. In the old days it was easy to go out and check the sunrise and sunset for your daily prayers but now using the watches and timetables is easier. No one will argue that we have made people dependent on watches nor will anyone argue that assembling a watch is easy. But watches are easily available. Similarly, it is very easy to find out today about the phases of the Moon through your daily news papers or checking through the internet. Those who live in areas where these facilities are not available they can use what is easier for them.

Q 8. The Prophet –peace be upon him- told us that we should make a du’a after sighting the Crescent, now how can we say our du’a?

A 8. According to scholars Hilal is not necessarily the Crescent of the first night. Some say that first seven nights of the month are the nights of Hilal. So whenever you see the Crescent you make the du’a. Du’a is also recommended. If you did not make du’a by sighting the Crescent, your fast is still valid. Du’a is recommended for every month when you see the Crescent, not only for the month of Ramadan.

Q 9. Why are you doing this now, why didn’t you do it 50 years ago?

A 9. We have been discussing this for a long time. I have been working for the Moon sighting committee for the past 30 years and most of the time saw Muslims in America divided on this subject. We also now have the benefit of many years of empirical evidence using the advanced scientific astronomical knowledge which we are now adopting. This empirical evidence has shown on numerous occasions the accurate birth and sightability of the Moon. If you have followed Moon sighting reports in the past, you may be aware of circumstances where Muslim communities have followed physical Moon sighting reports that were later found to be incorrect, and circumstances where it was later determined that the Crescent was present even

though no Moon sighting reports came forward. The scientifically calculated methodology has been proven through experience to avoid these mistakes. Moreover, we had to find a solution that can unite us and help us to move forward Insha'Allah. May Allah help us.

Q 10. Are you “liberal” Muslims? Is this a special madhhab that you are creating in America? Will all Madhahib agree on this position?

A 10. The members of the Fiqh Council are well-known Muslim scholars whose knowledge and services to the Ummah are well established. We do not seek to make large claims and instead we do fear Allah and wish to follow His Messenger's Sunnah to the best of our knowledge and capacity. We are not creating any new Madhhab and our members belong to various Madhahib, and Alhamdu'lillah they have all agreed upon this procedure for determining the Islamic dates.

Q 11. European Islamic councils as well as other individual's efforts have stated that by calculation 24th of September should be the first day of fasting. Why is there a difference in the results of Fiqh Council calculations?

A 12. European Islamic councils as well as other individuals efforts may have stated that by calculation the 24th of September should be the first day of fasting. These calculations have to assume certain Matla' (May be they assumed Morocco or North America). On Sep. 22, the crescent will be 14 hours old on the West Coast of USA. This moon will not be visible in North America, although it is possible to be seen near the International Dateline southwest of Hawaii (Latitude 40:00S), where it becomes over 18 hours old. Fiqh Council has taken the position after careful thought process and discussion that sightability (Imkan-e-Ru'yah) anywhere in the world before the end of the night in North America is acceptable to start the month. This is allowed in Fiqh.

Q. 12. Why Fiqh Council used Greenwich Mean Time as a factor in determining Islamic days or months. What does London have to do with our faith?

A. 12. Fiqh Council decision has nothing to do with London. It is just an alternate way to say 12:00 noon GMT instead of saying 3:00 PM Makkah time. Fiqh Council thought and discussed this 3:00 PM Makkah time, so that the moon becomes over 18 hours old at IDL in the Pacific, west of Hawaii. This moon is sightable.

Q 13. The Imam at my Masjid says he is not going to follow the Fiqh Council's new method and will continue to use Moon sighting reports to begin and end Ramadan. What should I do?

A 13. The Fiqh Council is encouraging all Muslims throughout North America to consider using the new methodology for the sake of unity and to avoid the confusion and disputes that have occurred in the past. However, the Fiqh Council does not and does not intend to force its decision on anyone or any Muslim community. You should follow the decision of your Imam and your Masjid. Moreover, you should do so with great respect and avoiding unnecessary disputes and discussion. It is not expected that everyone will embrace this decision immediately. As with all changes, it will take time for people to understand and appreciate the new method. But, Insha'Allah, once people see the new methodology as more objective and accurate standard, it will serve to unite us in the near future.

READING, SIGHTING, AND CALCULATING

From Moon Sighting to Astronomical Calculation

Louay Safi

هو الذي جعل الشمس ضياء والقمر نورا وقدره منازل لتعلموا عدد السنين والحساب ما خلق الله ذلك إلا بالحق يفصل
الآيات لقوم يعلمون (يونس 5)

It is He who made the sun to be a shining glory and the moon to be a light (of beauty), and measured out stages for it; that you may know the number of years and the count (of time). Allah has not created this but in truth. (Thus) does He explain His signs in detail, for those who understand. (10:5)

The debate over the determination of the birth of the new crescent (*Hilal*) has taken a new urgency in North America after the Fiqh Council of North America (FCNA) announced, in August 2006, its new ruling (*fatwa*) on the use of calculation for establishing the beginning of the Islamic lunar month. The ruling established for the first time in recent history astronomical calculations as the sole criteria for deciding the birth of the new crescent.¹ Thus for the first time we come face to face with the prospect of confirming the beginning of Ramadan and Eids without the recurring hassle and flare.

The debate over confirming the *Hilal* is an old one dating back to the second century of the Islamic era. The debate intensified in the second half of the last century as many Muslim scholars became concerned about the inconsistency of sighting reports and the fragmentation of Muslim communities over the determination of the first day of Ramadan and the two *Eids*. Although strong arguments were made several decades ago by illustrious scholars, such as Muhammad Mubarak and Ahmad Shakir, in support of replacing the practice of sighting the moon with astronomical calculation, Muslim communities, by and large, continued to follow the moon sighting tradition.

