

THE DATE OF CHRIST'S CRUCIFIXION AND THE EARTH'S ROTATION

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Abstract: Two dates 7 April AD 30 and 3 April AD 33 have remained as the candidate dates of the Crucifixion of Christ. This paper concludes that the Crucifixion was 7 April AD 30. Firstly, people in Jerusalem experienced a total solar eclipse at around the day of the Crucifixion from which the date of the solar eclipse should be 24 November AD 29. We obtain the range of the delay ΔT of the time measured by the rotation of the Earth from the uniform time is $8569\text{s} < \Delta T < 8949\text{s}$ assuming the solar eclipse was total at Jerusalem. Secondly the lunar eclipse mentioned in the Revelation to John, the Acts of Apostles, and the Report of Pontius Pilate should have been on 9 December AD 29. In fact, the four Gospels do not talk about a lunar eclipse on the day of the Crucifixion. On the other hand, the Report of Pontius Pilate says that a lunar eclipse was on the day of the Crucifixion. However, the lunar eclipse on 3 April AD 33 does not match the celestial circumstances described in the Report of Pontius Pilate. This implies that 3 April AD 33 was not the date of the Crucifixion. In the Concluding Remarks we discuss the differences of the authors and of their information among various books such as four Gospels, Revelation to John, Acts of Apostles, and Report of Pontius Pilate.

Keywords: Crucifixion of Christ, total solar eclipse, lunar eclipse, Earth's rotation, ΔT

1 INTRODUCTION

The date of the Crucifixion of Jesus Christ has been discussed for many years by scholars and scientists. Owing to their efforts the year of the Crucifixion has been constrained to AD 28–35 (Fotheringham, 1903), to AD 28–34 (Schoch, 1928), or to AD 26–36 (Humphreys and Waddington, 1983; 1992). A straightforward reading of the Synoptics (the Gospels according to Matthew, Mark, and Luke) would suggest that the date of the Crucifixion is Friday, the 15th day of Nisan (the first month in Jewish calendar). However, if the Last Supper was held on the evening of Passover, the four Gospels (the Synoptics and Gospel according to John) coincide on the date of the Crucifixion and the date becomes Friday, Nisan 14 (Fotheringham, 1903; Schoch, 1928; Humphreys and Waddington, 1983; 1992). Then 7 April AD 30 and 3 April AD 33 remain as two candidates of the Crucifixion date since these two dates only correspond to Friday, Nisan 14 or Nisan 15. In deriving these candidates the works of astronomers such as Fotheringham (1910) and Schoch (1928) have been used. They gave empirical formulae to determine the first day of the month in the Jewish calendar, i.e. the first appearance day of the Moon after conjunction of the Sun and Moon calculating the horizontal and vertical distances of the Moon from the Sun in the evening by taking into account the nonuniform motion of the Moon on its orbit. This is crucial in fixing the

date of the Crucifixion.

As is well known, there are descriptions in the New Testament and Apocrypha which suggest the occurrence of solar and lunar eclipses. These eclipses may help us to determine the date of the Crucifixion. However, there is a problem that the descriptions on these eclipses such as their existence and the occurrence dates are different among related documents (see Section 2). The Synoptics say that a solar eclipse took place on the day of the Crucifixion. The four Gospels do not mention the occurrence of a lunar eclipse on the day of the Crucifixion. The Revelation to John talks about the sequential occurrence of solar and lunar eclipses before the day of the Crucifixion. The Acts of the Apostles say that solar and lunar eclipses took place before the resurrection. The Report of Pontius Pilate, one of Apocrypha, says that solar and lunar eclipses took place on the day of the Crucifixion. It vividly describes the lunar eclipse. In short, the descriptions of the solar and lunar eclipses in the New Testament and the Apocrypha are tangled. This should be the cause of indeterminacy of the date of the Crucifixion.

Recent studies (Humphreys and Waddington, 1983; 1992) asserted that 3 April AD 33 was the Crucifixion date from several reasons. Firstly, they thought that the portrayal of Pilate in the Gospels, which says he was subject to the pressure of the Jews, is consistent with the Crucifixion occurring after the death of anti-

Semitic Sejanus on October AD 31. Secondly, they also thought that AD 30 cannot be the Crucifixion year if one accepts that the ministry of Jesus started at the earliest in autumn AD 28 and that there were three different Passovers during his ministry. Thirdly, they cited the passage of Acts of the Apostles 2:20 (King James, 1611) and suggested that the Crucifixion took place at the Full Moon just before the resurrection. In fact, a lunar eclipse took place on 3 April AD 33. However, we show in Section 3 that unfortunately their astronomical inference has serious defects.

In this paper we are going to resolve the above entanglement by adopting honestly the words and phrases describing the astronomical phenomena of the respective books and by looking for when and where the suggested solar and lunar eclipses took place. We do not attach importance to the political, social or religious circumstances around the day of the Crucifixion because the interpretations of these circumstances are different from scholar to scholar and unstable compared with the certainty of astronomical phenomena.

