The Mystical Correspondence Between The Epoch Of The Hijra And The Biblical Year Of Creation Supported By A Tradition Mentioned By Abu Al-Fadl And Abd Al-Qadir Baduni

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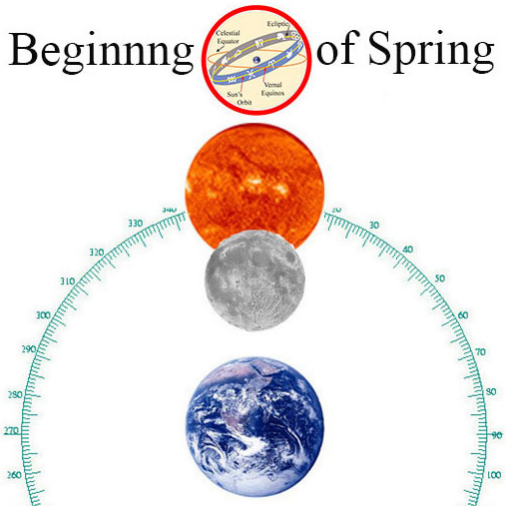
ABSTRACT

The connections between astronomy and timekeeping are longstanding. One approach to the teaching of Astronomy is it can serve as a unique platform to illustrate the advancement of science from ancient times along with the strong interrelation between science and religion. Here we chose to describe the influence of astronomical measurements that led to the determination of calendars with emphasis on the Islamic epoch: During the second century the Ethiopian Church placed the world's year of creation (YOC) at exactly 5500 years before the Incarnation, thus expressing the view that it is related to the first day of the second half of the sixth millennium since their believed to be the YOC. The Ethiopian Church also believed that the astronomical visualization of the sky in the YOC which placed the vernal equinox and the newmoon in the same day, repeated itself in the year 5500. In a previous work we showed that "Astronomical coincidence" is a notion originated from Jews who believed that the YOC, Exodus, and the building of the Temple were mystically connected by similar rare newmoon events relative to the vernal equinox. Here we show that the founders of Islam believed in a similar mystical coincidence, explicitly that the 16th of July, 622 AD,- the epoch of the Islamic calendar-, is exactly the day in which the 6000th lunar year started after the biblical creation based on the number of solar years from creation as determined by Eusebius. We show that our astronomical calculations are in accordance with a tradition mentioned by Abu al-Faḍl and Badāūnī.

Keywords: Teaching of Astronomy; Hijra; Islamic Calendar; Biblical Chronology; Astronomy and Religion; Al-Khwarizmi; Biblical Chronology; Astronomy and Religion; Ancient Cultures and Astronomy; Dating Ancient Cultural Events

In teaching fundamental concepts in spherical astronomy for the definition of the sky's coordinate systems, the vernal equinox (VE) is known to be the vital notion used on Earth for the determination of the beginning of spring. The exact measurement of the time in which the sun crosses the VE, had been a central requirement throughout the history of science for several cultures and religions, including, as we show below, the foundations of Islam. Therefore, we find it very rewarding to include in a higher education curriculum the study of the history of the measurement of the VE and its influence on the strong interrelations between religion and astronomy. In particular, when it is associated with either a newmoon (Cohen 2018), or the appearance of the first new visible crescent of the moon which determines the beginning of a new calendrical month (Figure 1).

Figure 1. A newmoon occurring at the Vernal Equinox.



In order to understand the methods used for the determination of calendars, we need to introduce an additional concept, namely, millennialism:

The approach of the end of the 6000th year AM[1], after Eusebius of Caesarea (3rd – 4th century AD) in Europe based on the Julian length of the year, brought Charlemagne to hold his imperial coronation by Pope Leo III during the Christmas and New Year's week of 800-801 AD (Figure 2).

Figure 2. Coronation of Charlemagne as Emperor. Rome, 800/801 AD (French educational card).

Modern historians that have analyzed this event described it as a pivotal week in Western history, being reinforced by its "unquestionably millennial significance" (Landes, 1999 [Encyclopedia Britannica, 2018], Verbeke, 1988).