The debate over how the new Islamic lunar month is to be decided transcends beyond just that of a debate in favor of one method over the other, and the transition from moon sighting to astronomical calculation is more than a transition from one *fiqhi* (juristic) position to another. The debate is, indeed, about how to read Islamic sources, and how to relate Islamic precepts to contemporary society; and the transition is about the ability of contemporary Muslim scholars to truly reclaim the authority of independent judgment (*ijtihad*), and hence build on the knowledge and achievements of early scholarship to reach better grounded consensus (*ijma'*).

FCNA's ruling in favor of using astronomical calculation for determining the beginning of the Muslim lunar month provoked a strong response, and the American Muslim community continues to be divided over this issue. Scholars on the two sides of the divide present arguments rooted in Islamic traditions, and often support their views by citing the same Qur'anic and Prophetic sources, or by referring to statements by early Muslim scholars.² It does not take much for an observer to realize that the division and disagreements are not about the

¹ See the full text of the fatwa at (http://www.fiqhcouncil.org/articles/Lunar_Calendar.html, accessed on November 5, 2006). FCNA has also produced a video in which FCNA chairman, Dr. Muzammil Siddiqui, discussed the basis of the fatwa, see <http://www.fiqhcouncil.org/articles/video.html>

² In addition to the FCNA's statement on the Islamic Lunar Calendar, two elaborate papers are presented by two North American scholars on this issue. The first one was authored by Zulfikar Ali Shah (http://www.isna.net/fileadmin/_temp_/FIQH/Calculations-Final%20_2_.pdf) and the other by Hamza Yusuf, *Cesarean Moon Births* (<http://www.zaytuna.org/articleDetails.asp?articleID=100>, accessed on November 8, 2006). Shaykh. Zulfikar's paper argued for adopting astronomical calculation, while Shaykh Hamza's paper adopted the traditional position, which favors moon sighting.

sources themselves, but about the interpretations and rationalizations of those sources. The division is between scholars who place emphasis on the apparent meaning of the text (*Zahir*) and those who emphasize its intended meaning and purpose (*maqsid*).

The tendency to split over interpretations has always been part of the Muslim experience. It can be traced to the split between the companions over the interpretation of the Prophet's command to pray the *asr* prayer at Banu Qurayza:

حدثنا عبد الله بن محمد بن أسماء حدثنا جويرية بن أسماء عن نافع عن ابن عمر رضي الله عنهما قال قال النبي صلى الله عليه وسلم يوم الأحزاب لا يصلين أحد العصر إلا في بني قريظة فأدرك بعضهم العصر في الطريق فقال بعضهم لا نصلي حتى نأتيها وقال بعضهم بل نصلي لم يرد منا ذلك فذكر ذلك للنبي صلى الله عليه وسلم فلم يعنف واحدا منهم (حديث متقف عليه)

Bukhari reported on the authority of [Abdullah] Ibn Omar, may Allah be please with both, who said that the Prophet, Allah's mercy and peace be with him, said on the day of the [battle of] Alliances: "No one should pray *asr* except in the [territories] of Banu Qurayzah." Some were still on the road at the *asr* time and said: "we will not pray *asr* until we reach it [Banu Qurayzah]. Others said: "we will indeed pray; this is not what was intended." The Prophet, Allah's mercy and peace be with him, was informed about [the disagreement], and he did not rebuke any of them.³

Evidently, some of the Prophet's companions understood his statement literally and continued their journey until they reached the territory of Banu Qurayza, while others stopped on the way to pray *asr* on time. It was also reported that the Prophet approved the actions of both, signaling that differences in opinion are abound to arise, and that the *ijtihad* of one group does not invalidate that of another.

For centuries, moon sighting was a better and more reliable method for deciding the beginning of the Islamic lunar month. Today, with the advancement of the science of astronomy, and the improvement of computing tools, astronomical calculations provide a much superior method, and are more in keeping with the Islamic requirements. Islam requires that we base certain religious duties, including fasting Ramadan and performing Hajj, on the lunar calendar, but does not regard the act of deciding the beginning of the Islamic month a religious act *per se*. The movement of the moon belongs to the natural order and its determination can better be handled by astronomy, which can today provide very precise calculation, and is by far more reliable and certain than moon sighting.

Distinguishing Religious Obligations from the Natural Order

Is moon sighting an *ibadah*? This question is a key for understanding the debate over replacing the practice of moon sighting with that of astronomical calculation.

The arguments for relying on sighting the new crescent as a means to determining the Islamic calendar confound religious duties with the empirical knowledge and practical skills required to identify the days on which these religious duties commence. Observing Ramadan and performing Hajj is *ibadah*, but observing the birth of the new crescent to determine the beginning of the lunar month is not. The latter relate to the human capacity for determining the beginning of the lunar month, and it is a function of the observer's scientific and physical capacity to identify the moment of the birth of the new crescent with increased precision. This capacity varies, needless to say, with the knowledge of the position of the new crescent in the sky, the sharpness of the eye-sight of the observer, the access to refined tools, the climatic conditions, etc.

³ The hadith was reported on the authority of Abdullah bin Omar in Sahih Bukhari, the book of maghazi (morales), no. 3804.

The Qur'an commands Muslims to fast the entire month of Ramadan, and to perform the Hajj. And the Prophet, Allah's mercy and peace be with him, taught Muslims to perform Hajj during the month of *Dhu Alhijja*, and to celebrate the first of *Shawwal* and the tenth of *Dhu Alhijja*.