We believe that the solar eclipse observed as total at Jerusalem was the one on 24 November AD 29 and the lunar eclipse was on 9 December AD 29. Accordingly, the date of the Crucifixion was determined to be 7 April AD 30. As a by-product we obtain the range of ΔT as $8569\text{s} < \Delta T < 8949\text{s}$ for AD 29 where ΔT is the measure of the variation of the Earth's rotation (Morrison et al., 2021; Stephenson, 1997) defined as the difference of TT (Terrestrial Time) and UT (Universal Time).

2 ARGUMENT USING BIBLICAL EVIDENCE

In this section we read the four Gospels, the Revelation to John, the Acts of Apostles, and the Report of Pontius Pilate, and we argue that there was a total solar eclipse at Jerusalem and that this eclipse was before the day of the Crucifixion and that there was a lunar eclipse before the day of the Crucifixion using the descriptions of the above documents on the eclipses.

(1) KATA MAΘΘAION 27 (Westcott and Hort, 1882)

[45] Ἀπὸ δὲ ἑκτῆς ὥρας σκότος ἐγένετο ἐπὶ πᾶσαν τὴν γῆν ἕως ὥρας ἐνάτης. [46] περὶ δὲ τὴν ἐνάτην ὥραν ἐβόησεν ὁ Ἰησοῦς φωνῇ μεγάλῃ λέγων “Ἐλωὶ ἔλωὶ λεμὰ σαβαχθανεῖ,” τοῦτ’ ἔστιν “Θεέ μου θεέ μου, ἵνα τί με ἐγκατέλιπες;” [51] Καὶ ἰδοὺ τὸ καταπέτασμα τοῦ ναοῦ ἐσχίσθη [ἀπ’] ἄνωθεν ἕως κάτω εἰς

δύο, καὶ ἡ γῆ ἐσείσθη, καὶ αἱ πέτραι ἐσχίσθησαν, [52] καὶ τὰ μνημεῖα ἀνεώχθησαν καὶ πολλὰ σώματα τῶν κεκοιμημένων ἁγίων ἠγέρθησαν, [53] καὶ ἐξελθόντες ἐκ τῶν μνημείων μετὰ τὴν ἔγερσιν αὐτοῦ εἰσῆλθον εἰς τὴν ἁγίαν πόλιν καὶ ἐνεφανίσθησαν πολλοῖς.

[Translation] The Gospel According to Matthew 27:

[45] Now from the sixth hour¹ there was darkness over all the land until the ninth hour.² [46] About the ninth hour Jesus cried with a loud voice, saying, “Eli, Eli, lima³ sabachthani?” That is, “My God, my God, why have you forsaken me?”⁴ [51] Behold, the veil of the temple was torn in two from the top to the bottom. The earth quaked and the rocks were split. [52] The tombs were opened, and many bodies of the saints who had fallen asleep were raised; [53] and coming out of the tombs after his resurrection, they entered into the holy city and appeared to many. (Chapter 27, Verses 45–46 and 51–53) (“The Good News According to Matthew” in World English Bible, <http://ebible.org/bible/web>).

(2) KATA MAPKON 15 (Westcott and Hort, 1882)

[33] Καὶ γενομένης ὥρας ἑκτῆς σκότος ἐγένετο ἐφ’ ὅλην τὴν γῆν ἕως ὥρας ἐνάτης. [34] καὶ τῇ ἐνάτῃ ὥρᾳ ἐβόησεν ὁ Ἰησοῦς φωνῇ μεγάλῃ “Ἐλωὶ ἔλωὶ λαμὰ σαβαχθανεῖ;” ὃ ἔστιν μεθερμηνευόμενον “Ὁ θεός μου [ὁ θεός μου], εἰς τί ἐγκατέλιπές με;”

[Translation] The Gospel According to Mark 15:

[33] When the sixth hour⁵ had come, there was darkness over the whole land until the ninth hour.⁶ [34] At the ninth hour Jesus cried with a loud voice, saying, “Eloi, Eloi, lama sabachthani?” which is, being interpreted, “My God, my God, why have you forsaken me?”⁷ (Chapter 15, Verses 33 – 34) (“The Good News According to Mark” in World English Bible, <http://ebible.org/bible/web>).

(3) KATA ΛΟΥΚΑΝ 23 (Westcott and Hort, 1882)

[44] Καὶ ἦν ἡδη ὥσει ὥρα ἑκτη καὶ σκότος ἐγένετο ἐφ’ ὅλην τὴν γῆν ἕως ὥρας ἐνάτης [45] τοῦ ἡλίου ἐκλείποντος, ἐσχίσθη δὲ τὸ καταπέτασμα τοῦ ναοῦ μέσον. [46] καὶ φωνήσας φωνῇ μεγάλῃ ὁ Ἰησοῦς εἶπεν Πάτερ, “εἰς χεῖράς σου παρατίθεμαι τὸ πνεῦμά μου;” τοῦτο δὲ εἰπὼν ἐξέπνευσεν.

[Translation] The Gospel According to Luke 23:

[44] It was now about the sixth hour⁸ and darkness came over the whole land until the ninth hour.⁹ [45] The sun was darkened, and the veil of the temple was torn in two. [46] Jesus, crying with a loud voice, said, "Father, into your hands I commit my spirit!" Having said this, he breathed his last. (Chapter 23, Verses 44 – 46) ("The Good News According to Luke" in World English Bible, <http://ebible.org/bible/web>).

