Erwin Reidinger

The Temple in Jerusalem: Using the Sun to Date its Origins*

For Judith and David

In my earlier work I reconstructed the complexes of Herod and Solomon, as well as determining the position and orientation of the Temple according to the criteria of building technology. The temple axis thereby discovered provided the basis for an astronomy-based examination that produced in turn the date for the orientation of the original founding of the Temple and for the consecration of the Second Temple.

What I did not succeed in doing at that time was to determine the date of the consecration of the First Temple, which is hence the central theme of this article. In the interest of clarity I repeat in abbreviated form the dates already published and organise the work in its temporal sequence as follows:

- First Temple / Temple of Solomon - orientation for the founding of the temple;
- First Temple / Temple of Solomon - consecration date;
- Second Temple / Temple of Serubbabel - consecration date.

Fig. 1 shows the reconstructed Herodian complex, the Solomonian complex and the position and orientation of the Temple.

For the Herodian complex a rectilinear pair of axes measuring 250 x 160 fathoms is of primary importance. This produced the quadrilateral of the complex in which the east side, which measures 250 fathoms (465.50 m), and the east side measuring 150 fathoms (279.30 m) represent "round planning values", whereas the lengths of the other sides are the result of planning in response to the "given natural circumstances" (Reidinger 2002a: 101-106; Reidinger 2004b: 14-19).

* The contribution represents a further development of a work of mine that initially appeared in in *Biblische Notizen*, München (Reidinger 2002a), in German and in *Assaph*, Tel Aviv (Reidinger 2004b), in English. The present contribution has already appeared - *Aktuelle Beiträge zur Exegese der Bibel und ihrer Welt*, Salzburg (Reidinger 2006c). Translated from the German by J. Roderick O'Donovan. The costs of the translation were met by the Austrian Federal Ministry for Education, Science and Culture and by the Office of the Lower Austrian Provincial Government (St. Pölten).

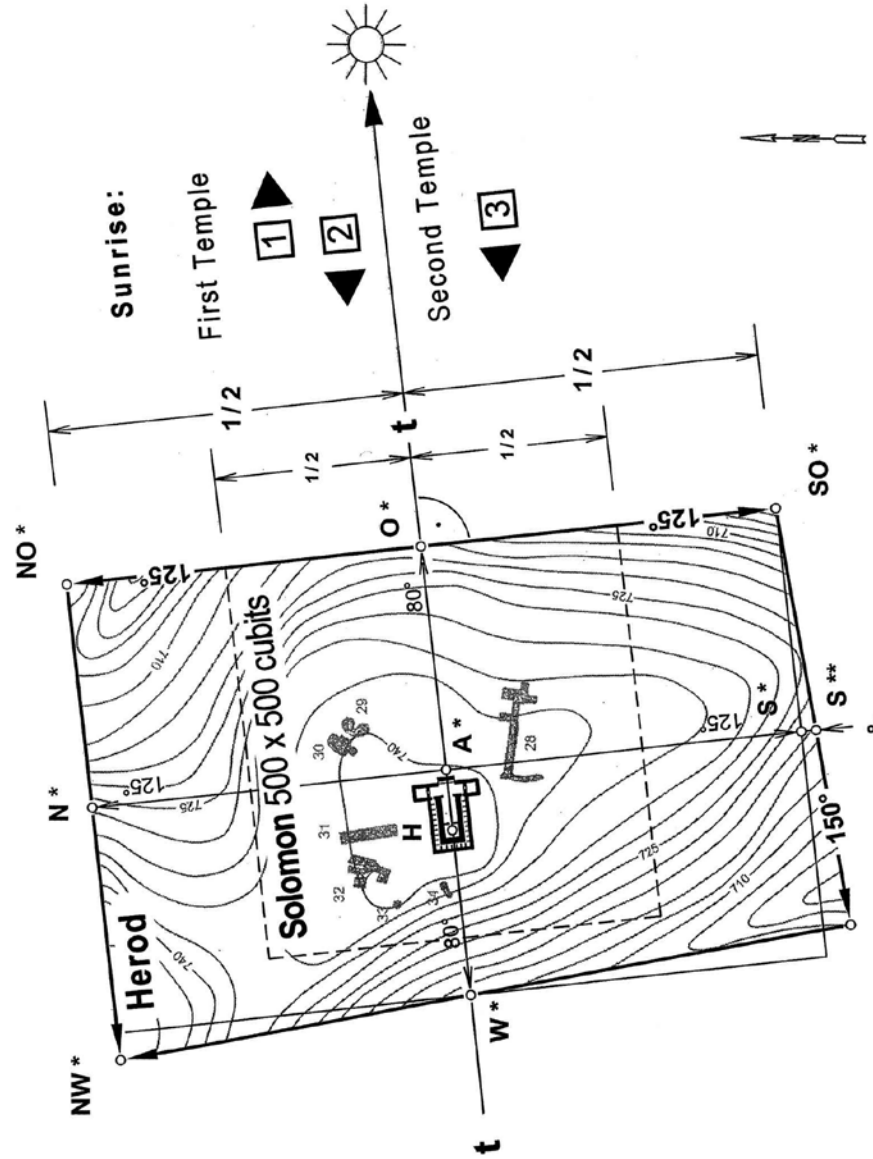

Fig. 1. Reconstruction of the Temple complex of Herod and the Temple of Solomon with the situation and orientation of the Temple (1 fathom = 1° = 1.862 m, 1 cubit = 0.52 m). Legend see next page.

t - t: Temple axis, geographical/astronomical orientation 83.82° from north

1. **First Temple/Temple of Solomon – orientation for the founding by** choosing as the axis of the temple sunrise on 18 April 957 BCE, which is the 15 Nissan (Pessach, first full moon in spring).
2. **First Temple/Temple of Solomon – day of consecration** based on sunrise on the temple axis (already determined for the founding) on 14 September 951 BCE, which is 22 Etanim (eighth day of the Feast of Tabernacles, Day of Holy Convocation).
3. **Second Temple/Temple of Serubbabel – day of consecration** based on sunrise on the temple axis (earlier determined, see 2) on 11 September 515 BCE, which is 10 Tischri (Yom Kippur, Day of Atonement).

I was able to reconstruct the Solomonian complex with dimensions of 500 x 500 cubits. Decisive here was a slight bend in the east wall that I discovered 130 m to the north of the middle of the side (point O) (Reidinger 2002a: 113-119; Reidinger 2004b: 26-32). It is not of essential relevance whether Solomon himself built this complex or not. What is important is the rectangular planning concept.

It is particularly remarkable that the temple axis turned out to be a perpendicular to the east side from the middle of that side (point O) (cf. Fig. 1). It runs precisely through the centre point of the Dome of the Rock and through the centre of the Holy Rock that lies beneath the dome (Reidinger 2002a: 98-99; 119-123; Reidinger 2004b: 11-12; 30-36). It also allows us to determine a geometrical relationship to the rock (which shows clear signs of having been worked upon) and allows us to recognise the rock as the 'imprint' of the Temple. The point O at the centre of the east side was clearly derived by Herod's engineers from the Temple building (that was still standing at the time) by simply extending its axis. This was the starting point for laying out the Herodian east side. In relationship to this side the Temple axis is the axis of symmetry of both the Herodian and Solomonian complexes.

For the astronomical examination the geographical/astronomical difference of the temple axis to north (83.82°) is of considerable importance. The same applies to the height of the natural horizon on the extended temple axis at the Mount of Olives, which is 3.97° (Reidinger 2002a: 126-129; Reidinger 2004b: 38-41). For an observer standing on the Rock this means that the height of the horizon was 3.84°, this figure that will use in evaluating the significance of the different sunrises.