This millennial background originated from the fact that as of the 5th century AD, large parts of the Christian world found it necessary to adopt a new interpretation of the biblical chronology. During most of the first half of the 1st Millennium AD, the 6000 AM millennial milestone was expected to occur at the end of the 5th century based on the

age of the world as calculated, for example, by Theophilus, Bishop of Antioch (Negru, 2018: 5529 BC) the Ethiopian Church (Molla, 2011), or by Hippolytus of Thebes (Finegan, 2014: 5501 BC = -5500).

But, when it was realized that no real apocalyptic signs followed by the appearance of a new world leader had taken place, most of the Christian world replaced the older chronologies by the chronology of Eusebius and St. Jerome.

As mentioned above, according to this chronology the YOC_1 was 5200 BC (See, for example, Finegan, 1964) – leading to the coronation of Charlemagne at the end of the year 800 AD:

801- 6000 = -5199 = 5200 BC.

It is our claim that the year 5200 BC had been also adopted by the founders of the Islamic calendar (See below, and see, for example, Mozarabs records from the 8th century, Christys, 2002, emphasizing their use of the year 5200 BC).

The example of the millennial coronation of Charlemagne thus proves our statement that Eusebius' chronology had been used during the 6th throughout the 9th centuries AD believed to have been the correct general interpretation, within a year, of the Septuagint version of the Biblical chronology. In fact, several other researchers (Fomenko, 1990) interpreted Eusebius' YOC to be YOC_2 = 5199 BC = -5198.

The determination of the YOC played an important role in all ancient and medieval cultures. The belief that the world is coming to a crucial moment had, then, been expected when a repetition of the astronomical visualization of the YOC^2 or Millennialism could be applied. As stressed by Stowasser (2000), astronomy and Millennialism have accelerated and stimulated beliefs in a moment of rebirth of the world. Thus, the end of a millennium generated millenarian anticipations.

Below we show that Eusebius' YOC had also a profound influence on the eschatological doctrine of Islam playing a dominant factor, as in Judaism and Christianity, in the determination of the date of the Hijra taking place in the year 622 AD.

PRE-ISLAMIC CALENDAR

Al-Biruni (Sachau, 1879) and other scholars, claim that at the time of paganism the pre-Islamic Arabs used a calendar in which the months were similar to the months of the Muslims, and their pilgrimage went wandering around through the four seasons of the year (Burnaby, 1901, al-Biruni, Scaliger, 1583).

The pilgrimage to the Kaa'ba was always in the last (12th) lunar month of the lunar year. But, about 200 years before the Hijra (in 412 AD – See Burnaby, 1901) they desired to perform the pilgrimage at such time as their merchandise was ready for the market, so that it should occur in the amplest season of the year. Therefore, since a lunar calendar does not match with the seasons (as detailed below), this sometimes led to logistic difficulties in finding food for the trip and animals for butchery. To ensure sufficient supplies they started to intercalate a month, so as to keep the pilgrimage in the autumn. It is generally accepted that they had learnt of this scheme from the Jews (see Rubin's annotations (2005) in his translation of the Quran), and, in particular, from the Jews of Yathrith (Medina), and adopted it in 412 AD.

Moreover, due to the importance of the Jewish tribe, Banu Qurayza, living in the Yathrith area and the strong interrelation between them and the neighboring Arab tribes, the Jews of Yathrith also provided their Arab neighbors with the Metonic cycle of 19 years according to which the length of the Jewish solar year was calculated in the 6-7th centuries AD to be Yj = 365.2468222 days replacing the value of 365.25 days, as discussed by Maimonides (12th century AD), and detailed by us (Cohen, 2018). This value of Yj was also revealed in al-Khwarizmi's essay from 820 AD (Kennedy, 1963).

The addition of one month (called Nasi) at the beginning of the year every second or third lunar year, as suggested by the metonic cycle was announced by the head of the Arab Tribe Kianna.