(4) ΚΑΤΑ ΙΩΑΝΗΝ 19 (Westcott and Hort, 1882)

[28] Μετὰ τοῦτο εἰδὼς ὁ Ἰησοῦς ὅτι ἤδη πάντα τετέλεσται ἵνα τελειωθῇ ἡ γραφή λέγει "Διψῶ." [29] σκεῦος ἔκειτο ὄξους μεστόν: σπόγγον οὖν μεστόν τοῦ "ὄξους" ὑσώπῳ περιθέντες προσήνεγκαν αὐτοῦ τῷ στόματι. [30] ὅτε οὖν ἔλαβεν τὸ ὄξος [ὁ] Ἰησοῦς εἶπεν Τετέλεσται, καὶ κλίνας τὴν κεφαλὴν παρέδωκεν τὸ πνεῦμα.

[Translation] The Gospel According to John 19:

[28] After this, Jesus, seeing¹⁰ that all things were now finished, that the Scripture might be fulfilled, said, "I am thirsty." [29] Now a vessel full of vinegar was set there; so they put a sponge full of the vinegar on hyssop, and held it at his mouth. [30] When Jesus therefore had received the vinegar, he said, "It is finished." He bowed his head, and gave up his spirit. (Chapter 19, Verses 28 – 30) ("The Good News According to John" in World English Bible, <http://ebible.org/bible/web>).

(5) ΑΠΟΚΑΛΥΨΙΣ ΙΩΑΝΟΥ 6 (Westcott and Hort, 1882)

[12] Καὶ εἶδον ὅτε ἤνοιξεν τὴν σφραγίδα τὴν ἕκτην, καὶ σεισμός μέγας ἐγένετο, καὶ ὁ ἥλιος ἐγένετο μέλας ὡς σάκκος τρίχινος, καὶ ἡ σελήνη ὅλη ἐγένετο ὡς αἷμα, [13] καὶ οἱ ἀστέρες τοῦ οὐρανοῦ ἔπεσαν εἰς τὴν γῆν, ὡς συκῇ βάλλει τοὺς ὀλύνθους αὐτῆς ὑπὸ ἀνέμου μεγάλου σειομένη,

[Translation] The Revelation to John 6:

[12] I saw when he opened the sixth seal, and there was a great earthquake. The sun became black as sackcloth made of hair, and the whole moon became as blood. [13] The stars of the sky fell to the earth, like a fig tree dropping its unripe figs when it is shaken by a great wind. (Chapter 6, Verses 12–13) ("The Revelation to John" in World English Bible, <http://ebible.org/bible/web>).

(6) ΠΡΑΞΕΙΣ ΑΠΟΣΤΟΛΩΝ 2 (Westcott and Hort, 1882)

[20] ὁ ἥλιος μεταστραφήσεται εἰς σκότος, καὶ ἡ

σελήνη εἰς αἷμα, πρὶν ἔλθεῖν ἡμέραν Κυρίου τὴν μεγάλην καὶ ἐπιφανῆ.

[Translation] Acts of the Apostles 2:

[20] The sun will be turned to darkness, and the moon into blood, before the great and glorious day of the Lord comes. (Chapter 2, Verse 20) ("Acts of the Apostles" in World English Bible, <http://ebible.org/bible/web>).

(7) Original texts have not been available.

(7) [Translation] Report of Pontius Pilate (a Book in Apocrypha of the New Testament):

And when he had been crucified, there was darkness over the whole earth, the sun having been completely hidden, and the heaven appearing dark though it was day, so that the stars appeared, but had at the same time their brightness darkened, as I suppose your reverence is not ignorant of, because in all the world they lighted lamps from the sixth hour until evening. And the moon, being like blood, did not shine the whole night, and yet she happened to be at the full. And the stars also, and Orion, made a lament about the Jews, on account of the wickedness that had been done by them. (Roberts et al., 1886).

Let us argue that the solar eclipse suggested in the four Gospels (Westcott and Hort, 1882), the Revelation to John (ibid.), the Acts of Apostles (ibid.), and the Report of Pontius Pilate (Roberts et al., 1886) was total at Jerusalem. In Section 3 we will show that the place of the observation of this eclipse was Jerusalem. Here we show that the eclipse was total. They say "... there was darkness over all the land ...," "... the sun became black as sackcloth of hair ...," "... the sun will be turned to darkness ..." and "... there was darkness over the whole earth, the sun having been completely hidden." These expressions are concordant with those of known total solar eclipses. Let us cite several descriptions of total solar eclipses from general sources. The first (Sage, 1936) is the solar eclipse on 17 July 188 BC on the Ides of March: "... darkness had covered everything (tenebrae obortae fuerant)." The second (Shen Yue, 1974) is for the solar eclipse on 12 December AD 429 at Jiānkāng, China: "At Hébēi darkness covered the whole land." The third (Said et al., 1989) is for the solar eclipse on 17 June AD 912 at Cordoba: "The stars appeared and darkness covered the horizon." The fourth (Said et al., 1989) is for the solar eclipse on 11 April AD 1176 at Cizre: "The Sun was eclipsed totally and the Earth was in darkness so that it was like a dark night and the stars appeared."