Using a Julian calendar 'extrapolated backwards', so to speak, if we calculate according to these criteria the sunrises on the temple axis correspond:

- At the time of Solomon: to 18 April or 14 September and
- At the time of Serubbabel: to 11 September.

Relationship: Sun-Temple

Matthias Albani (Albani 1994: 311) sees a reference to the importance of the sun in the Jerusalem Temple cult in the much discussed Bible passages in 2Kgs 23:11 and Ezek 8:16 as well as in the so-called 'Temple dedication saying', 1Kgs 8:12: *Then Solomon said, 'The LORD has said that he would dwell in thick darkness'*. Othmar Keel (Keel 2002: 18) states that JHWH in Jerusalem obviously lives in cohabitation with the sun god (possessor of the place, open air sanctuary). As JHWH wished to live in darkness, he needed a building. This was achieved by erecting the temple.

1. Temple of Solomon - Orientation for the Founding

There is biblical reference to the start of the construction of the Temple in 1 Kgs 6:1: … *in the fourth year of Solomon's reign over Israel, in the month of Ziv, which is the second month, he began to build the house of the LORD*.

There is no completely reliable date. In working out on which 18 April during the time of Solomon the sun rose along the temple axis, I noticed that this date lies close to the movable feast of Pessach. If I could assume that the orientation for the founding of the Temple was determined on this important feast day, I had found a means of calculating the year of the founding. Within a broad time framework extending from 976 to 938 BCE there turned out to be only one exact solution where 18 April coincided with Pessach (15 Nissan[1]) (Table 1 and Fig. 2). This was in the year 957 BCE. Therefore I assume that the construction of the Temple started in this year.

Solution 957 BCE and the periods ±8, ±11 and ±19 years

In determining the sunrise on the temple axis it is not only the days on which the 18 April coincides with 15 Nissan that are of importance but also the exact astronomical solutions. These can be determined precisely by calculating the respective path of the sun taking into account the temple axis (83.82° from north) and the natural horizon provided by the Mount of Olives (3.84°). Fig. 2 shows the path of the sun on the temple axis in the year 957 BCE (solution) and in the years that come close to a solution during the periods ± 8, ± 11 and ± 19 years (cf. Table 1, column 10). The relevant astronomical data about the height of the disc of the sun on the temple axis are given in Table 2.

[1] The name Nissan for this month did not exist at the time of Solomon. Nevertheless I use it here and throughout as the term for the "first month".

year		new moon			1 Nissan		15 Nissan	difference to	
historical BCE	astrono-mical	on	at MEZ	true local time	new crescent moon	sunrise	sunrise	18.4. days	957 years
1	2	3	4	5	6	7	8	9	10
976	-975	2.4.	14:18	15:33	3.4.	4.4.	18.4.	0	+ 19
975	-974	23.3.	7:03	8:18	24.3.	25.3.	8.4.		
974	-973	11.4.	6:33	7:48	12.4.	13.4.	27.4.		
973	-972*	30.3.	16:33	17:48	31.3.	1.4.	15.4.		
972	-971	19.3.	19:22	20:37	21.3.	22.3.	5.4.		
971	-970	7.4.	11:46	13:01	8.4.	9.4.	23.4.		
970	-969	27.3.	14:08	15:23	28.3.	29.3.	12.4.		
969	-968*	14.4.	9:30	10:45	15.4.	16.4.	30.4.		
968	-967	3.4.	22:02	23:17	4.4.	5.4.	19.4.	+ 1	+ 11
967	-966	24.3.	14:34	15:49	25.3.	26.3.	9.4.		
966	-965	12.4.	14:53	16:08	13.4.	14.4.	28.4.		
965	-964*	1.4.	5:19	6:34	2.4.	3.4.	17.4.	- 1	+ 8
964	-963	21.3.	13:06	14:21	22.3.	23.3.	6.4.		
963	-962	9.4.	6:44	7:59	10.4.	11.4.	25.4.		
962	-961	29.3.	7:13	8:28	30.3.	31.3.	14.4.		
961	-960*	16.4.	0:20	1:35	17.4.	18.4.	2.5.		
960	-959	5.4.	7:55	9:10	6.4.	7.4.	21.4.		
959	-958	25.3.	21:58	23:13	26.3.	27.3.	10.4.		
958	-957	13.4.	22:00	23:15	14.4.	15.4.	29.4.		
957	**-956***	2.4.	14:46	16:01	3.4.	4.4.	**18.4.**	**0**	**± 0**
956	-955	23.3.	3:30	4:45	24.3.	25.3.	8.4.		
955	-954	10.4.	23:33	24:48	12.4.	13.4.	27.4.		
954	-953	31.3	2:09	3:24	1.4.	2.4.	16.4.		
953	-952*	17.4.	18:21	19:36	18.4.	19.4.	3.5.		
952	-951	6.4.	21:09	22:24	8.4.	9.4.	23.4.		
951	-950	27.3.	6:46	8:01	28.3.	29.3.	12.4.		
949	-948*	3.4.	22:21	23:36	4.4.	5.4.	19.4.	+ 1	- 8
946	-945	1.4.	20:05	21:20	3.4.	4.4.	18.4.	0	-11
938	-937	3.4.	10:48	12:03	4.4.	5.4.	19.4.	+ 1	- 19

Table 1. 15 Nissan in the Julian calendar from 976 to 938 BCE (-975 to - 937). 18 April and 15 Nissan coincide in the years 976, 957 and 946 BCE. According to Fig. 2 the years 976 and 946 BCE must be excluded as possible solutions. The conversion of the calendar was carried out using the dates of new light (the visibility of the first crescent moon, column 6).