Although some Muslims tried to root the practice of moon sighting, particularly for the month of Ramadan, in the Qur'anic injunctions, on a closer examination one finds that the Qur'an only requires that Muslims observe fasting during the month. Two verses are relevant in this regard:

"فمن شهد منكم الشهر فليصمه"

"So whoever witnesses the month, let him fast" (2:185)

Some scholars, mostly contemporary, use this verse as evidence for the requirement of moon sighting. The term *shahida*, translated here as "witness," means, they insist, to "see it with one's eyes."⁴ However, on examining the Qur'anic usage of the term, it becomes evident that the Qur'an does not confine "*shahida*" to eye witnessing, but also uses it in reference to expert witnessing. In *Surat Yusuf*, for example, the Qur'an uses the term "*shahida*" to refer to an act of witnessing in which the witness provides a testimony based on rational argument, rather than actual eye-witnessing:

قال هي راودتني عن نفسي، وشهد شاهد من أهلها إن كان قميصه قد من قبل فصدقت وهو من الكاذبين، وإن كان قميصه قد من دبر فكذبت وهو من الصادقين. (يوسف 26-27)

He said: "It was she that sought to seduce me, from my (true) self." And one of her household bore witness, (thus) "If it be that his shirt is torn from the front, then is her tale true, and he is a liar! But if it be that his shirt is torn from the back, then is she the liar, and he is telling the truth! (12:26-7)

The witness to whom these verses refer, who testified in the case of Prophet Yusuf and the king's wife, was not present in person when the disputed incident took place. Rather, his testimony was a rational argument based on his knowledge of the habitual behavior and the physical limitations of human beings. The witness testified that if Yusuf's shirt was torn from the back, this would then be good evidence that the king's wife was lying as she would have made an attempt to grab him from the back as he ran away from her. But if his shirt was torn from the front, this would be evidence that she was trying to defend herself against his unwanted advances, and he would be the person who lied.

The other Qur'anic verse relevant to the determination of the new lunar month refers to the crescent (*hila*), and has been cited by scholars who favor sighting the Moon, as well as scholars who support astronomical calculations:

يسألونك عن الأهلة قل هي مواقيت للناس والحج (البقرة 189)

They ask you concerning the crescents. Say: They are but signs to mark fixed periods of time in (the affairs of) men, and for Hajj. (2:189)

Those who require moon sighting see in the Qur'anic reference to the crescent an evidence to support their claims, while those who permit calculation take the correlation between the crescent and the infinite form of the verb "time," i.e. *mawaqit*, in the above verse as an additional indication that the crescent birth may be calculated. The word "mawaqit" connotes "measure" (*taqdir*), and refers to a specific time or place for performing a required act.⁵

What is clear, though, is that the above *ayah* (verse) is inconclusive, one way or the other, in settling the dispute between those who favor moon sighting and those who privilege calculation.

In several *ayahs*, the Qur'an relates the movement of the sun and the moon with the human ability to learn the passage of time and measure it:

⁴ See for instance, Hamza Yusu, *Cesarean Moon Births*, Part I, p. 15

⁵ See Ibn Manzoor, *Lisan al-Arab* (Cairo, Egypt: Dar al-Ma'arif), pp. 4887-8

هو الذي جعل الشمس ضياء والقمر نورا وقدره منازل لتعلموا عدد السنين والحساب ما خلق الله ذلك إلا بالحق يفصل الآيات لقوم يعلمون (يونس 5)

It is He who made the sun to be a shining glory and the moon to be a light (of beauty), and measured out stages for it; that you may know the number of years and the count (of time). Allah has not created this but in truth. (Thus) does He explain His signs in detail, for those who understand. (10:5)

فالق الباصباح وجعل الليل سكنا والشمس والقمر حسباناً ذلك تقدير العزيز العليم (الأنعام 96)
He it is that cleaves the daybreak (from the dark): He makes the night for rest and tranquility, and the sun and moon for the reckoning [of time] (*husban*), such is His judgment and ordering, the Exalted in Power, the Omniscient. (6:96)

وجعلنا الليل والنهار آيتين فمحونا آية الليل وجعلنا آية النهار مبصرة لتبتغوا فضلا من ربكم ولتعلموا عدد السنين والحساب وكل شيء فصلناه تفصيلا (الإسراء 12)

We have made the night and the day as two signs; the sign of the night have We obscured, while the sign of the day We have made to enlighten you; that you may seek bounty from your Lord, and that you may know the number and count of the years: all things have We explained in detail. (17: 12)

Evidently, the Qur'an does not consider sighting of the new crescent an act of worship that has to be performed for its own sake, but states clearly that the moon and the sun are means through which people can learn of the passage of time, and can count and measure the days, months, and years. While the words "*hisban*" and "*hisab*" have affinity with such words: count, measure, and calculation, it is fair to say that the Qur'an does not, however, provide any conclusive evidence one way or the other.

It is abundantly clear that while the Qur'an places fasting of Ramadan and performing of Hajj as religious obligations, it considers the sun and moon movements as part of the natural order. It follows, therefore, that fasting and Hajj obligations must be studied in accordance with *shari'ah* sciences, while the elaboration of the moon movement must be entrusted to astronomers and the science of astronomy.

If the distinction between these two areas of knowledge is confirmed, then the only reason for moon sighting to be favored over astronomical calculation is when the former is more certain in determining the birth of the new crescent than the latter. On the other hand, the *faqih* (Muslim jurist) must follow the calculation of the astronomer at any time the latter provides a higher level of certainty. As I will show below, the lack of confidence in the precision of the calculation of the astronomer was a main hindrance for relying on astronomical calculations by the bulk of early Muslim jurists.

However, before we examine the key positions of early Muslim scholars, let us see whether the Prophetic tradition require Muslims to rely exclusively on moon sighting.

The Prophetic Tradition on Moon Sighting

Scholars who insist that sighting the waxing crescent is the only acceptable way for determining Ramadan rely on the Prophet's injunction that Muslims should see the crescent to begin their fasting and see the next crescent to conclude their fasting. The various *hadiths* cited in this regard follow variations of the following two authentic *hadiths*:

روى الإمام البخاري في صحيحه من طريق آخر عبد الله بن عمر رضي الله عنهما أن رسول الله صلى الله عليه وسلم قال الشهر تسع وعشرون ليلة فلا تصوموا حتى تروه فإن غم عليكم فأكملوا العدة ثلاثين.