Table 1: List of solar eclipses.

Date	Maximum Magnitude
6 February AD 26	0.73–0.77
26 January AD 27	0.01–0.11
24 November AD 29	0.79–1.01
28 April AD 32	0.00–0.14
12 September AD 33	0.04–0.36
1 September AD 34	0.17–0.48

Let us argue that the solar eclipse took place before the day of the Crucifixion. The whole related documents except the Gospel according to John report that the solar eclipse took place either on or prior to the day of the Crucifixion, among which the Synoptics say that the solar eclipse took place on the day of the Crucifixion. There are different indications that a solar eclipse was not on the day of the Crucifixion. Firstly, the day of the Crucifixion was a Full Moon day, so a solar eclipse could not have occurred. Secondly, according to the Acts of Apostles the solar eclipse took place before the resurrection. This implies that the solar eclipse preceded the day of the Crucifixion. Thirdly, according to the Revelation to John the solar eclipse took place when he (Christ) opened the sixth seal. This means that the solar eclipse preceded the day of the Crucifixion. Fourthly, we sometimes observe that, in legendary periods, different events which took place in different days may have been degenerated into a single day and remembered as such. We believe that this applies to the case of the Crucifixion.

Let us argue that the lunar eclipse took place before the day of the Crucifixion. The four Gospels do not talk about the occurrence of the lunar eclipse on the day of the Crucifixion. Again, the Revelation to John suggests that the lunar eclipse preceded the day of the Crucifixion. The Acts of Apostles ([Westcott and Hort, 1882](#)) say that the lunar eclipse was before the resurrection. For the moment we cannot say decisively when the lunar eclipse occurred the above passages. The Report of Pontius Pilate only says that the lunar eclipse

took place on the day of the Crucifixion. But, in Section 4 we will show that a lunar eclipse did not take place on the day of the Crucifixion.

We will determine the dates of the solar and lunar eclipses in the following Sections.

3 IDENTIFICATION OF THE SOLAR ECLIPSE

In this Section we look for the solar eclipse described in the New Testament. According to the preceding works ([Fotheringham, 1903](#); [Schoch, 1928](#); [Humphreys and Waddington, 1983](#); [1992](#)) the date of the Crucifixion was either 7 April AD 30 or 3 April AD 33. We look for a total solar eclipse before 3 April AD 33. The time difference between the solar eclipse and the Crucifixion is not necessarily a day or two. We therefore looked for a solar eclipse dating between AD 26 and AD 36. There were 28 solar eclipses around the world during this period. We exclude 22 solar eclipses from the list which were not visible at Jerusalem because the eclipse shadow was far away from there. The remaining six solar eclipses visible at Jerusalem are listed in [Table 1](#). The solar eclipses in the list have a magnitude of 0.77 at most, except the one in AD 29.¹¹ The eclipse on 24 November AD 29 can only have been total.

Now we fix that the eclipse on 24 November AD 29 was total at Jerusalem. Let us calculate the start and end times of the eclipse and the time of the maximum magnitude, and compare these with the descriptions of the New Testament. We have written in the last paragraph of Section 1 the conditions that the eclipse was total at Jerusalem. Then the eclipse proceeded at Jerusalem in the order as shown in the second column of [Table 2](#). We have adopted $\Delta T = 8760$ s to calculate the values for Jerusalem. We added for later convenience in the third column the time sequences of the phenomena at Nicaea for $\Delta T = 10120$ s, the generally adopted value ([Morison et al., 2021](#)). The times are in Local Ap-

Table 2: Circumstances of the solar eclipse of 24 November AD 29.

Place name Longitude Latitude ΔT	Jerusalem 35° 13' E 31° 47' N 8760s	Nicaea 29° 43' E 40° 26' N 10120s
Phenomena		
Sunrise	06h 49m 14s	07h 09m 24s
Beginning of partiality	10h 25m 52s	09h 25m 48s
Beginning of totality	11h 50m 20s	10h 41m 42s
Maximum magnitude	11h 51m 17s	10h 42m 21s
End of totality	11h 52m 14s	10h 42m 59s
End of partiality	13h 20m 35s	12h 04m 43s
Sunset	17h 10m 30s	16h 50m 16s

parent Time (LAT)¹² at respective sites. The time sequence in the table has a 3-minute uncertainty due to the width of the totality band.

The time sequence at Jerusalem accords with “Now from the sixth hour there was darkness over all the land until the ninth hour.” (the Gospel according to Matthew). Here the sixth hour corresponds to 12 at noon (see the second column of Table 2). The Gospel says that the darkness continued for three hours. This kind of exaggeration is frequently observed in ancient literature, legends or myths. Our interpretation is that the eclipse continued for three hours.