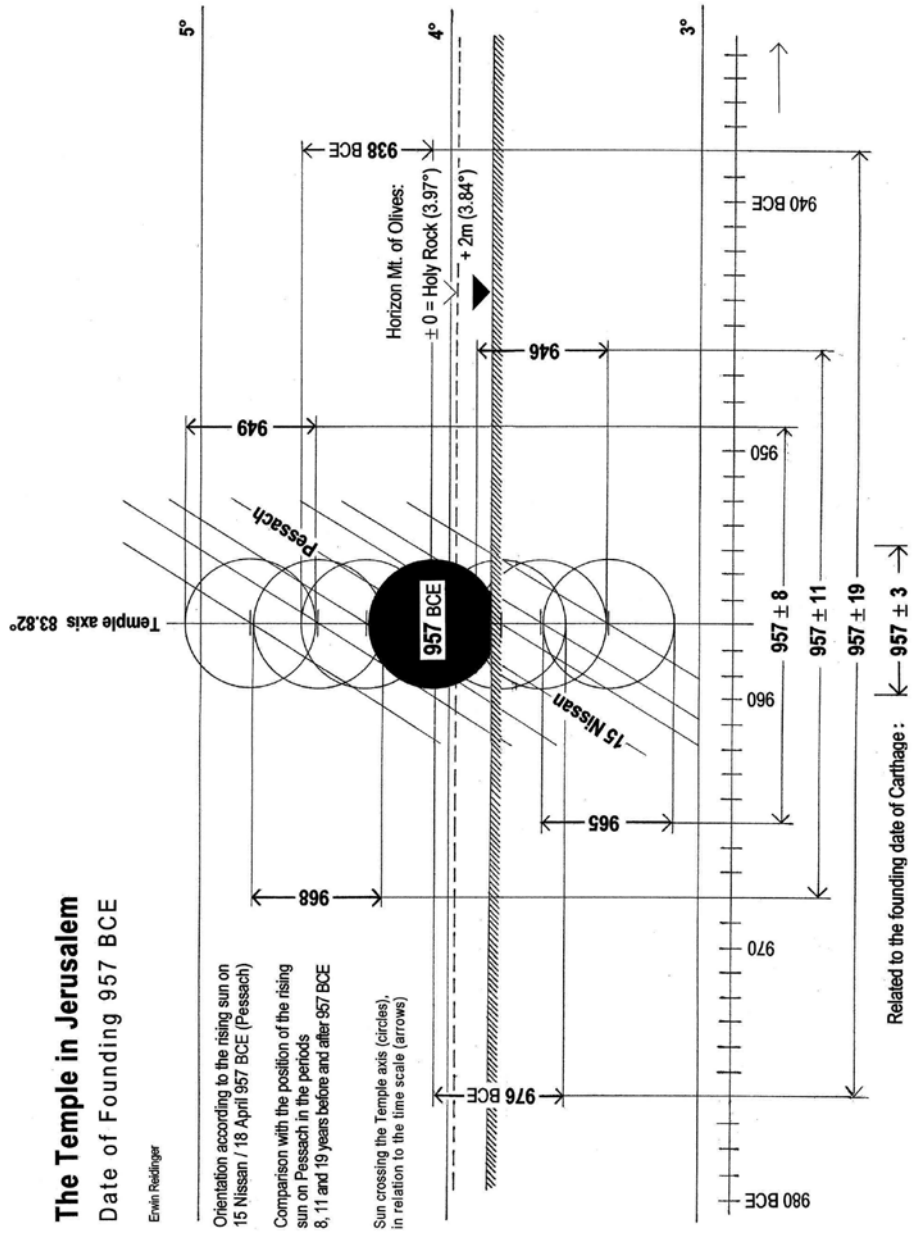

Fig. 2. The movement of the sun along the temple axis in the years 957 BCE ± 8, ± 11 and ± 19 years. Sunrise on the temple axis occurs only in the year 957 BCE, all other solutions are rejected.

Year BCE	Periods years	Astronomical date of Pessach year/month/day	Elevation of the sun on the temple axis	Sun top / bottom edge (± 0.26°)	Evaluation see below
1	2	3	4	5	6
976	+ 19	- 975 / 04 / 18	+ 3.80°	4.06° / 3.54°	rejected
968	+ 11	- 967 / 04 / 19	+ 4.53°	4.79° / 4.27°	rejected
965	+ 8	- 964 / 04 / 17	+ 3.36°	3.62° / 3.10°	rejected
957	**± 0**	**- 956 / 04 / 18**	**+ 4.07°**	**4.33° / 3.81°**	**solution**
949	- 8	- 948 / 04 / 19	+ 4.80°	5.06°/ 4.54°	rejected
946	- 11	- 945 / 04 / 18	+ 3.63°	3.89° / 3.37°	rejected
938	- 19	- 937 / 04 / 19	+ 4.34°	4.60° / 4.08°	rejected

Table 2. astronomical data (temple axis 83.82°, horizon - Mount of Olives 3.84°)
The solution is the year 957 BCE because in that year the full disc of the sun "sits" on the horizon (cf. Fig. 3)

Evaluation of the solutions (Table 2/column 6 and Fig. 2)

957 BCE: orientation of the Temple (temple axis) according to the rising sun (full disc). Within the period 957 ± 7 years (i.e. 964 to 950 BCE.) there is no other solution.

957 ± 8 years:

965 BCE: the sun on the temple axis did not rise above the horizon; therefore I reject this solution!

949 BCE: the sun on the temple axis was too high above the horizon (around 1.35 times the disc's diameter); therefore I also reject this solution!

957 ± 11 years:

968 BCE: the sun on the temple axis is already too high (the bottom edge of the disc of the sun was c. 0.83 times its diameter above the horizon); I therefore reject this solution!

946 BCE: orientation was possible (c. 0.10 of the diameter of the disc of the sun

is visible), but given the date, orientation was rather unlikely (cf. remarks under "Carthage" below); I also reject this solution!

957 BCE ± 19 years:

976 BCE: orientation was possible (about 0.42 of the diameter of the disc of the sun was visible), but, given the date, orientation was rather unlikely (cf. remarks under "Carthage" below); this solution is rejected.

938 BCE: The sun on the temple axis is too high (the bottom edge of the disc of the sun was a distance of c. 0.45 times its diameter above the horizon); I therefore reject this solution!

Table 3 clarifies the relationship between the annual sunrise on the temple axis on 18 April and the movable feast of Pessach on 15 Nissan. The astronomical calculation of the sunrise is shown in Table 4. Fig. 3 shows sunrise on the temple axis at the moment of the founding of the Temple on 18 April 957 BCE (Pessach).

Carthage

Independent of my solution there is other proof (outside the Bible) that leads to the same results. Lowell K. Handy (Handy 1997: 97) has conducted extensive research into the duration of the reign of King Solomon. He relies on Josephus (*Contra Apionem* 1.17), which contains references, independent of the Bible, that Carthage was founded 143 years and 8 months after the start of construction of the Temple in Jerusalem.

Handy gives 814 BCE ± 1 year as the likely founding date for Carthage. He dates Solomon's accession to the throne with an accuracy of ± 3 years and justifies this with the imprecision of the expression "year 1" and the imprecise method of numbering the years of a reign in Tyre and Judea, whereby he uses the founding of Carthage as his starting point.

Because the start of construction of the Temple is dated in relation to Solomon's accession to the throne (1Kgs 6:1: *in the fourth year of Solomon's reign over Israel, in the month of Ziv, which is the second month, he began to build the house of the* LORD), this date is subject to the same uncertainty. Handy therefore gives the date of the start of construction of the Temple as 957 BCE ± 3 years (cf. Fig. 2, time scale, bottom line).