Imam Bukhari reported in his *Sahih* through a different chain of narrators on the authority of Abdullah bin Omar, may Allah be pleased with both, that the Prophet, Allah's mercy and peace be with him, said: The month is twenty nine days, so do

not fast until you see it [the crescent], but if it was obscured from you then complete your count to thirty.⁶

روى البخاري ومسلم في عن عبد الله بن عمر رضي الله عنهما أن رسول الله صلى الله عليه وسلم ذكر رمضان فقال لا تصوموا حتى تروا الهلال ولا تفطروا حتى تروه فإن غم عليكم فاقدروا له.

Bukhari and Muslim reported in their *Sahih*s on the authority of Abdullah bin Omar, may Allah be pleased with both, that the Prophet, Allah's mercy and peace be with him, said: Do not fast until you see the crescent and do not end your fast until you see it, but if it was obscured from you then estimate for it.⁷

In both *hadiths*, the Prophet, Allah's mercy and peace be with him, directs Muslims to rely on actual sighting of the new crescent to commence and conclude fasting. Scholars who favor moon sighting take these *hadiths* as the ground for rejecting calculation. We need to once again raise the question we addressed in the previous section: Is moon sighting an *ibadah* that has to be followed without examining the efficient reason ('*illah*) of the rule (*hukm*), or is it a reasoned rule (*hukm mu'allal*)?

It is important to recall the conclusion we reached in the previous section, that while the act of fasting is an *ibadah*, the act of determining the beginning of the lunar month is an act of knowledge of the natural order. The Prophet himself asked Muslims to rely on their own practical knowledge in matters that relate to the natural order.

حدثنا عبد الصمد حدثنا حماد عن ثابت عن أنس قال: سمع رسول الله صلى الله عليه وسلم أصواتا فقال ما هذا قالوا يلحقون النخل فقال لو تركوه فلم يلحقوه لصلح فتركوه فلم يلحقوه فخرج شبيصا فقال النبي صلى الله عليه وسلم ما لكم قالوا تركوه لما قلت فقال رسول الله صلى الله عليه وسلم إذا كان شيء من أمر دنياكم فأنتم أعلم به فإذا كان من أمر دينكم فإلي

Ahmed reported in his *Musnad* on the authority of Anas bin Malik that the Prophet, Allah's mercy and peace be with him, heard noise and asked about the source, and was told that it [resulted from the process of] the pollination of palm trees. He said: "if they left [the palms] alone without pollination they would be fine, and so they did. The next year the palms produced infertile dates. When the Prophet, Allah's mercy and peace be with him, inquired about the reason, they told him that they did not pollinate as he suggested. He then said: If the question relates to your worldly matters (*dunyakum*), you would know better about it, but if it relates to your religion (*dinakum*), then to me it belongs.⁸

In fact, the Prophet himself shared with his companions the reason for his specific directive to rely on moon sighting. In a *hadith* that was reported by Bukhari and Muslim on the authority of Abdullah bin Omar, the Prophet, Allah's mercy and peace be with him, said:

إن أمة أمية لا نكتب ولا نحسب الشهر هكذا وهكذا يعني مرة تسعة وعشرين ومرة ثلاثين
We are illiterate community that does not write or calculate; month is this much and this much, indicating with his fingers 29 days once and 30 days once.

In the absence of astronomers who have the know-how and the tools to determine with accuracy the beginning of the lunar month, moon sighting was the only tool available for the early Muslim community.⁹ The absence of the scientific knowledge for calculating the beginning of the month was the '*illah* (efficient reason) for the Prophet's directive for sighting the moon, and the removal of the '*illah* will render the directive inapplicable. It is a well established principle of *fiqh* (*qa'ida fiqhiyah*) that the rule or judgment is dependent on its '*illah*, and revolves around it, when the '*illah* is no longer in operation, the rule is no longer applicable:

الحكم مقرون بعلمته يدور معها وجودا وعدما

⁶ Shahih Bukhari, Kitab al-Sawm, no. 1774.

⁷ Ibid., no. 1773.

⁸ Musnad Ahmad, *hadith* no. 12086; and Sunan Ibn Maja, *hadith* no. 2462

⁹ Sunan Abu Dawud, no. 1975.

The rule is interconnected with its efficient reason, and revolves around it in both its presence and absence.¹⁰

The claim¹¹ that the Prophet, Allah's mercy and peace be with him, chose moon sighting over calculation because he chose not to use advanced astronomical knowledge already acquired by the pre-Islamic Arabs is unfounded. The assertion that pre-Islamic Arabs have had access to astronomical knowledge is refuted by both the above *hadith* and historical facts. Yes, astronomy was known by the ancient Egyptians and Greeks prior to Islam, but this knowledge was limited, and was not spread throughout the pre-Islamic world. There is no historical account of established astronomers in the Arabian Peninsula. As we will see in the next section, calculation of the new moon was often part of the pseudo-science of astrology. Many Muslim jurists believed that early astronomers were magicians and fortunetellers. Although astronomy made great strides with the contributions of Muslim astronomers such as Khawarizmi, Bayruni, and Altusi, predicting the moon movements with precision had to wait until the late nineteenth century. A major complaint by early Muslim scholars was that the astronomers of their times did not provide accurate predications, and that their predications had a margin of error of up to two days.

It is also true that pre-Islamic Arabs practiced intercalation (*nasi'*), whereby they moved the months around to avoid their obligation to observe the Sacred Months. But the practice was based on irresponsible tinkering, rather than an establish science.

إنما النسبي زيادة في الكفر يضل به الذين كفروا يحلون ما يحلون وما يحرمون ما حرم الله فيحلوا ما حرم الله
زين لهم سوء أعمالهم والله لا يهدي القوم الكافرين (التوبة 37)

Verily intercalation (*nasi'*) is an increase in disbelief: the disbelievers are led to wrong thereby: for they make it lawful one year, and forbidden it another year, in order to adjust the number of months forbidden by Allah and make such forbidden ones lawful. The evil of their course seems pleasing to them. But Allah guides not those who reject Faith. (9:37)

The Qur'an has, indeed, put an end to the practice of intercalation, but this cannot be used by any stretch of imagination as ground to reject astronomical calculations.