There are opinions (Fotheringham, 1903; 1920; Stephenson, 1997) that the eclipse was total at Nicaea. These are based on the translation of *Chronicon* of Eusebius (Fotheringham, 1920: 112):

And Phlegon also who compiled the *Olympiads* writes about the same things in his thirteenth book in the following words: ‘In the fourth year of the 202nd Olympiad (32–33 A.D.) an eclipse of the Sun took place greater than any previously known, and night came on at the sixth hour of the day, so that stars actually appeared in the sky; and a great earthquake took place in Bithynia and overthrew the greater part of Nicæa.’

Note that Stephenson (1997: 360) has a similar opinion:

Computation ... indicates that the eclipse of AD 29 was indeed fully total at Nicaea (at 10.8 h), while at Tralles the phase would be virtually total (0.997) at 11.0h. Quite possibly the eclipse recorded by Phlegon may have been witnessed in this region but the precise place of observation is purely a matter of speculation.

We do not agree with these opinions. There are four reasons.

- (1) They neglect that the phenomena in the New Testament related to the Crucifixion were experienced by the people living in Jerusalem and that the eclipse should have been observed at Jerusalem.
- (2) The magnitude of the eclipse was 0.95 rather than 0.997 at Tralles (27° 51' E, 37° 51' N) and Jerusalem if the eclipse was total at Nicaea (see Figure 1(b)). This contradicts the descriptions of the New Testament which suggest that the eclipse was total (at Jerusalem).
- (3) Phlegon seems to cite the New Testament

in recording the eclipse of AD 29 because his phrases “... night came on at the sixth hour of the day ...” is from the Synoptics and “... so that stars actually appeared in

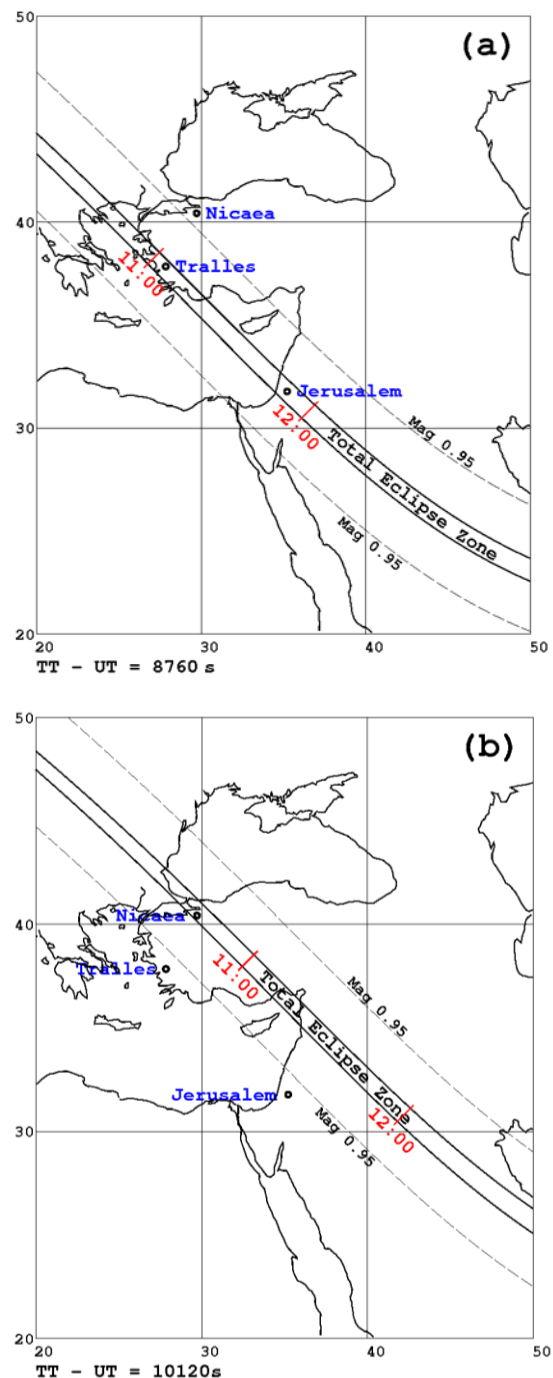


Figure 1: Shadow bands of the eclipse on 24 November AD 29 for $\Delta T = 8760s$ (a) and $\Delta T = 10120s$ (b). The dashed lines are the equi-magnitude lines of 0.95. Local apparent times 11h 00m and 12h 00m are plotted in the total eclipse zones.

the sky ...” is from the Report of Pontius Pilate. In other words, Phlegon did not connect the total eclipse to Nicaea.

Table 3: Lunar eclipses seen in Jerusalem (35°13'E, 31°47'N) between December AD 29 and April AD 33. The Beginning, Maximum, and End are the local apparent times of the beginning, maximum, and end of the lunar eclipse. Max. Mag. is the maximum magnitude. Times and magnitudes inside the parentheses indicate that the phenomena took place below the horizon. We have adopted $\Delta T = 8760$ s with JPL's ephemeris DE431.