Only ten years after the beginning of the Hijra, the Muslims believed that Allah prohibited the Nasi as declared in the Qur'an (sura 9:36-37). This prohibition was announced by the prophet Muhammad as part of "the farewell sermon" on 9 Dhu al-Hijja on Mount Arafat during the pilgrimage to Mecca (Julian date of 7 March 632 AD):

"The number of months with Allah has been twelve months by Allah's ordinance since the day He created the heavens and the earth."

al-Biruni added an explanation to the fact that the prohibition of the Nasi took place only in the year 632 AD:

'The Prophet waited with the announcement of the prohibition till the "*farewell pilgrimage",* on which occasion he could address the people with the following statement:'

"The season, the time has gone around as it was on the day of God's creating the heavens and the earth." (al-Biruni cited Sura 9:38, but in present times, I could not find a version of the Quran with the above statement, a statement which however can be found in the farewell sermon as collected by the early historian Ibn Ishaq [Poonawala, 1990])", 'by which he meant that the months had returned to their original places, and that they had been freed from what the Arabs used to do with them.'

'Therefore,' al-Biruni added, 'the' *farewell pilgrimage,"* was also called "*the correct pilgrimage."* Thereupon intercalation was prohibited and altogether neglected.'

Below we present our explanation for what, particularly as astronomers, we should find the most important statement made in the farewell speech. The Prophet is comparing the astronomical-atmospheric values at the time of the Farewell Pilgrimage to their corresponding values in the time of the creation of the world. For us, it is a very specific statement: It provides us with the tools required for suggesting the determination of the year of creation of the Islamic calendar. Moreover, we show below that by counting the years from the YOC containing each 12 lunar months, millennial expectations can be realized by the appearance of the Prophet. Below we show that for all believers in Islam and in Millennialism, there was an additional proof that Prophet Muhammad is the new Messiah sent by Allah: In the year of the Hijra, the Islam had been established as the main power in the Arab world exactly 6000 lunar years after creation.

THE MILLENNIAL SIGNIFICANCE OF THE YEAR 622 AD

The Julian calendar is based on a tropical year of 365.25 days. But, Hipparchus and Ptolemy (2nd century BC, and 2nd century AD) suggested, that its length is shorter as documented in the Almagest (Toomer, 1984): Ya=365.24667 days, whereas the Jews adopted (in the 5-6th century, Cohen, 2018) the value of Yj=365.2468222 days. On the other hand, as emphasized by Richards (2000) the average length of the month used by the Muslims was Mi=29 days, 12 hours and 44 minutes. Therefore, it was soon realized by Calif Umar and his astronomers, 7 years after the death of Prophet Muhammad, that the formation of the new calendar should be based on Prophet Muhammad's statement that the first month of the Islamic year, the month of Muharran, should be related to the beginning of spring in the year of his farewell speech. According to the Almagest at the end of the month of the farewell sermon presented on the Julian date of 7 March, 632 AD, 9 Dhū al-Ḥijja, 10 AH (JDN_f= 1951961)[3] the newmoon of Nisan took place on March 26, close to the beginning of spring[4]. But, in the pre-Islamic calendar, the month of Nisan, the Jewish month celebrating the spring holiday Passover, had been made to coincide with the month of Dhū al-Ḥijja, the month of the Ḥajj, the Pilgrimage, and the Festival of the Sacrifice (the Islamic position equating Nisan with Dhū al-Ḥijja, is discussed, for example, by Hideyuki, 2014). As a result, Umar chose the Julian date of 9 April 631 AD (JDN_2 = 1951628) in which the beginning of Muharran coincided with the Jewish month of Iyar (Richards, 2000), and then calculated 9 lunar years backwards (3 of them with 1 additional day at the end of the 'intercalated' years) to the Julian date of 16 July 622 (A Friday, JDN_0 = 1948439) in order, as claimed by him, to commemorate the Hijra occurring in that year.

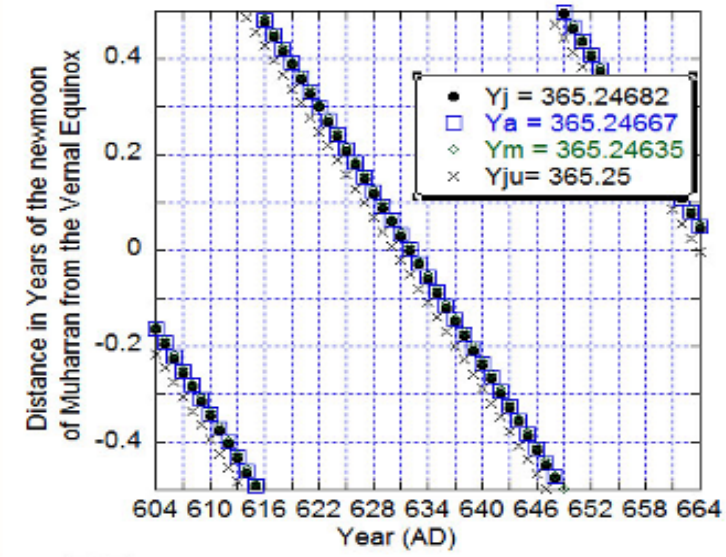
In doing so, Umar admitted that the date of the epoch of the calendar is not the date of Prophet Muhammad's flight, and not that of his arrival in Medina either: He knew that the actual dates of both these events probably occurred about two months after the epoch in 622 (Richards, 2000).