The Shifting Ground of Consensus

Perhaps the most serious challenge to contemporary scholars who advocate astronomical calculation is the historically established consensus (*ijma'*) among early Muslim scholars on this issue. Early scholars, by and large, rejected calculation and agreed on moon sighting as the only acceptable way for determining the beginning of the new lunar month.

Consensus is a very important principle of Islamic jurisprudence (*usul al-fiqh*). It helps to substantiate the independent judgments (*ijtihad*), of individual jurists and hence confer on them a higher degree of certainty and authority. The claim of certainty and authority is derived from the assertion that as legal decisions move from the domain of the individual to that of the community, they give up their individual certainty and acquire general certainty and objectivity.

However, when the facts upon which an early *ijma'* is acquired have changed, the *ijma'* loses both certainty and authority. The consensus reached by early Muslim jurists on rejecting astronomical methods resulted from the lack of any clear line of demarcation between astronomy and astrology. Most early Muslim scholars equated astronomy with magic and fortunetelling. A quick review of the understanding of leading Muslim jurists reveals this serious confusion.

Al-Sarakhsi, a leading Hanafi jurist, argued against calculation on the basis that it was done by an astrologists and fortunetellers.¹²

¹⁰ For elaboration on this point, please see Abu Ishaq Al-Shatibi, *Al-Muwafaqat*, vol. 3, pp. 43-52, and 78-81.

¹¹ See Hazma Yusuf, *ibid*.

¹² Al-Sarakhsi, *Al-Mabsut*, vol 3, p. 78

ومنهم من قال يرجع إلى قول أهل الحساب عند الإشتباه , وهذا بعيد فإن النبي صلى الله عليه وسلم قال: "من أتى كاهنا أو عرافا وصدقه بما يقول فقد كفر بما أنزل على محمد."

Among them those who say: we should consult with the people of calculation (*hisab*) when we are uncertain [about the birth of the new crescent]. This is a far cry because the Prophet, Allah's mercy and peace be with him, said: "whoever consults with a magician or fortuneteller and believed them in what they said, he has rejected what was revealed to Muhammad."

Ibn Qudamah cites the same reason for rejecting calculation, as he evidently confuses calculation with fortunetelling.¹³

لو بنى على قول المنجمين وأهل المعرفة بالحساب , فوافق الصواب , لم يصح صومه , وإن كثرت إصابتهم , لأنه ليس بدليل شرعي يجوز البناء عليه , ولا العمل به , فكان وجوده كعدمه

If the determination [of birth of the crescent] was based on the sayings of the fortunetellers and those who know calculation, and if their sayings were correct, his fasting was still invalid, even if they were correct frequently, because this is not based on an evidence acceptable by *shari'ah* to rely on or to follow: its presence and absence are the same.

Ibn Taymiyyah, who is often cited by contemporary authors opposed to calculation, indicated clearly that his objection for the use of astronomical calculation stemmed partially from the fact that the calculation lacks the accuracy and reliability needed to decide with certainty the birth of the new lunar month. He gives us a deep insight into the state of astronomy of his time in his voluminous work, *Al-fatawa al-kubra*.¹⁴

والمعتمد على الحساب في الهلال، كما أنه ضال في الشريعة، مبتدع في الدين، فهو مخطئ في العقل وعلم الحساب. فإن العلماء بالهيئة يعرفون أن الرؤية لا تنضبط بأمر حسابي، وإنما غاية الحساب منهم إذا عدل أن يعرف كم بين الهلال والشمس من درجة وقت الغروب مثلا؛ لكن الرؤية ليست مضبوطة بدرجات محددة، فإنها تختلف باختلاف حدة النظر وكلاله، وارتفاع المكان الذي يترأى فيه الهلال، وانخفاضه، وباختلاف صفاء الجو وكدره. وقد يراه بعض الناس لثمانى درجات، وآخر لا يراه لثنتي عشرة درجة؛ ولهذا تنازع أهل الحساب في قوس الرؤية تنازعا مضطربا، وأئمتهم: كبطليموس، لم يتكلموا في ذلك بحرف، لأن ذلك لا يقوم عليه دليل حسابي. وإنما يتكلم فيه بعض متأخريهم، مثل كوشياز الديلمي، وأمثاله. لما رأوا الشريعة علقت الأحكام بالهلال، فأروا الحساب طريقا تنضبط فيه الرؤية، وليست طريقة مستقيمة، ولا معتدلة، بل خطأها كثير، وقد جرب، وهم يختلفون كثيرا: هل يرى؟ أم لا يرى؟ وسبب ذلك: أنهم ضبطوا بالحساب ما لا يعلم بالحساب، فأخطئوا طريق الصواب

The person who relies on calculation (*hisab*) for the birth of the crescent (*Hilal*), in addition to being in error in matters of *shari'ah* and innovator in religion, is mistaken in matters of reason and calculation. For the scholars of physics know that sighting the moon cannot follow mathematical formula. The best they can do in way of calculation is, for instance, to estimate the distance between the crescent and the sun at the time of sunset. Sighting the moon cannot, however, be determined with precise angulations, because it varies with the sight sharpness, the altitude of the observatory, and weather conditions. Some people can see it at 8 degrees, while others at 12 degrees. For this reason, the people of calculations are in dispute over the arc of observation a great deal. The leading among them, such as Ptolemy, never addressed the question because it is not subject to any mathematical rendering. The latter [astronomers], such as Koshiaz al-Daylami mentioned it as they realized that *shari'ah* has based the ruling on moon sighting, so they thought that calculation can guide sighting. But this is not a sound and measured method, as it has many flaws. The [method] has been tried, leading to many disagreements: can it be seen or cannot? The reason for that is that they have tried to predict through calculation that which cannot be known by calculation, and hence they mistaken the true way.

¹³ Ibn Qudamah, *Al-Mugni*, vol. 3, p. 9.

¹⁴ Ibn Taymiyyah, *Al-fatawi al-kubra*, vol. 2, pp. 464-65.