Temple of Solomon

Pessach / 15 Nissan 957 BCE

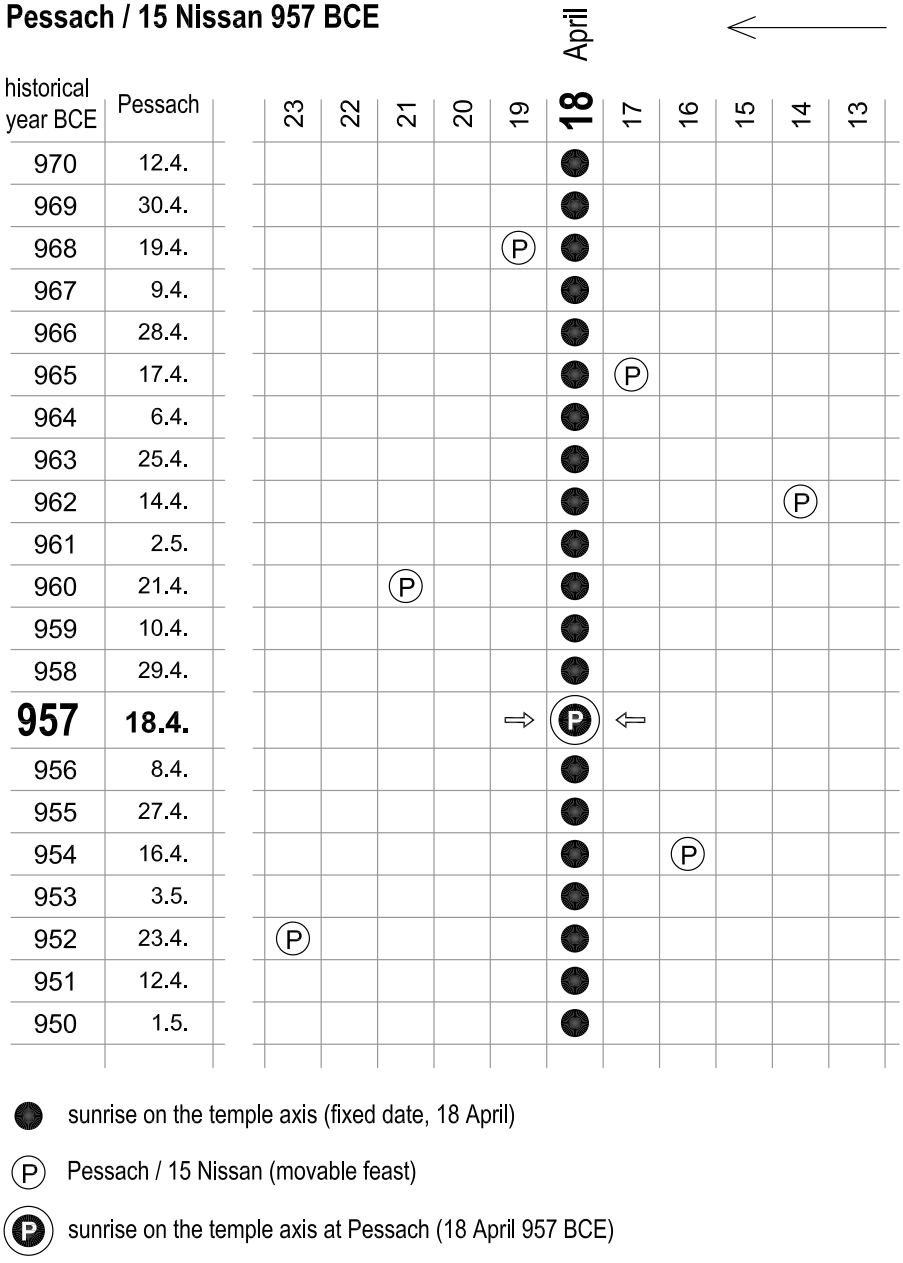

Table 3. The relationship between 18 April and 15 Nissan / Pessach (a movable feast). Between 970 and 950 BCE these dates coincide only in the year 957 BCE.

Jerusalem, Sunrise on the Temple axis on 18 April 957 BCE (15 Nissan)					
Date CET:	**-956/04/18** 4h38m46s Due		Sideral time 19h07m34s		
Date UT:	-956/04/18.1519		JD (UT) : 1371986.6519		
Date DT:	-956/04/18.4110 (□T= 6h13.1m)		JD (DT) : 1371986.9110		
Geogr.longitude = **-35.2346°**, Geogr.latitude = **+31.7777°**, Height = 744m					
Sun and Moon: Rise/Set and Twilight					
Begin:	astronom.twilight	2h 53m		Moonrise	8h 36m
	nautical twilight	3h 23m		Moon culmination	-- --
	civil twilight	3h 52m		Moonset	5h 09m
Sunrise		4h 16m	**Moon:**	illuminated fraction	0.98
				age	15.6 days
Sun culmination		10h 39m		after full moon	
Sunset		17h 01m	**Sun:**	**geometrical altitude**	**+3.87°**
End:	civil twilight	17h 26m		**refraction**	**0.20°**
	nautical twilight	17h 55m		**apparent altitude**	**+4.07°**
	astronom.twilight	18h 25m		**azimuth**	**83.82°**

Table 4. Calculation of sunrise on the temple axis on 18 April 957 BCE, astronomically -956 04 18 (reformatted computer printout)

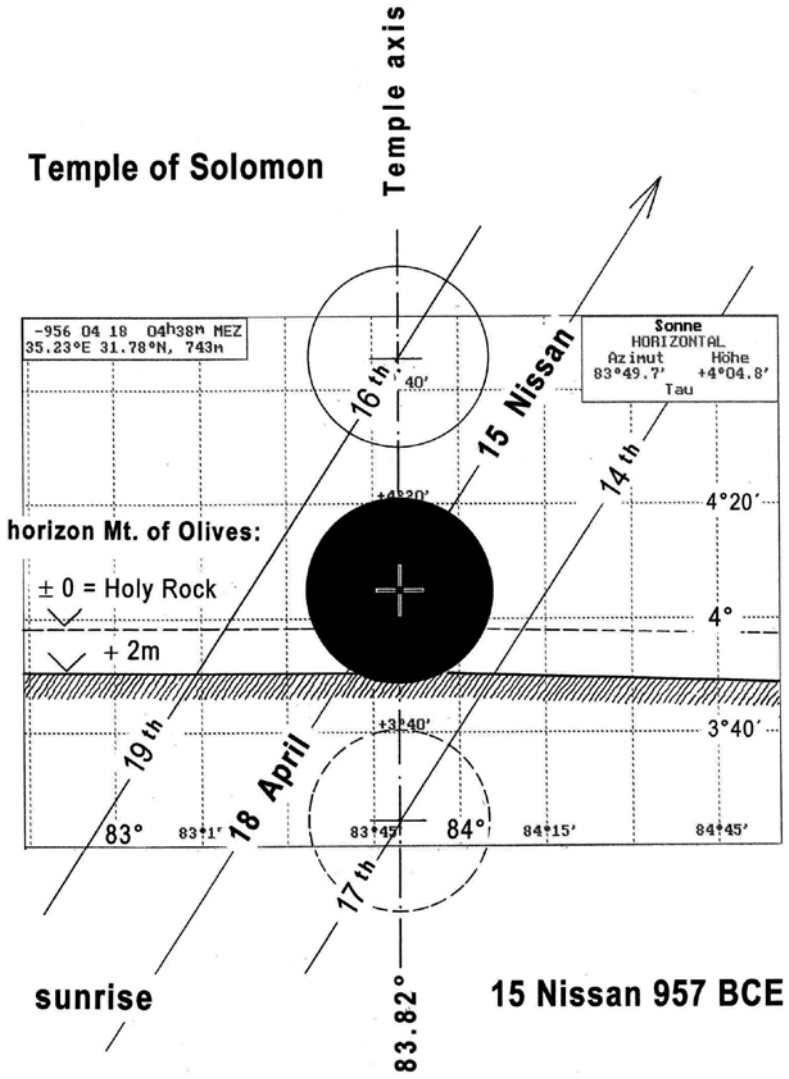

Fig. 3. Depiction of sunrise on the temple axis (83.82°) on 18 April 957 BCE, which was also 15 Nissan (Pessach). A height of + 2 m above the Holy Rock was chosen as the reference point for the evaluation horizon. This is approximately eye level of an observer standing on the Rock (computer graphic with additions).

Influence of the retardation of the earth's rotation

There is another variable that should be examined more closely, namely the "irregular retardation of the earth's rotation". Hermann Mucke has dealt exhaustively with this phenomenon (Mucke 2003: 84-86). In the astronomical programme "Urania Star" (Pietschnig and Vollmann 1998), which I used, the retardation of the earth's rotation is taken into account. The calculation with the standard setting gives the most likely values. Other settings are also possible and can be used to examine special cases such as, for example, here (Table 5).

Date	Time (MEZ)	ΔT	h_s	Δh_s	Difference to the standard setting
1	2	3	4	5	6
-956 / 04 / 18	4h 38m 35s	5h 13,1m	+ 4.05°	- 0.02°	- 1 hour
-956 / 04 / 18	**4h 38m 46s**	**6h 13,1m**	**+ 4.07°**	**± 0**	**± 0** (cf. Table 4)
-956 / 04 / 18	4h 39m 05s	7h 13,1m	+ 4.11°	+ 0.04°	+ 1 hour
-956 / 04 / 18	4h 39m 20s	8h13,1m	+ 4.14°	+ 0.07°	+ 2 hours

Table 5. Influence of the retardation of the earth's rotation on the orientation of the Temple of Solomon according to the rising sun on 18 April 957 BCE (Pessach).
ΔT... dynamical time (taking into account the retardation of the earth's rotation)

To find the proof required I selected differences from the standard setting of –1, +1 und +2 hours.[2] The results given show the apparent height of the sun (h_s) on the temple axis (83.82°) and the differences (Δh_s) in relation to the value of the standard setting of h_s= + 4.07°.