The Epoch of the Islamic Calendar is thus A Result of a Calculation

But in calculating 9 lunar years backwards from 9 April 631 AD, no reference was made to the YOC The above mentioned most important statement made in the Farewell Sermon had been seemingly ignored by Umar: His method of calculation of the epoch discounted the requirement that the time of the newmoon associated with the beginning of the first month of 632 (or 631) should be as close as possible to a time of the corresponding newmoon in the YOC. Below we add this requirement and use it for the determination of the Islamic YOC:

As emphasized by al-Biruni, Prophet Muhammad had to wait until the year 632 AD (See Figure 3), in which the first month of the year, Muharran, matched with the beginning of spring. This wait was due to the fact that during approximately 33.5 solar years there are about 34.5 Islamic years with the month of Muharram starting in different celestial longitudes in each Islamic year as in Figure 3.

Figure 3. The Deviations are calculated for Ya and Yi as well as for Ym = 235 lunar years divided by 223, and Yju, the Julian year. The values in the Figure are calculated with the horizontal axis starting at Eusebius's YOC_2 corresponding to 5199 BC.



Consequently, if we take the first newmoon of the month of Muharran to coincide with the vernal equinox, the following newmoon of Muharran will take place in a backward celestial longitude step of $\approx 11^0$ relative to the vernal equinox. In the cases of Ya and Yj, for example, the more accurate steps backwards are:

$(1 - 12 * Mi/Ya) * 360 = 10^0.7237$, and

$(1 - 12 * Mi/Ya) * 360 = 10^0.7239$

It follows that after 33 and 34 years the average celestial longitude of Muharran's newmoon will be for Ya and Yj $353^0.8874$ and $4^0.6113$, respectively. In general, the newmoon of Muharran after several 33-34 years periods can always be within

$Dm \approx \pm 10^0.72/2 \approx \pm 5^0.36 (\approx 5.45\ days)$

relative to the vernal equinox (see the maximal deviations in Figure 5).

The above calculated values for the average drifting celestial longitudes of the newmoon of Muharran that can, thus, obtain any value between 360^0 and 0^0 during the years from the YOC, suggests that Prophet Muhammad's farewell statement inferred to a unique value of the YOC:

The YOC used for the statement in the farewell sermon, must be a year from which the number of lunar years will bring the newmoon of Muharran in the year of the Farewell Pilgrimage to be within Dm degrees relative to its original celestial longitude after an integer number of solar years.

Starting from this YOC all months were lunar months as stated in Sura 9:36.

But, would any value within the full range of Dm promptly describe Prophet Muhammad's statement? It can be assumed that such a result wouldn't earn it the statement in the farewell sermon, because it could describe an event that repeats itself in relatively small cycles of 33.5-34.5 years.

In order to find a large cycle which would bring back the celestial longitude as close as possible to the same original longitude, we have used the continued fraction approach to detect such large cycles for Mi and Yj as our example (Figure 4).

Figure 4. The large cycles of the combined pairs of Yj vs. Yi.

$Yj = 365.2468222$

$Yi = 354.3666667$

A1=number of Islamic Years in a cycle	A2=number of Jewish solar years in a cycle	Deviation (in days) of the beginning of Muharran in a cycle vs. the number of Islamic Years in a cycle	Deviation (in minutes) from the number of minutes in a cycle Aj*Yi vs. the number of minutes in Ai*Yi
1	1	10.88016	-15675.1
33	32	6.20169	8930.4
34	33	4.67847	-6741.6
67	65	1.52322	2193.4
235	228	0.10880	-161.3
3357	3257	0.00008	0.1
4844386	4700079	0.00002	0

It can be seen that after 2 long cycles of 3357 Islamic years minus 3 smaller cycles of 235 years equaling 6009 Islamic years, the beginning of Muharran will return to its original celestial longitude (within 0.3 degrees).