Other early jurists have repeatedly objected to the use calculation by pointing out to the speculative and imprecise nature of calculation, and by equating astronomy with astrology and fortunetelling.¹⁵

It is not difficult to understand why Ibn Taymiyyah, or any other scholar for that matter, would count out imprecise and inaccurate method for deciding on the birth of the new Moon. It is disturbing, though, to see contemporary jurists espouse the same position when modern astronomy is now capable of providing a high degree of precision.

Despite the lack of confidence in the precision and accuracy of astronomical calculations, there were considerable opinions among early jurists that favored and allowed calculation as a viable alternative during adversarial weather conditions, advanced by such leading scholars as Al-Shafi'i, Ibn Sarij al-Shafi'i, Ibn Qutaybah, Mutarif bin Abdullah al-Shakhr, as reported by Ibn Zar'ah and al-Nawawi. These opinions, which received significant following during the first five centuries of Islam, were subsequently discounted by the latter-day scholars, who formulated a new consensus that completely rejected calculation and insisted on moon sighting.¹⁶

Abu Zar'ah identified another reason as to why astronomical calculation was not endorsed by early jurists. Quoting al-Mazari, he writes:

قال المازري عن الجمهور ولا يجوز أن يكون المراد حساب المنجمين؛ لأن الناس لو كلفوا به ضاق عليهم؛ لأنه لا يعرفه إلا أفراد والشرع إنما يعرف الناس بما يعرفه جماهيرهم.

Al-Mazari, referring to the opinion accepted by the majority of scholars (*jumhur*), said: calculation cannot rely on what the astrologists produce, because if this was required from people it would have placed great burden on them; this is because [calculation] is known to few people, and the *shari'ah* requires what is known to the majority.¹⁷

Al-Nawawi cites similar concerns for the opposition of calculation:¹⁸

ومن قال بحساب المنازل فقولته مردود بقوله صلى الله عليه وسلم في الصحيحين: "إننا أمة أمية لا نكتب ولا نحسب الشهر هكذا وهكذا." الحديث. قالوا: ولأن الناس لو كلفوا بذلك ضاق عليهم، لأنه لا يعرف الحساب إلا أفراد من الناس في البلدان الكبار.

Whoever argues for the calculation of the moon mansions, his argument is refuted by the saying of the Prophet, Allah's mercy and peace be with him, "We are illiterate community that does not write or calculate; month is this much and this much," the *hadith*. The [majority] says: This is also because if people were required to do it, they will find it cumbersome, since few individuals from big towns know calculation.

It should have become evident by now that the consensus that was reached towards the sixth century of Islam was greatly influenced by the state of the science of astronomy, as well as the lack of direct access by the scattered Muslim villages and towns to reliable astronomers. Four elements of this consensus are of particular interest to contemporary scholars:

1. Astronomy, and its corollary science of mathematics, was considerably less developed and mathematical precision was still lacking around the time the consensus against calculation was reached. This is also apparent in the fact that many Muslim jurists equated astronomy with astrology and fortunetelling.
2. Even with the willingness of eminent Muslim scholars to use calculation during obscure days, the fact that few people in big towns mastered the art of calculation has compelled Muslim jurists to reject calculation to avoid creating undue hardship for those who lived in small cities and towns, thus have had no access to astronomical calculations.
3. Communication and transportation were not advanced enough to allow consultation and exchange of information in a timely fashion across the vast expands of Muslim lands.

¹⁵ See also Al-Jassas, *Ahkam al-Qur'an*, vol. 1, pp.279; Al-Shanqiti, *Adwa' al-bayan*, vol. 6., p. 347; and Abu Zar'ah al-Iraqi, *Tarh al-Tathrib*, vol. 4. p. 112.

¹⁶ Abu Zar'ah, *ibid*.

¹⁷ *Ibid*.

¹⁸ Al-Nawawi, *Al-majmu'*, (Cairo: Almuniriyyah), vol. 6, p. 270

4. The desire to keep central authority away from imposing a particular *fiqhi* opinion adopted by a particular school on the rest of the Muslim society was another factor in discounting astronomical calculations. Al-Dhahabi reveals this concern in *Siyar al-Alam* when he refers to the tragedy that struck the Qadi of Burqah in North Africa when he objected to Al-Mansour, the 'Ubaydi Caliph, and refused to follow his decision to follow calculation, and chose to stick to the opinion of his maliki school of *fiqh*. He was executed for refusing to acknowledge and support Al-Mansour's ruling.¹⁹

None of the above factors that influenced early Muslim scholars who opposed calculation is in operation today: (1) Astronomy, as we will see in the next section, has developed into an advance science, employing advanced technologies, and providing accurate and precise predications of celestial body movements; (2) scientific information and knowledge is fairly widespread and, with the availability of advanced means of communication, it can be shared expeditiously across the globe; and (3) Muslim communities do follow decisions made by relevant authorities within the body politic to which they belong.

The Question of Certainty

One central and decisive factor in deciding between calculation and moon sighting concerns the question of certainty: which of the two methods provides a higher degree of certainty and confidence?

On its face value, the choice seems to be between the certainty of seeing and that of calculating. The question may be formulated, initially, as: Which method is more certain for verifying an empirical reality, a direct observation or mathematical calculation?

To simplify the question and reduce it to its essential elements, it would help to consider a straightforward example. If the empirical reality to be verified was the determination of the time at which an object (say a stone) that was thrown from the top of a building would hit the ground, then both methods would enjoy a similar degree of certainty. A trained timekeeper would be able to provide as close measurement of the time of the impact as would a mathematician who has knowledge of the building height. However, if the person who was asked to measure the time of impact was a novice observer, or the degree of accuracy required was raised to a split of a second, then the mathematician would predictably provide more reliable results.

When we come to consider a more complex empirical reality, such as the beginning of the lunar month, which is a function of the complex movement of the earth, the Moon, and the Sun, calculation becomes considerably more elaborate and intricate. Yet, with all its complexity, astronomical calculations are done with a great precision, a precision that cannot be matched by any level of experience acquired by the human observer. To understand the nature of this complexity, let us break it down to its constituting components.