Date	Beginning	Maximum	End	Max. Mag.
9 December AD 29	21h 18m	22h 34m	23h 49m	0.450
25 April AD 31	21h 59m	23h 01m	24h 03m	0.346
19 October AD 31	05h 15m	06h 11m	(07h 07m)	0.240
Moonset was at 06h 22m after the maximum				
3 April AD 33	(16h 04m)	(17h 29m)	18h 55m	(0.581)
Moonrise was at 18h 15m with observable maximum magnitude 0.39				

- (4) The time of the totality of the eclipse tells us that the place of the observation was not Nicaea but Jerusalem. In fact, according to our calculation the time at Jerusalem was 11h 51m (nearly the sixth hour of the day; see [Figure 1\(a\)](#)) while the time at Nicaea was 10h 42m (before the fifth hour of the day; here we use $\Delta T = 8760$ s for Jerusalem while $\Delta T = 10120$ s for Nicaea). See [Figure 1](#) and [Table 2](#).

4 IDENTIFICATION OF THE LUNAR ECLIPSE

The Gospels, the Revelation to John, and the Report of Pontius Pilate seem to contradict each other on the occurrence and occurrence day of a lunar eclipse (see the second paragraph of Section 1). We are going to resolve the apparent contradiction. Let us make a list, [Table 3](#), of lunar eclipses (1) after the solar eclipse on 24 November AD 29, and (2) prior to or at the Crucifixion. In [Table 3](#) the first column shows the date of the lunar eclipses, second column to fourth the times of the beginning, maximum, and end of the eclipse, and the fifth the maximum magnitude.

As [Table 3](#) shows, there was a lunar eclipse on 3 April AD 33, one of the candidate dates of the Crucifixion. We here show that the circumstance of this lunar eclipse does not match the description of the Report of Pontius Pilate. Neither the Moon was seen red nor stars should be seen because the sky was bright during the eclipse at around sunset, and Orion was in the west sky, far away from the Moon¹³ and was not a conspicuous constellation to the observers.

In summary we have shown that the lunar eclipse on 3 April AD 33 is not the eclipse which was described in the Report of Pontius Pilate. We need to look for the lunar eclipse of the Report of Pontius Pilate. At the lunar eclipse on 19 October AD 31 the Sun was just rising. The sky was bright and hence stars in particular the Orion could not be seen. Therefore, this lunar eclipse was not the one the Report of Pontius Pilate implies. At the lunar

eclipse on 25 April AD 31 Orion was not seen because it was below the horizon. This is not the lunar eclipse mentioned in the Report of Pontius Pilate. At the occasion of the lunar eclipse on 9 December AD 29 the stars could be seen since it was at midnight, Orion could be seen near the Moon as shown in [Figure 2](#), and the Moon became red since the magnitude was 0.45 ([di Cicco, 1982](#)). This lunar eclipse fulfills the circumstances described in the Report of Pontius Pilate.

As we have shown above the lunar eclipse on 3 April AD 33 does not suit the circumstances described in the Report of Pontius Pilate. We interpret that the lunar eclipse in the Report of Pontius Pilate did not take place on the day of the Crucifixion. This is concordant with the four Gospels which did not say anything about a lunar eclipse on the day of the Crucifixion.

Thus, 3 April AD 33 is not the date of the Crucifixion. Then 7 April AD 30 remains as the unique candidate of the date of the Crucifixion. This in turn means that the two lunar eclipses in AD 31 are automatically rejected as candidates of the lunar eclipse mentioned in the Revelation to John. As a result, we see that there was a great earthquake, a solar eclipse, a lunar eclipse, and a meteor shower ("the stars of heaven fell unto the earth") sequentially before the Crucifixion.

Our final conclusions are that the solar eclipse was on 24 November AD 29, the lunar eclipse was on 9 December AD 29, and the date of the Crucifixion was 7 April AD 30.

5 CONCLUDING REMARKS

In the present work we have obtained a set of dates related to the death of Christ: 24 November AD 29, 9 December AD 29 and 7 April AD 30. These are the dates of the solar eclipse, lunar eclipse, and the Crucifixion of Christ. In deriving these results we have used (1) the descriptions which suggest that people at Jerusalem experienced a total solar eclipse (Synoptics, Revelation to John, Acts of Apostles,