Consequently, 10 lunar years earlier would be the end of 5999 lunar years from the original celestial longitude, which we assume to be the celestial longitude in the YOC_2. Finally, 5999 lunar years are equal to 5820.3 solar years.

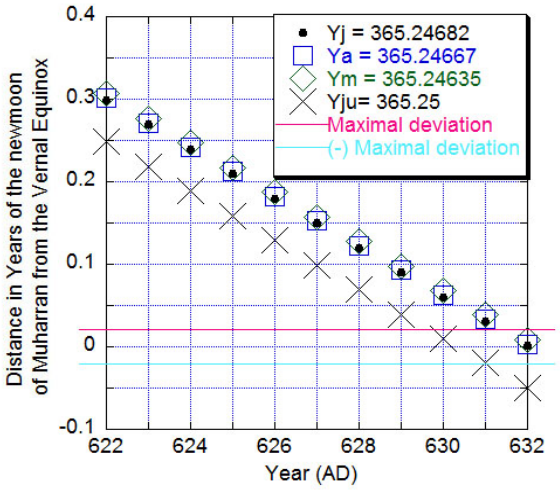
Applying this number of solar years to be the number of years since the YOC_2, we get:

-5198 + 5820.3 = 622.3 from the vernal equinox

≈ Mid-July of the year 622 AD.

Accurate calculations are presented in Figure 5 and Figure 6.

Figure 5. The celestial longitudes expressed as a fraction of a year (vertical axis) vs.YOC_2 (-5198) + 5999 to 6009 lunar years. The horizontal axis is expressed in solar years. The approximate date of 1 Muharran in each solar year can be derived from the Figure as follows: 1 Muharran in 632 AD was 29 March. Therefore in the year 622 AD the date of 1 Muharran would be a day or two less than 0.3 of a year ≈ 108 days after 29 March, namely July 16. For the more accurate value, see Figure 6. A similar result is achieved when we assume as in the last column in Figure 6 that in the YOC 1 Muharran was in 9 of April. 0.269 * Yj ~ 98, leading to July 15/16.



The year of the farewell sermon, thus, provided a unique resemblance between the astronomical visualization of the YOC's sky and the astronomical-atmospheric sky in 632 AD. No such match occurred within 228 solar years before the year of the sermon and Prophet Muhammad was presenting a unique and meaningful statement by saying "The season, the time has gone around as it was on the day of God's creating the heavens and the earth".

We, thus, claim that the counting of 10 lunar years backwards, to the year 622 AD, presented an independent value not related to the Hijra: the number of pure lunar years from the YOC developed to be 5999 years from creation at the end of which was the right time for the new Prophet to be sent and set up the first Islamic state as also emphasized by Crone and Cook (1976).

In order to reinforce our claim we refer to Stowasser (2000) who highlighted the fact that in '999/1000 AH (Anno Hijri), the Moghul Emperor Akbar (1542-1605) knew about the Muslim millenarian tradition that regarded the end of the first Islamic millennium (1592 AD) as the ending of a cycle of 7000 lunar years of the world. Stowasser adds that Akbar was not only aware of but also supported the fact and that in some Arab communities he was believed to be the new messiah who was expected to show up at the end such a cycle.

In addition, the advisor to the Moghul Emperor Akbar, Abu al-Fadl wrote several letters from which we learn that Akbar was indeed aware of the existence of a Muslim belief that regarded the end of the first Hijri millennium as reaching 7000-year of the earth. Abu al-Faḍl found a direct testimony in Abd al-Qadir Badāūnī's treatise (Badauni, 1024/1615) in which the following description is included: 'And Khwájah Mouláná of Shíráz, the heretic of Jafrdán, came with a pamphlet by some of the Sharífs of Mecca, in which a tradition was quoted to the effect that the earth would exist for 7,000 years, and as that time was now over the promised appearance of the Mahdí would immediately take place'. Even though Abd al-Qadir Badāūnī himself did not believe in the Millenarian signs, he knew that his own disagreement was not shared by his Emperor Akbar and he added that: 'All this made the Emperor the more inclined to claim the dignity of a prophet'.