The complexity in deciding the beginning of new lunar month stems from four basic factors:

1. The complexity of the movement of the moon in relation to both the earth and the sun, and the degree of precision of the mathematical formula used to calculate the moment of conjecture;
2. The size and brightness of the lunar crescent, which depends on the apparent angular distance between the centers of the moon and the Sun. This distance is what astronomers call the elongation of the moon from the Sun.
3. Sky conditions, including air density and humidity, the presence of objects in the sky that obscure the young crescent. In recent times, the increase in the level of air pollutants, particularly around cities, has impacted negatively sky conditions.

¹⁹ Al-Dhahabi, *Siyar alamal-nubala*, vol. 15, p. 114

4. The observer's situation and conditions, including location, experience, and preparation. An observer who is located at low latitude and high altitude, and who knows where and when to look for the waxing crescent has a better chance of observing the new Moon.

The first two factors, which relate to astronomical knowledge, have improved greatly over the last two centuries. Today, astronomers can calculate with great precision the date and time of conjunction, i.e. the birth of the new Moon. Similarly, the impact of elongation on the visibility of the new moon (more accurately the waxing crescent) is estimated at 8.5 to 10 degrees for the aided eye, and 10 to 15 degrees for the unaided eye.²⁰

The latter factors that relate to the conditions of the sky and the observers have deteriorated markedly. Muslims do not only live in middle latitude regions of mostly clear sky—as was the case in the early years of Islam—but also in high latitude regions, and in areas of high humidity and frequent rain. The sky conditions have worsened in most inhabited regions.

Observation of the new moon is quite disturbing in countries where Muslims do not employ the service of qualified observers using advance tools and facilities. Communities in the United States, for instance, rely on claims by ordinary Muslims with limited experience and astronomical knowledge. Even in Muslim countries where fairly advanced facilities are available, religious authorities accept the sighting of laymen with little or no training.

It must be asserted, therefore, that astronomical calculations provide a higher degree of certainty than an actual moon sighting by the human eye. For while astronomical calculations provide a precise date and time of the birth of the new Moon, sighting the moon produces, even with the use of advanced telescopes, less accurate and reliable results.

Yet the actual choice is not one in which we are asked to choose between astronomical calculation and moon sighting. The choice is essentially between calculations and individual testimonies. For several centuries, the Hanafi school of *fiqh* required that every qualified person must go to open fields outside his village or town to observe the new Moon. Other school of *fiqh* required two qualified witnesses, in some cases one, to verify the actual sighting of the Moon. The group requirement was intended to establish *tawatur* (the multiplicity of the sources) to ensure that the reported sighting is certain (*qat'i*), and hence to avoid the uncertainty (*zanni*) of individual reports. The Hanafi school ultimately abandoned the group requirement, and followed the practice of verifying the sighting with two witnesses.

Those who insist that Muslims abandon astronomical calculation and rely on individual testimonies are in actuality asking Muslims to abandon the certainty of reliable knowledge, for the inconsistency of unverifiable individual reports. Individual reports, every student of *fiqh* knows, produce uncertain knowledge (*ma'rifah zaniyah*). This is amply illustrated by the established records of moon sighting testimonies. These testimonies have been exceedingly inconsistent, and have resulted in numerous contradictions and reversals.²¹

The Imperative to Seek Sound Knowledge and Greater Good

²⁰ See the Appendix for discussion on the calculation method adopted by FCNA. US Naval Observatory asserts that the date and time of the new lunar month can be predicted with precision, and elaborates on the impact of elongation on its visibility. See the article "Crescent Moon Visibility and the Islamic Calendar,"

(<http://aa.usno.navy.mil/faq/docs/islamic.html>, accessed on Tuesday, November 07, 2006). For detailed discussion of the q-parameter method, see B. D. Yallop, "A Method for Predicting the First Sighting of the New Crescent Moon," Nautical Almanac Office Technical Note No. 69, Council for the Central Laboratory of the Research Councils, June 1998: <http://www.crescentmoonwatch.org/download/NAOTN69.pdf>, accessed on November 16, 2006.

See also by the same author *A Modern Guide to Astronomical Calculations of Islamic Calendar, Times, and Qibla* (Kuala Lumpur, Malaysia: Berita Publishing, 1984). Khalid Shawkat has also done extensive work on this question. His work can be accessed through his website <http://www.moonsighting.com>

²¹ Khalid Shawkat lists on his website ([moonsighting.com](http://www.moonsighting.com)) and extensive list of mistaken sightings of the moon, which provide a practical illustration of both imprecision of moon sighting, and the inconsistency of testimonies and reports.

As illustrate above, there is an ample evidence to convince anyone who is familiar with both *shari'ah* injunctions and contemporary astronomy that astronomical calculations provide a more reliable and certain approach for determining the beginning of the Islamic lunar calendar. The fact that contemporary Muslim scholars are reluctant to embrace this certainty underscores the challenges facing contemporary Muslim scholarship.

Many Muslim jurists are beholden to a historical consensus, even though the foundation of this consensus has shifted drastically. Early Muslim scholars had good reasons to reject the method of astronomical calculations, but it is no longer acceptable to question the certainty of this method. Rather than standing comfortably on a consensus whose foundation has shifted, it is about time that the Muslim community shifts its consensus and set it on a new and sounder foundation. Muslim jurists owe it to the traditions of Islamic learning, that have always brought a balanced synthesis between *shari'ah* and science, to embrace more reliable methods for deciding with certainty the beginning of the Islamic month.