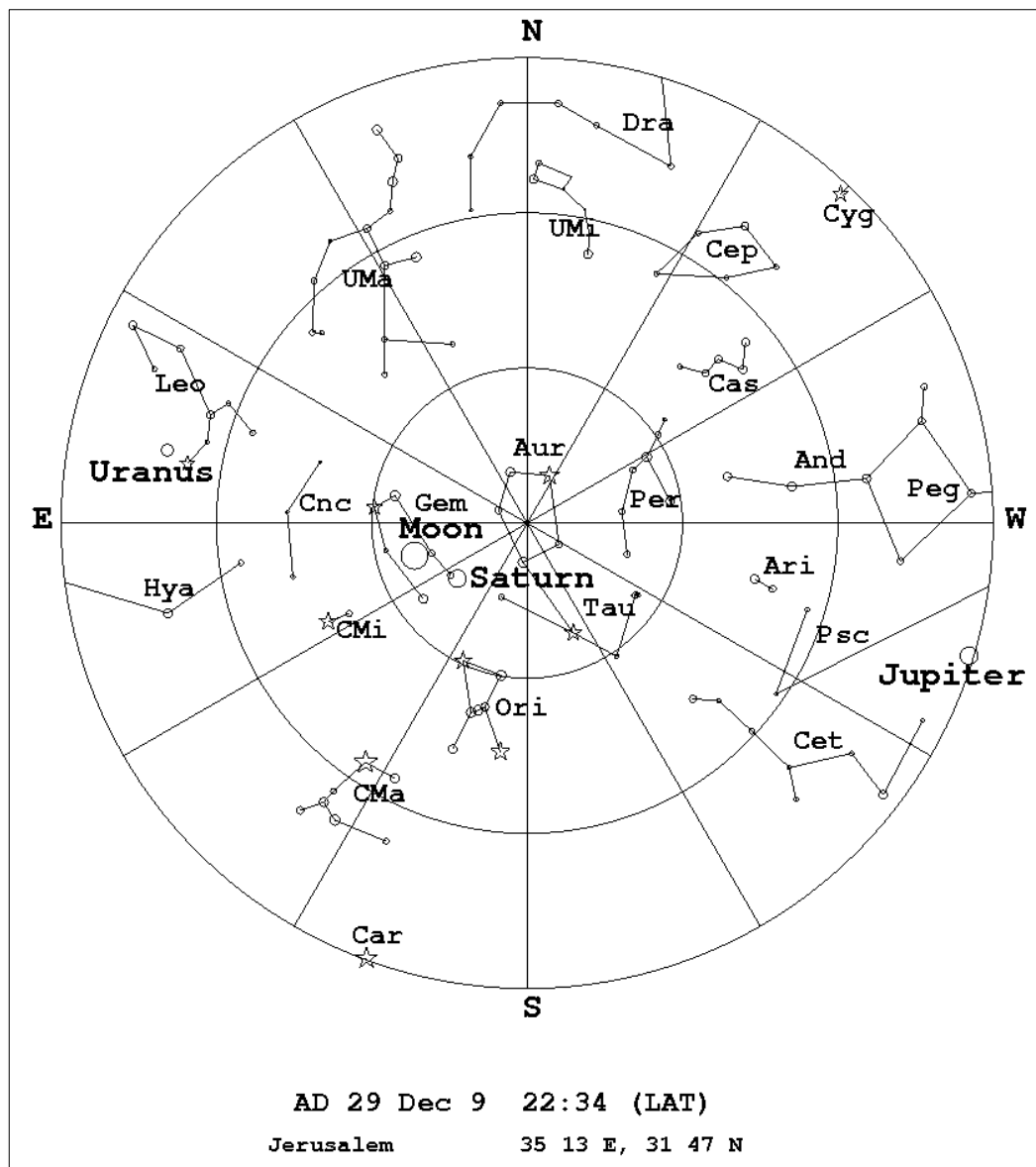


Figure 2: Stars seen from Jerusalem at the maximum of the lunar eclipse on 9 December AD 29.

and Report of Pontius Pilate), (2) the descriptions which suggest that people at Jerusalem experienced a lunar eclipse (Revelation to John, Acts of Apostles, and Report of Pontius Pilate) during which stars and Orion were seen (Report of Pontius Pilate), and (3) the descriptions which suggest the order of the occurrence of the solar and lunar eclipses (Revelation to John and Acts of Apostles).

There are no solar eclipses which were deep at Jerusalem other than the ones on 24 November AD 29 and 20 May AD 49 even if the candidate date of the solar eclipse is looked for among the extended interval between AD 1 and 50. The latter was deep but at most annular at Jerusalem so the land was not covered by darkness. Therefore, the solar eclipse on 24 November AD 29 is the unique can-

didate described in the New Testament. The Report of Pontius Pilate writes erroneously the dates of the solar and lunar eclipses, but the description of the circumstances of the lunar eclipse is so vivid. We are surprised that these not-so-remarkable events and their surroundings were transmitted to the author of the Report of Pontius Pilate.

In the case of Synoptics the dates of the solar eclipse and the Crucifixion are degenerated into one. This happens if the observer of the solar eclipse and the author of the Synoptics were different. In other word the author did not watch the solar eclipse and was not informed of the date of the solar eclipse. This may imply that the author was one generation or more later than the observer. In addition, the author had poor knowledge of astronomy

because he did not know that solar eclipses never take place on the day of Full Moon.

In the case of the Report of Pontius Pilate the dates of the solar and lunar eclipses and the Crucifixion are degenerated into one. In this case the degeneracy is higher. We may consider that the author belonged to a generation later than that of the author of the Synoptics.

It is usually considered that the Gospel according to John was written later than Synoptics (Wenham, 1972). However, we tend to disagree. In fact, the Gospel according to John does not talk about solar and lunar eclipses at the date of the Crucifixion, which is consistent with the reality we found. It seems that the Gospel according to John has independent information from Synoptics. In other words, the Gospel according to John is not polluted by Synoptics.

The Gospel according to Luke says that the solar eclipse took place on the day of the Crucifixion, while the Acts of Apostles transmit correctly the occurrence order of the solar and lunar eclipses to us, and suggest that these astronomical events were off the date of the Crucifixion. Then the authors of the Acts of Apostles and the Gospel according to Luke should not be the same though these two books were said to have been written by the same author (Burkett, 2002). There is another possibility. A unique author of both the books may have obtained two different oral legends and have written the two books without adjusting the contents of the two legends.