This examination has shown that the different approaches to the retardation of the earth's rotation have no significant influence on the outcome of the research on the orientation of the Temple of Solomon according to the rising sun on 18 April 957 BCE, because the daily paths of the sun, and therefore the apparent height of the sun on the temple axis, differ only slightly.

The results of the calculation tend to confirm an orientation based on the full disc of the sun.

[2] This framework certainly includes the true value (and was personally recommended by H. Mucke)

2. Temple of Solomon - Date of Consecration

In contrast to the dates already established for the orientation for the founding of the First Temple (957 BCE) and the date for the dedication of the Second Temple (515 BCE), the answer to the question whether perhaps the day of consecration of the First Temple might be related to sunrise on the temple axis is still open. I have already worked out that during the time of Solomon the sun always rose on the temple axis on 14 September. If we wish to establish the concrete year of the consecration of the Temple then the only available references are biblical ones. A possible solution could be found if, through examining these references, we can prove a relationship to sunrise on the 14 September. As a starting point we can use the report about the completion of the First Temple in 1Kgs 6:37-38:

[37] In the fourth year the foundation of the house of the LORD *was laid, in the month of Ziv.*
[38] And in the eleventh year, in the month of Bul, which is the eighth month, the house was finished in all its parts, and according to all its specifications. He was seven years in building it.

This text refers to the completion "in all its parts". In contrast to the relative date given (in the eleventh year), the "eighth month" and, possibly, the seven-year-long construction period have an absolute significance. In calculating the date of consecration that we are looking for this text must however be ignored from the astronomical viewpoint, as during the eighth month the sun did not rise on the temple axis. Therefore for further research the construction period cited of seven years is our only remaining basis.

Further biblical sources that relate to the consecration of the Temple are found in 1Kgs 8:2-4 and Lev 23:34-36. These texts are as follows:

1Kings 8:2-4:
[2] All the people of Israel assembled to King Solomon at the festival in the month Ethanim, which is the seventh month.
[3] And all the elders of Israel came, and the priests carried the ark.
[4] So they brought up the ark of the LORD*, the tent of meeting, and all the holy vessels that were in the tent; the priests and the Levites brought them up.*

Leviticus 23:34-36:
[34] *Say to the people of Israel, on the fifteenth day of this seventh month and for seven days is the feast of booths [Feast of Tabernacles] to the LORD.*

[35] On the first day shall be a holy convocation; you shall do no laborious work.
[36] Seven days you shall present offerings by fire to the LORD; on the eighth day you shall hold a holy convocation and present an offering by fire to the LORD; it is a solemn assembly; you shall do no laborious work.

The first quotation relates to the transfer of the Ark of the Covenant on the "feast" in the seventh month. The second quotation reveals that this feast is the "Feast of Tabernacles". This feast begins on the fifteenth of the seventh month (15 Etanim) and finishes on the eighth following day, which is 22 Etanim. No indication of the year is given.

The solution sought seems to lie in the seventh month, as in this month there is a sunrise on the temple axis. The day of the transfer of the Ark of the Covenant seems to point towards an "essential date" which in my opinion can only be this event. Seemingly, the goal was to give the Temple over to its function on the "feast in the month of Etanim" by bringing in the Ark of the Covenant on this particular day.

Here I wish to recall the day of consecration of the Second Temple in 515 BCE, where I have proven the sunrise on the temple axis. This took place on 11 September, which in that year coincided with 10 Tischri[3], i.e. the Day of Atonement (Yom Kippur). In comparing the two consecrations the analogy suggests itself that the consecration ritual of the First Temple could have been repeated in the consecration of the Second Temple by incorporating the rising sun. In further investigating the first day of consecration according to the biblical sources there are two criteria that must be fulfilled:

- *The day of consecration must fall on a feast day in the seventh month* (1Kgs 8:2)
- *The period of time between the start of construction and the transfer of the Ark of the Covenant must amount to about seven years* (1Kgs 6:38).

The "biblical construction period" of the Temple between the start of construction (according to 1Kgs 6:1 in the second month of the fourth year) and its completion "with all its parts" (according to 1Kgs 6:38 in the eighth month of the eleventh year) amounts to seven years and seven months. At the same time the same passage (1Kgs 6:38) says "he was seven years in building it". It can be seen that we are dealing here with two different periods of time. The first relates to the completion of the building "with all its parts" and the second refers to the state of the building at the time of the consecration.

I have already dated the start of the construction of the Temple with the year

[3] Tischri (Babylonian) is the older name for Etanim (Cananean).

957 BCE. I therefore begin the examination of the year of consecration taking into account the seven-year construction period by examining the years 951, 950 and 949.

Sunrise on the temple axis on 14 September coincided with the following dates in the years:

- *951 BCE with 22 Etanim (6 years and 6 months after the start of construction)*
- *950 BCE with 3 Etanim (7 years and 6 months after the start of construction)*
- *949 BCE with 15 Etanim (8 years and 6 months after the start of construction).*

The possible solution 950 BCE is disqualified from the very beginning because 3 Etanim does not coincide with any feast day in the seventh month. The situation regarding the other two solutions (951 and 949 BCE) is different, as in both cases the sunrise on the temple axis coincides with a feast day in the seventh month. In the first case this is the eighth day of the Feast of Tabernacles, which is celebrated on 22 Etanim and is regarded as the "Feast of Convocation" (calculation see Table 6). In the second case it is the first day of the Feast of Tabernacles, which falls on 15 Etanim.

Julian calendar **951** BCE	Etanim (seventh month)	Feast days T	C	Remarks T ... Feast of Tabernacles C ... Temple Consecration Feast
22. 8.				New moon
23. 8.				New crescent moon, 1 Etanim begins in the evening
24. 8.	1.			The first sunrise in the new month is on 1 Etanim
25. 8.	2.			
..	..			
5. 9.	13.			
6. 9.	14.			
7. 9.	15.	1.		Start of the Feast of Tabernacles (15th day of the 7th month; Lev 23:34)
8. 9.	16.	2.		
9. 9.	17.	3.		
10. 9.	18.	4.		***Feast of Tabernacles***
11. 9.	19.	5.		***15-21 Etanim***
12. 9.	20.	6.		
13. 9.	21.	7.		
14. 9.	**22.**	**8.**	**1.**	**Day of the Holy Convocation** (Lev 23:36) **Eighth Day of the Feast of Tabernacles** **Sunrise on the temple axis** (Reidinger) **First day of the Feast of the Consecration of the Temple (?)** **Day of the transferral of the Ark of the Covenant (?)**
15. 9.	**23.**	9.	2.	Dismissal of the people on 23 Etanim (2Chr 7:10)
16. 9.	24.	10.	3.	
17. 9.	25.	11.	4.	***Temple Consecration Feast***
18. 9.	26.	12.	5.	***22-28 Etanim***
19. 9.	27.	13.	6.	
20. 9.	28.	14.	7.	End of the fourteen-day feast (1Kgs 8:65)

Table 6. Shows the relationship between 14 September and 22 Etanim in the year 951 BCE, that is the eighth day of the Feast of Tabernacles (first day of the Feast of the Consecration of the Temple?). New moon is on 22 August at 1h 24m (Pietschnig and Vollmann 1998: Ephemeridenrechnung), new crescent moon is on 23 August (Schoch 1927: Planetentafel) and the first sunrise in the month of Etanim is therefore on 24 August. Consequently, it follows that sunrise on 14 September is on 22 Etanim. This is the Day of the Holy Convocation, which, in my opinion, is also the day on which the Ark of the Covenant was transferred.