There are still others who have grown accustomed to the anticipation and excitement surrounding the "rituals" of moon sighting, and who regret the prospect of being asked to give up the opportunity to wonder at the majesty of Allah's creation. The Qur'an enjoins us, indeed, to constantly engage with Allah's creation—to observe and ponder His signs in our own human existence and in the universe, to watch the changing seasons, to consider the alteration of day and night, and much more. We must be in touch with the natural world to be reminded of Allah's creative power and the beauty and majesty of His creation, and this can be an important source for spiritual renewal. Yet this exercise must not be confined to, or imposed on, the question of deciding the beginning of the Islamic lunar month. The vast majority of Muslims desires accurate information on the new crescent, and is neither in a position to actively and effectively participate in moon sighting, nor are they required to do so. Those who find moon sighting spiritually uplifting owe it to every Muslim in the world to place the certainty of knowledge and the wellbeing of the *ummah* over and above personal fulfillments.²²

The Fiqh Council of North America's decision to formally adopt astronomical calculation represents a major step forward in overcoming historical inertia. Although the decision of the FCNA has not so far brought about a consensus among North American Muslims, it has set the foundation for the development of a position that can potentially bring a new consensus in deciding the beginning of Ramadan and the two *Eids* for the world-wide Muslim community.

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²² In addition to being less accurate, moon sighting has created a lot of hardship, particularly to Muslims in North America. In the eastern and northern parts of North America the *hilal* is usually unsightable, residents of these areas therefore simply have to wait until late into the night checking Islamic websites or waiting for a phone call. Their "moon sighting" is a message received by the most modern of technologies, and they are exhausted on *Eid* morning after waiting late into the night for sighting results from the western half of the continent

Appendix

A Note on the Criteria Adopted by the FCNA for Deciding the Birth of the New Crescent Moon

Fiqh Council of North America (FCNA) has adopted an Islamic Calendar based on the following criteria:

1. Astronomical calculations will be used to determine the beginning of the Islamic lunar months with the consideration of the sightability of the crescent anywhere on the globe.
2. To determine a lunar Islamic calendar, a conventional point of reference must be used. The International Date Line (IDL) or the Greenwich Mean Time (GMT) may be used.
3. The new Islamic Lunar month begins at sunset of the day when the conjunction occurs before 12:00 Noon GMT. If the conjunction occurs after 12:00 UT, then the month begins at sunset of the next day. The moon born before 12:00 Noon UT will be 18+ hours (or more) old at a point just East of IDL at local sunset. This convention has a basis of visibility at a point just East of IDL, and is born before the day begins at IDL.

The selection of the 12:00 noon GMT as the time of conjunction is based on research that was done by astronomers who developed methods to calculate the sightability of the waxing crescent with high precision.

Astronomers can today calculate the first sighting of the new moon using the q-parameter method, one of the most sophisticated methods for calculating the birth of the new crescent moon. The method, developed by B. D. Yallop of the Council of the Central Laboratory of Research Councils (CCLRC), United Kingdom, combines theoretical and empirical research to produce precise predictions.

The q-parameter method synthesizes major research on first visibility of the new crescent moon. It employs the Indian method used in producing the annual *Indian Astronomical Ephemeris*, F. Bruin's method for calculating the best time for visibility, published in 1977, and the work of Edward W. Maunder (1851-1928). It also uses B. E. Schaffer's analysis of empirical data collection.

The method uses a single test parameter, the q-parameter, to predict the first sighting of the new crescent moon. The parameter "q" is calculated at the best time for making the observation of the waxing crescent from the equation

$$q = (ARCV - (11.8371 - 6.3226 W' + 0.7319 W'^2 - 0.1018 W'^3))/10$$

ARCV (the Arc of Vision) is the geocentric difference in altitude between the center of the sun and the center of the moon for a given latitude and longitude, ignoring the effects of refraction.

W' is the topocentric width of the crescent, and is calculated from the equations

$$\begin{aligned} W' &= SD' (1 - \cos ARCL) \\ SD' &= SD (1 + \sin h \sin \pi) \\ SD &= 0.27245 \pi \end{aligned}$$

Whereby SD is the semi-diameter of the moon, *ARCL (Arc of Light)* is the angle subtended at the center of the earth by the center of the sun and the center of the moon, π is the parallax of the moon, and h is the geocentric altitude of the moon.

The best time of the waxing crescent observation, T_b , is calculated from the equation

$$T_b = (5 T_s + 4 T_m)/9 = T_s + 4/9 \text{ Lag}$$

Whereby T_s is the time of sunset, T_m is the time of moonset, and Lag is the time from sunset to moonset.

Yallop empirically calibrates "q" by applying its resulting value to a standard set of 295 first sightings of the new crescent moon that cover the period 1859 to 1996. He, further, contrasts actual observations with predictions based on q-test, and the results reaffirm the reliability of the calculation.

The results also help construct six ranges for the parameter "q" that inform us as to when observation is possible with the unaided eye, and when there is a need to use optical aid, such as binoculars or telescopes.

Criterion	Range	Visibility Type
<i>A</i>	$q > +0.216$	<i>Easily visible - ARCL ≥ 12 degrees</i>
<i>B</i>	$+0.261 \geq q > -0.014$	<i>Visible under perfect climate conditions</i>
<i>C</i>	$-0.014 \geq q > -0.160$	<i>May need optical aid to find the crescent</i>
<i>D</i>	$-0.160 \geq q > -0.232$	<i>Will need optical aid to find the crescent</i>
<i>E</i>	$-0.232 \geq q > -0.293$	<i>Not visible with telescope - ARCL ≤ 8.5 degree</i>
<i>F</i>	$-0.293 \geq q$	<i>Not visible - Below Danjon limit or ARCL ≤ 8 degree</i>

FCNA has decided that Muslims are required to use all tools available to them to investigate the birth of the moon, and therefore consider the q-test to be positive when it falls in the ranges A through D, a condition that corresponds to ARCL > 8.5 degrees.

For detailed discussion of the q-parameter method, see B. D. Yallop, "A Method for Predicting the First Sighting of the New Crescent Moon," Nautical Almanac Office Technical Note No. 69, Council for the Central Laboratory of the Research Councils, June 1998: <http://www.crescentmoonwatch.org/download/NAOTN69.pdf>, accessed on November 16, 2006.