These dates are consistent with the descriptions in the Gospel according to John and the Revelation to John. Actually, there was neither a solar eclipse nor a lunar eclipse on the day of the Crucifixion. In addition, the solar and lunar eclipses took place in the above order in the Revelation to John. In this sense these two books are most reliable and reflect the flow of historical events.

Nonetheless other books keep some of the important events except their occurrence dates. Synoptics keep the experience of observing the total solar eclipse. The Report of Pontius Pilate describes vividly the experience of observing the lunar eclipse.

Synoptics attribute the solar eclipse to the day of the Crucifixion and the Report of Pontius Pilate put the lunar eclipse on the day of the Crucifixion. In ancient times ominous astronomical phenomena were frequently connected to the deaths of great figures. We believe that there were many years between the

above three events and the editing of the Synoptics and the Report by Pontius Pilate. There were oral transmission periods, and we believe that memories of the exact dates of the events were lost.

6 NOTES

1. Time was counted from sunrise, so the sixth hour was about noon.
2. 3:00 pm.
3. TR reads "lama" and "lima", where TR stands for Textus Receptus textual variants.
4. Psalm 22:1.
5. Noon.
6. 3:00 p.m.
7. Psalm 22:1.
8. Noon
9. 3:00 p.m.
10. NU, TR read 'knowing' instead of 'seeing', where NU stands for Nestle-Aland UBS critical New Testament text variants.
11. The magnitude M of a solar eclipse is defined as follows: $M = (r_s + r_m - d)/(2r_s)$, where M is the magnitude, r_s and r_m are the apparent radii of the Sun and Moon, and d is the apparent distance of the centers of the Sun and Moon. During a partial eclipse the magnitude is the ratio of the eclipsed to the total radius of the solar disk.
12. LAT is the time shown by sundials.
13. Humphreys and Waddington (1983; 1992) attributed this lunar eclipse to the eclipse on the day of the Crucifixion. However, they misunderstand the magnitude of the eclipse including the penumbral shadow, saying "The ancients, however, made no distinction between the umbral and penumbral shadows." In reality, the penumbral eclipse is almost unnoticeable to the naked eye.

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8 REFERENCES

- Burkett, D., 2002. *An Introduction to the New Testament and the Origins of Christianity*. Cambridge, Cambridge University Press. ISBN 978-0-521-00720-7.
- di Cicco, D., 1982. Observer's Page: More about July's lunar eclipse. *Sky and Telescope*, 64, 390–393.
- Fotheringham, J.K., 1903. The date of the crucifixion. *Journal of Philology*, 29, 100–118.
- Fotheringham, J.K., 1910. On the smallest visible phase of the Moon. *Monthly Notices of Royal Astronomical Society*, 70, 527–531.
- Fotheringham, J.K., 1920. A solution of ancient eclipses of the Sun. *Monthly Notices of Royal Astronomical Society*, 81, 104–126.
- Humphreys, C.J., and Waddington, W.G., 1983. Dating the Crucifixion. *Nature*, 306, 743–746.
- Humphreys, C.J., and Waddington, W.G., 1992. The Jewish Calendar, a lunar eclipse and the date of Christ's Crucifixion. *Tyndale Bulletin*, 43, 331–351.
- King James, I. (ed.), 1611. *The Authorized the King James Version of the Bible* (<http://kjv.ibibles.net/>).
- Morrison, L.V., Stephenson, F.R., Hohenkerk, C.Y., and Zawilski, M., 2021. Addendum 2020 to 'Measurement of the Earth's rotation: 720 BC to AD 2015'. *Proceedings of the Royal Society A*, 477, 20200776.
- Roberts, A., Donaldson, J. and Coxe, A.C. (eds.), 1886. Report of Pontius Pilate. In *Ante-Nicene Fathers*, 8, (translated by Alexander Walker).
- Sage, E.T. (ed.), 1936. Livy T., *The History of Rome*, Book XXXVIII Chapter 36, Section 4 (<http://www.perseus.tufts.edu/hopper/searchresults?q=Sage>).
- Said, S.S., Stephenson, F.R., and Rada, W., 1989. Records of solar eclipses in Arabic chronicles. *Bulletin of the School of Oriental and African Studies*, 52, 35–64.
- Schoch, K., 1928. Christi Kreuzigung am 14. Nisan. *Biblica*, 9, 48–56.
- Shen Yue (ed.), 488. *Songshu* (Book of Song, in Chinese), 34. Modern printing: Zhonghua Bookstore, Beijing, (1974).
- Stephenson, F.R., 1997. *Historical Eclipses and Earth's Rotation*. Cambridge, Cambridge University Press.
- Wenham, D., 1972. The synoptic problem revisited: some new suggestions about the composition of Mark 4:1–34. *Tyndale Bulletin*, 23, 3–38.
- Westcott, B.F., and Hort, F.J.A. (eds.), 1882. *New Testament* (in Greek). New York, Harper (see, also, <http://www.perseus.tufts.edu/hopper/text?doc=Perseus:text:1999.01.0155>).

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