A discussion of both solutions favours the 22 Etanim 951 BCE because on this day the entire disc of the sun "sat" on the horizon. This would have guaranteed the complete illumination of the Holy of Holies.

Jerusalem, Sunrise on the Temple axis on 18 April 957 BCE (15 Nissan)					
Date CET :	**-950/09/14** 4h38m18s Th			Sideral time 4h52m45s	
Date UT :	-950/09/14.1516			JD (UT) : 1374326.6516	
Date DT :	-950/09/14.4095 (□T= 6h11.3m)			JD (DT) : 1374326.9095	
Geogr.longitude = **-35.2346°**, Geogr.latitude = **+31.7777°**, Height = 744m					
Sun and Moon: Rise/Set and Twilight					
Begin:	astronom.twilight	2h 52m		Moonrise	23h 17m
	nautical twilight	3h 22m		Moon culmination	5h 47m
	civil twilight	3h 51m		Moonset	13h 10m
Sunrise		4h 16m	**Moon:**	illuminated fraction	**0,34**
				age	23.1 days
Sun culmination		10h 38m		after last fourth	
Sunset		17h 00m	**Sun:**	**geometrical altitude**	**+3.90°**
End:	civil twilight	17h 24m		**refraction**	**0.20°**
	nautical twilight	17h 53m		**apparent altitude**	**+4.10°**
	astronom.twilight	18h 23m		**azimuth**	**83.82°**

Table 7. Calculation of sunrise on the temple axis on 14 September 951 (22 Etanim), BCE, astronomically: -949 09 14 (reformatted computer printout).

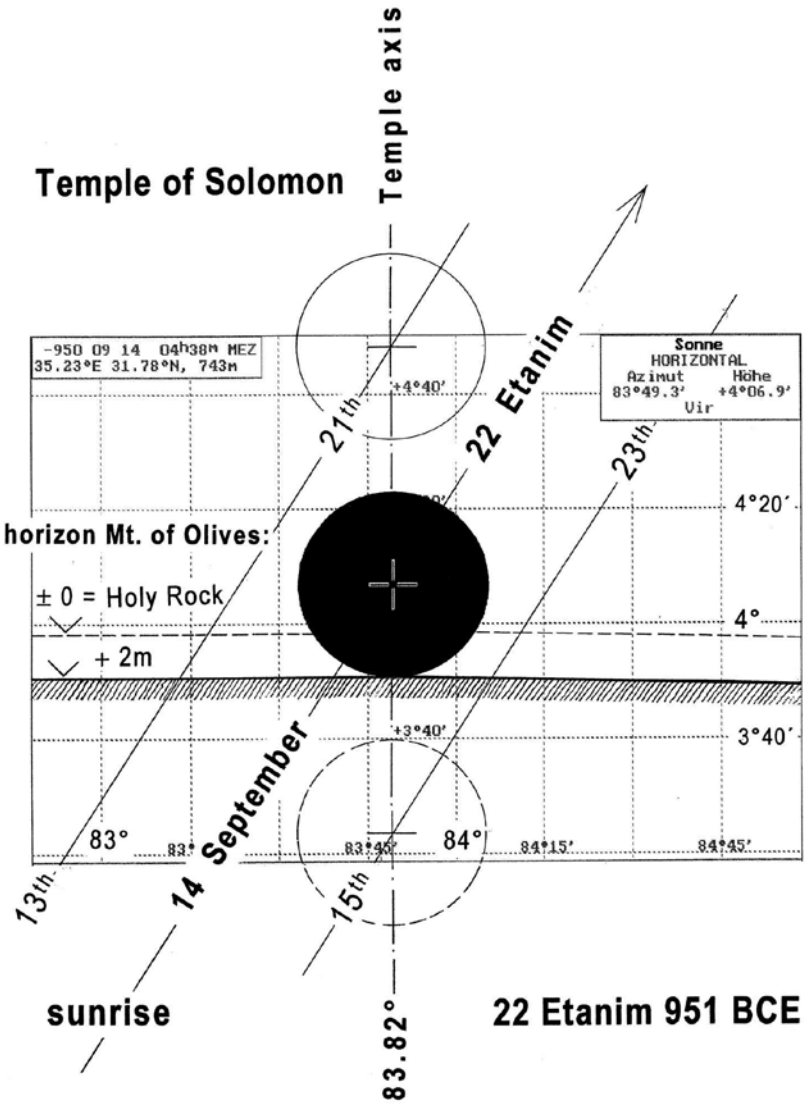

Fig. 4. Depiction of sunrise on the temple axis (83.82°) on 14 September 951 BCE, which coincided with 22 Etanim. For the evaluation horizon a height of + 2 m above the Holy Rock was assumed. This would be about the eye level of an observer standing in the Temple (computer graphics augmented).

The astronomical calculation is shown in Table 7 (apparent altitude 4.10°); Fig. 4 shows the related position of the sun on the temple axis. When compared with the position of the sun on the orientation for the founding on 18 April 957 BCE (15 Nissan) the positions correspond exactly (cf. Fig. 3, apparent altitude 4.07°). On the days preceding and following there are no solutions because on 13 September (21 Etanim) the sun was too high on the temple axis and on 15 September (23 Etanim) the sun did not rise on the temple axis.

On 15 Etanim 949 BCE only 29% of the diameter of the sun extended above the horizon. This day is therefore not relevant, in addition to which this solution is eight years and six months after the start of construction and contradicts the logical goal of using the sanctuary at the earliest possible date.

According to my solutions that are based upon to sunrises and are therefore independent of biblical statements, between the orientation for the founding of the Temple (Pessach 957 BCE, 15 Nissan, the first month, with the start of construction in the second month) and the consecration date 951 BCE (eighth day of the Feast of Tabernacles, 22 Etanim, seventh month) there is a period of "six days and six months". This solution conforms with the biblical statement of seven years because from the start of construction to the consecration of the Temple seven years are involved (first year = 957 BCE, seventh year = 951 BCE).

Day of the transfer of the Ark of the Covenant

It remains for me to interpret the day of the transfer of the Ark of the Covenant as it only says in 1Kgs 8:2: *on the feast in the month of Etanim*. Here the question arises whether this day might be identical with 22 Etanim. If one notes the word "convocation" in Lev 23:36 and equates it with the gathering in 1Kgs 8:1-2, then the logical conclusion is that 22 Etanim is the day on which the Ark of the Covenant was carried into the Temple.

Further details about the holding of this ceremony (consecration of the Temple) are to be found in 1Kgs 8:65-66 and 2Chr 7:8-10. The relevant passages are as follows:

1Kings 8:65-66:
[65] So Solomon held the festival at that time, and all Israel with him a great assembly, […] before the LORD *our God, for seven days (and seven days, 14 days)*
[66] On the eighth day he sent the people away; …

2Chronicles 7:8-10:
[8] At that time Solomon held the festival [of tabernacles] for seven days (… as in 1Kgs 8:65)
[9] And on the eighth day they held a solemn assembly; for they had kept the dedication of the altar seven days and the festival [of tabernacles] for seven days.

[10] On the twenty-third day of the seventh month he sent the people away to their homes…

The insertion in 1Kgs 8:65 about the 14-day feast is a later addition that assumes that the Feast of Tabernacles and the consecration were not held simultaneously but rather one after the other, each feast lasting seven days.[4] This interpretation favours 22 Etanim as the day on which the Ark of the Covenant was transferred. It is the eighth day after the start of the Feast of Tabernacles and at the same time the first day of the Feast of Consecration (cf. Table 6).