Consequently, we can state that the Emperor Akbar, his advisors, and, most significantly, some Sharifs of Mecca, were all aware of the fact that the appearance of Prophet Muhammad could have been associated in the Muslim millenarian tradition to the end of the 6000 years' cycle of the earth.

We conclude that even though the Islamic calendar is not related to the seasons, it could not have been developed without the determination of the beginning of spring in the year 632 AD.

Finally, based on our claims above, we calculated the accurate date of the epoch of the Islamic calendar by adding 5999*Y to the YOC_2 including the fraction of the year after the beginning of the solar year for 4 different lengths of the solar years (Figure 6). In the last column of Figure 6 we have also included Calif Umar's assumption, that the astronomical-atmospheric statement made by Prophet Muhammad, could be referred to the year 631 AD. In such a case the YOC_1= 5200 BC was the interpretation of Eusebius's chronology used by the founders of the Islamic calendar and the epoch took place 6000 years after creation[5].

Figure 6. The solar year of the Islamic epoch calculated for 4 different values of the length of the solar year, 5999 or 6000 lunar years after YOC_2 and YOC_1. The fractions of the years in the last two columns are related to the dates in 622 after the vernal equinox

The Solar Year	Length of the year	R=Y/Yi Yi=354.3667	A2 Number of Solar Years = 5999/R	A1 Number of Solar Years = 6000/R	The Solar Year after 5999 Lunar Year - 5198+A2	The Solar Year after 6000 Lunar Years - 5199+A1
Yj	365.24682	1.0307031	5820.299	582.269	622.298	622.269
Ya	365.24667	1.0307027	5820.3010	5821.2713	622.3010	622.2713
Ym	365.2435	1.0307018	5820.3061	5821.2763	622.3061	622.2763
Yju	365.25	1.0307121	5820.248	5821.2182	622.248	622.2182

All results lead to the year 622 AD without any dependence of an actual events in that year (Figure 6) nor in any other year in Prophet Muhammad's life.

Is that a coincidence?

DISCUSSION

The expectations for the appearance of the new Messiah have played a fundamental role in Judaism and Christianity throughout their history:

"*The world will continue for six thousand years, the first two thousand of which were a chaos (Tahu), the second two thousand were of Torah, and the third two thousand are the days of the Messiah*" (Babylonian Talmud, Avoda Zara, Ch. 1 p. 16).

This Talmudic view was adopted word by word by Martin Luther who decorated the opening page of his famous book *Supputatio annorum mundi* (1541 AD) by citing there the Talmudic description of the 6 Millennia in Latin.

Another citation which sheds light on the importance of the 6000 years from creation in Christianity and Judaism, is found in Lighfoot's chronology (1643): "Everyone knows the old conceit of the worlds lasting six thousand years, because it was made in six days: and of Elias Prophesy among the Jews, of the world ending, at the end of six thousand: which prophesy of his is flat against the words of Christ: Many believe these opinions, yet few prepare for the end which they think is so near". In this present work we have shown that a similar approach to this millenarian tradition is found in the foundations of the Islamic religion. In fact, as mentioned above, it appears to be one of the major reasons for the determination of the Julian date of $15/16^{th}$ of July 622 AD as the Epoch of the Islamic calendar.

However, the description of the similarities between the newmoons connecting the Hijra and Creation as a "striking coincidence", was justified only when the scientific world used the values of 365.2468 and 29.50556 days as the lengths of the solar year and the mean synodic month, accordingly. With the development of the science of astronomy and of atmospheric sciences, it was realized that such lengths are inaccurate. Consequently, the similarities had been ignored by modern researchers and religious leaders, and they are not discussed nor mentioned anymore by the present Islamic theological community.

Nevertheless, in the academic study of the history of the role of the millenarian tradition in Islam, Stowasser (2000) debated the correspondence discussed above between 7000 AH – 1592 AD, thus emphasizing its importance in academic Islamic studies.