There are no other possible days on which the Ark of the Covenant could have been transferred as King Solomon only called the people together on the eighth day (Lev 23:36) and according to 1Kgs 8:66 sent them away on the same day (22 Etanim) or, according to 2Chr 7:10 on the day after, 23 Etanim.

In contrast to the orientation for the founding on 18 April 957 BCE, when the orientation day (15 Nissan, Pessach, first full moon in spring) could be freely chosen, here the day on which the sun rose on the temple axis was a given constraint and could therefore no longer be freely chosen. This means that the day of consecration on 22 Etanim must have been decisive in determining the dates of the Feast of Tabernacles, which lasted from 15 to 21 Etanim.

The eighth day after the start of the Feast of Tabernacles, 22 Tischri (22 Etanim) today corresponds with the concluding festival "Schemini Azeret". According to my research this is the day of the consecration of the Temple that was determined by the sunrise on the temple axis. It is identical with the day of the transfer of the Ark of the Covenant.

3. Temple of Serubbabel - Date of Consecration

To determine the date of the consecration of the Second Temple I have adopted the same procedure as in the research into the founding orientation 957 BCE by selecting a period of tiem (from 520 to 500 BCE) although the year of consecration is already known (Table 8).

Similar to the founding orientation of the Temple where the day on which the sun rises on the temple axis, 18 April, lies within the range of the movable feast of Pessach, in this case there is a relationship between 11 September and the movable Day of Atonement (Yom Kippur) on 10 Tischri.

The task therefore consists of finding out those years in which 11 September coincides with 10 Tischri. The solution is the year 515 BCE, which is known to be the year of consecration of the Second Temple.

[4] New Revised Standard Bible (note to 1Kgs 8:65)

year		new moon			1 Tischri		10 Tischri	difference to 11.9.	difference to 515
historical BCE	astrono-mical	on	at MEZ	true local time	new crescent moon	sunrise	sunrise	days	years
1	2	3	4	5	6	7	8	9	10
520	-519	26.8.	21:40	23:00	28.8.	29.8.	7.9.		
519	-518	14.9.	20:42	22:02	16.9.	17.9.	26.9.		
518	-517	4.9.	3:11	4:31	5.9.	6.9.	15.9.		
517	-516*	23.8.	3:50	5:10	24.8.	25.8.	3.9.		
516	-515	10.9.	21:30	22:50	12.9.	13.9.	22.9.		
515	**-514**	31.8.	1:32	2:52	1.9.	2.9.	**11.9.**	**0**	**0**
514	-513	20.8.	12:58	14:18	21.8.	22.8.	31.8.		
513	-512*	7.9.	13:45	15:05	8.9.	9.9.	18.9.		
512	-511	28.8.	6:09	7:29	29.8	30.8.	8.9.		
511	-510	17.8.	20:29	21:49	18.8.	19.8.	28.8.		
510	-509	5.9.	18:15	19:35	6.9.	7.9.	16.9.		
509	-508*	24.8.	22:46	24:06	26.8.	27.8.	5.9.		
508	-507	12.9.	16:24	17:44	13.9.	14.9.	23.9.		
507	-506	1.9.	16:45	18:03	2.9.	3.9.	12.9.	+ 1	+ 8
506	-505	21.8.	22:57	24:17	23.8.	24.8.	2.9.		
505	-504*	8.9.	22:13	23:33	10.9.	11.9.	20.9.		
504	-503	29.8.	13:24	14:44	30.8.	31.8.	9.9.		
503	-502	19.8.	5:48	7:08	20.8.	21.8.	30.8.		
502	-501	7.9.	5:24	7:02	8.9.	9.9	18.9.		
501	-500*	26.8.	15:22	16:42	27.8.	28.8.	6.9.		
500	-499	14.9.	10:44	12:04	15.9	16.9.	25.9.		

Table 8. 10 Tischri in the Julian Calendar from 520 to 500 BCE (-519 to -499). 11 September and 10 Tishchri (Yom Kippur) coincide only once, in the year 515 BCE which is the year of the consecration. The conversion of the calendar was made according to the dates of new light (visibility of the first crescent moon, column 6).

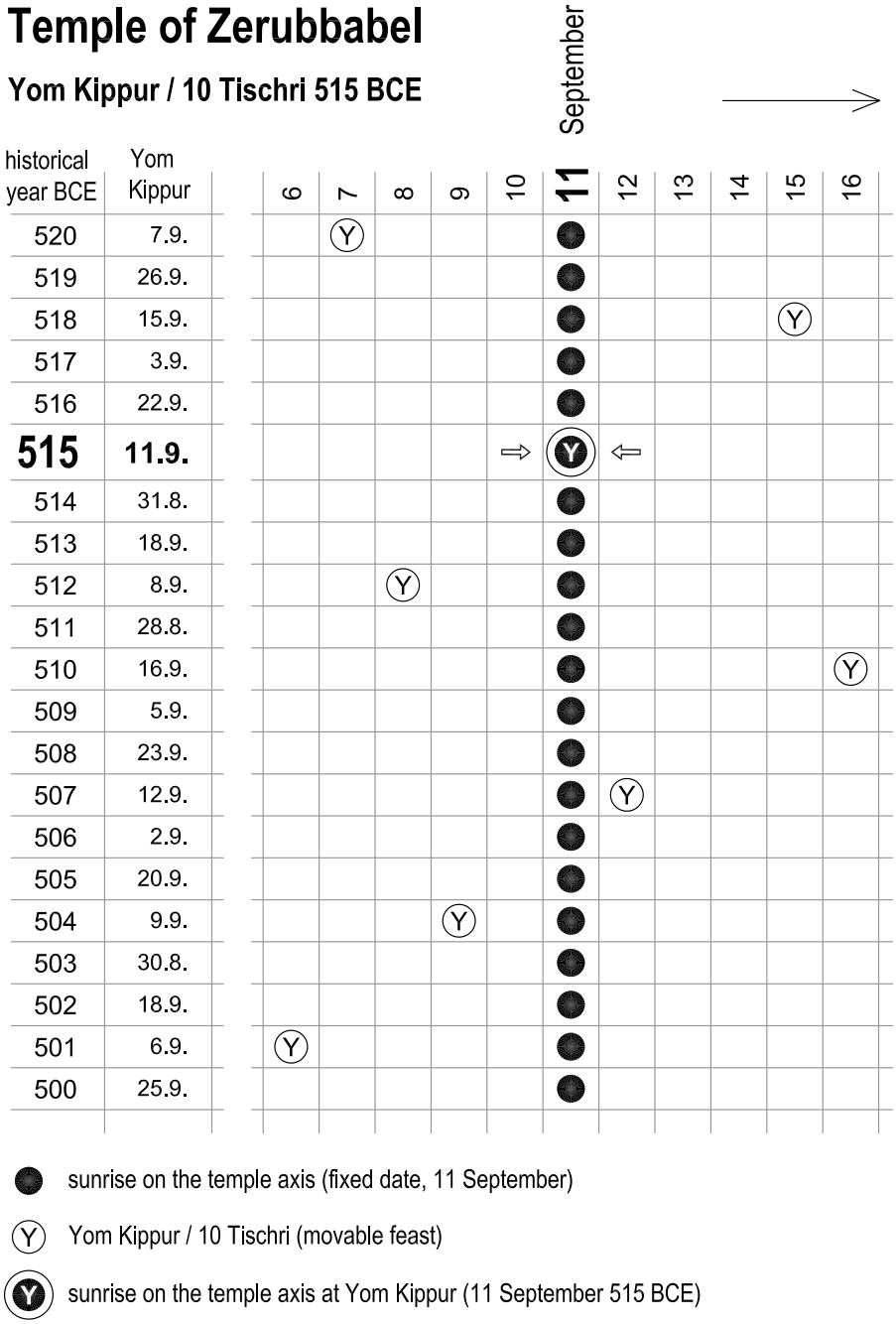

Table 9. The relationship between 11 September and 10 Tischri / Yom Kippur (a movable feast). In the years between 520 and 500 BCE these days coincide only once, in the year 515 BCE.