A similar theological fortune of the concept of the "striking coincidence" can be found in Judaism and in Christianity where other major milestones were related to Creation.

The evidence for a "striking coincidence", a concept that is appealing to the believers, has continued to be propagated by the Byzantine and Episcopal Churches, for example, was left without any accurate explanation. In fact, its explanation has been ignored during the last Millennium and all that has remained are vague, and general arguments for its justification, simply due to the fact that as shown in our work they were originally based on presently known to be inaccurate lengths of the year and the mean month. So was the case of estimating the age of the world by the Ethiopian Church: During the second century the Ethiopian Church placed the world's YOC at exactly 5500 years before the Incarnation. In doing so they based their arguments on a striking coincidence relating the Incarnation to the first day of the second half of the sixth millennium of the World. The Ethiopian Church also believed that the astronomical visualization of the sky in the YOC in which the vernal equinox and the newmoon were in the same day (Figure 1), repeated itself in the year 5500.

This is very much the same as in the case of the "Blessing of the Sun" custom, celebrated by several thousand Jews all over the world, most recently on April 8th (Gregorian), 2009, 18 days after March 21st. This date was originally set, 2000 years ago, to celebrate the appearance of the sun as in Creation, believed to be on a Wednesday, on the first day of the first spring, in steps of 28 years with 365.25 days each.

CONCLUSIONS FOR THE EDUCATION OF ASTRONOMY

This work enlightens the most important contribution of astronomers in the development of several ancient cultures. All researchers should always consider the assumption that in spite of strong cultural beliefs, seemingly coincidental events result from brilliant scientific and astronomical interpretations and calculations.

Science has tools to estimate the low (sometimes negligible) probabilities for different single coincidences. Such estimations result in even much lower values when it comes to a series of seemingly coincidences in different religions:

1. Following our derivations in Cohen (2018) is it a coincidence that the varying chronologies in the Jewish Masoretic against the Septuagint versions of the Old Testament, can be explained by the different astronomical assumptions with respect to the changing astronomical input about the length of the mean month?) – It is our claim (Cohen, 2018) that the different chronologies were required to bring up the sky of the YOC as in Figure 1, and, in addition, according to both versions, on the weekday of Wednesday).

   Is it a coincidence that the ages of the first 10 Patriarchs in the Septuagint version can be explained by a sophisticated understanding of astronomy in ancient times (Cohen, 2019)? Is it a coincidence that all major events in the biblical Jewish history – The birth of Abraham, Exodus, the building of the Temples I and II took place according to the accepted Jewish biblical chronology when the astronomical sky returned after large cycles to Figure's 1 YOC sky (Cohen, 2018)? In fact, the accepted Jewish biblical dates of the building of the Temples are known to be about 165 years off their historical dates, but within a few years from our astronomical calculations.

2. Following the biblical chronology, Bishop Ussher found that the YOC was 4004 BC. Is it a coincidence that it is exactly 4000 years before the believed to be the birthdate of the new Messiah of the Christian world?
3. And, again, is it a coincidence that the epoch of the Islamic calendar can be explained as resulting from just worldly-wise astronomical calculations?

We suggest that all of the examples above are demonstrating to the educator of astronomy that along with the gigantic role of the religious beliefs in the shaping up of ancient cultures, science in general and astronomy in particular had always provided invaluable tools for their developments.

AUTHOR BIOGRAPHIES

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END NOTES

1 AM = Anno Mundi – the year from creation.

[2] As described, for example, in Figure 1.

3 According to which 1 Muharran 11 AH, was on March 29 [JD N_1 = 1951983] with Dhū al-Ḥijja assumed to be 30 days long at the end of year 10 AH. We note that in several other sources the dates of the farewell sermon are off by a day or two and, therefore, we are including the Julian day numbers for the discussed events.

4 In the first Millennium AD the Jews believed that Nisan's newmoon occurred on the first day of the spring as in Figure 1, or 7 days after the vernal equinox (Maimonides, 12th century AD).

5 The number of weekdays separating the weekday of creation and the epoch is 1.633 days for YOC2 a result which brings the epoch to Thursday 18 h (Friday) since according to the Jews, the first newmoon of the YOC took place on a Wednesday and 0.4 of the day. In the case of YOC1 the separation is 6 days.

NOTES