Jerusalem, Sunrise on the Temple axis on 11 September 515 BCE (10 Tischri)					
Date CET :	**-514/09/11** 4h37m09s Sun			Sideral time 4h52m50s	
Date UT :	-514/09/11.1508			JD (UT) : 1533572.6508	
Date DT :	-514/09/11.3328 (□T= 4h22.1m)			JD (DT) : 1533572.8328	
Geogr.longitude = **-35.2346°**, Geogr.latitude = **+31.7777°**, Height = 744m					
Sun and Moon: Rise/Set and Twilight					
Begin:	astronom.twilight	2h 52m		Moonrise	14h 09m
	nautical twilight	3h 22m		Moon culmination	19h 28m
	civil twilight	3h 51m		Moonset	-- --
Sunrise		4h 16m	**Moon:**	illuminated fraction	**0.79**
				age	11.1 days
Sun culmination		10h 37m		befor full moon	
Sunset		16h 59m	**Sun:**	**geometrical altitude**	**+3.72°**
End:	civil twilight	17h 24m		**refraction**	**0.21°**
	nautical twilight	17h 53m		**apparent altitude**	**+3.93°**
	astronom.twilight	18h 22m		**azimuth**	**83.82°**

Table 10. Calculation of sunrise on the temple axis on 11 September 515 BCE, astronomically - 514 09 11 (reformatted computer printout).

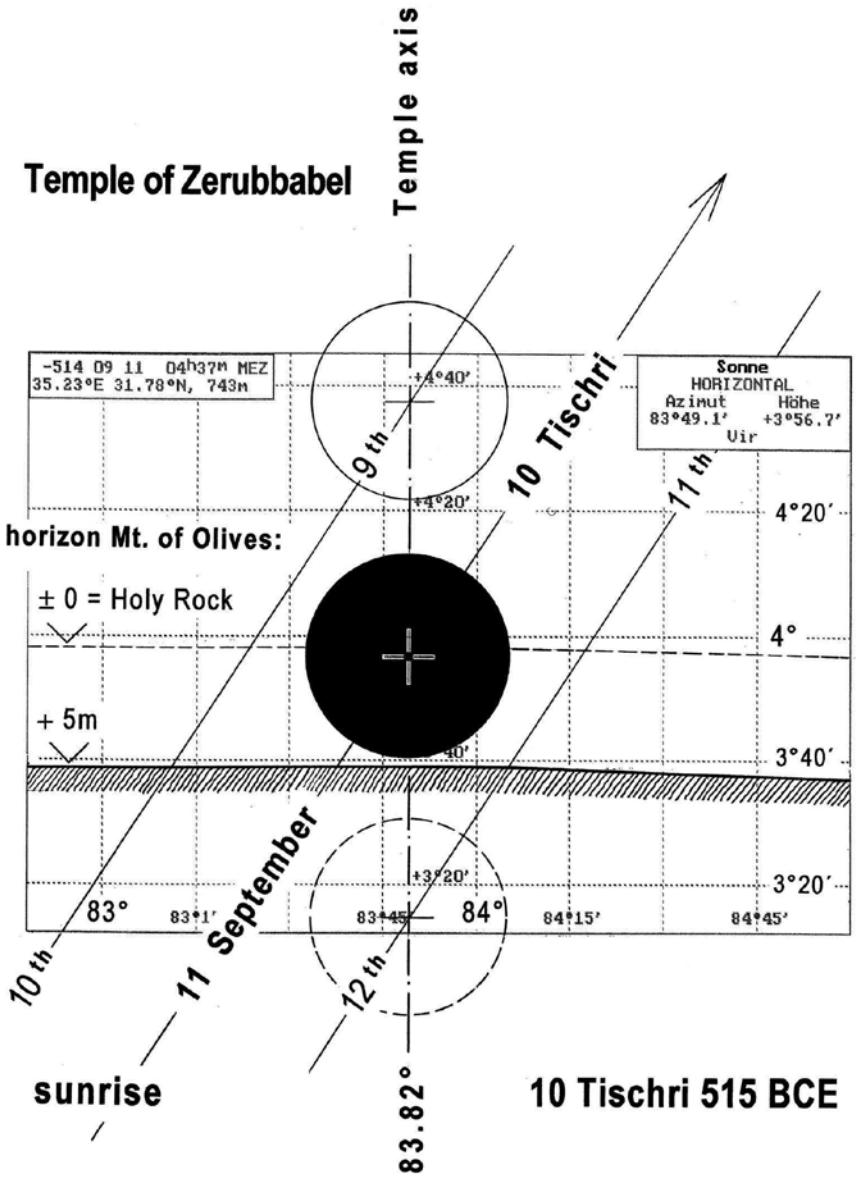

Fig. 5. Representation of sunrise on the temple axis (83.82°) on 11 September 515 BCE / 10 Tischri, using two assessment horizons (± 0 = top of the Holy Rock, and + 5 m). On the preceding and following days there is no possible solution (computer graphic augmented).

Table 9 shows the relationship between the yearly sunrise on the temple axis on 11 September and the movable Day of Atonement (Yom Kippur) on 10 Tischri.

The astronomical calculation of the sunrise is shown in Table 10. Fig. 5 shows sunrise on the temple axis on 11 September 515 BCE (Yom Kippur).

On the preceding day, 10 September (9 Tischri) and on the day following, 12 September (11 Tischri) there are no solutions. The fact that the elevation of the sun is + 3.93° and thus somewhat lower than in the case of the orientation for the founding on 18 April 957 BCE (+ 4.07°) or on the day of consecration of the First Temple on 14 September 951 BCE (+ 4.10°) does nothing to alter this fact. In any case this position of the sun produces the full illumination of the Holy of Holies. The assessment horizon of + 5 m (full disc of the sun) is based upon to a door of a size appropriate to the temple building.

4. Summary (Relationship between sunrise and the temple axis)

First Temple - Solomon:	
Orientation for the founding:	18 April 957 BCE. (15 Nissan, Pessach, first full moon in spring)
Day of consecration:	14 September 951 BCE. (22 Etanim, Day of the Holy Convocation, the eighth day of the Feast of Tabernacles)
Second Temple - Serubbabel:	
Day of consecration:	11 September 515 BCE. (10 Tischri, Day of Atonement, Yom Kippur)

An important part of my research into the Temple Mount complex in Jerusalem involves the historical mapping of biblical dates. The researched dates relate in particular the First and the Second Temples. These dates are “movable feasts or festivals” which therefore apply only in the years 957, 951 and 515 BCE. These “feast day solutions” offer an indication that the biblical dates were correctly handed down from the very start.

The basis of the astronomical examination is the Temple axis, 83.82° from north, which I worked out from the planned Herodian complex. The significant points in working out this axis are the corners of the complex and not the age of the sections of wall lying between them. The Mount of Olives forms the natural horizon for observing the sunrise.

For the "orientation for the founding" of the Temple the planners of the sacred building chose sunrise on the feast of Pessach. The days of consecration (951 and 515 BCE) also relate to specific sunrises, but unlike the orientation for the founding here the dates could no longer be freely chosen, as the temple axis was already in existence. That these dates nevertheless are biblical feasts is because they were made into such.

In conclusion it is my belief that the linking of the Temple with the rising sun reveals an intention to connect the building with the universe for all time. This is a process that can be logically traced and the solutions it offers are presented here.

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List of tables and figures in the order that they occur in the text