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Dating the Birth of Jesus Christ on Hanukkah

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Abstract

The still controversial date of the birth of Jesus Christ (Nativity Day) is investigated by using multidisciplinary elements: historical tradition, ancient calendars (Julian and luni-solar) and astronomical calculations. The Nativity Day dates of Western—December 25—and Eastern traditions—January 6—have been compared with Kislev 25, the initial day of the Jewish feast Hanukkah, reported in an ancient source of the IV century as the Nativity Day. The same source sets the Epiphany on Tevet 6. Astronomical calculations allow us to reconstruct moon phases and ancient luni-solar calendars, and to verify whether Hanukkah can be associated to the Nativity Day of the Christian tradition. By considering the leap years wrongly introduced in the first decades of the Julian calendar, and the flexibility of the Jewish luni-solar calendar of 2000 years ago—regarding the beginning of months and embolismic years—our astronomical calculations show that the Nativity Day set on Kislev 25 is compatible with the Eastern tradition, 6 January 1 after Christ, in agreement with the year calculated by Dionysius Exiguus. Moreover, also the Epiphany is compatible with the Eastern tradition of January 6, if it is set on Tevet 6 of a year later, just in the day indicated by an ancient source of the IV century.

Keywords

Hanukkah, Jesus of Nazareth, Nativity Day, Epiphany, Julian Calendar, Jewish Luni-Solar Calendar, Astronomical Calculations

1. The Birth of Jesus of Nazareth: A Still Controversial Dating

For Christians, history has a before and an after. Time coordinates are determined by the birth, death and resurrection of Jesus of Nazareth. Therefore, the dating of his birth and death has produced many studies reported in books and articles. Despite this large literature, not even the date of birth (Christmas, Nativity Day) has been determined unambiguously, set today in the years from 6

BC (Before Christ) to 1 AC (After Christ), with the lower year connected to the death of Herod the Great, mentioned by Josephus, set by most historians in the year 4 BC. Recently, however, some studies (La Greca & De Caro, 2017; La Greca & De Caro, 2019; La Greca & De Caro, 2020a; La Greca & De Caro, 2020b; De Caro et al., 2021) have reassessed and agreed upon the date established in the VI century by Dionysius Exiguus, who set Jesus' birth at the end of 1 BC (Krusch, 1884; Krusch, 1938; Schwartz, 1905; Ginzel, 1914; Jones, 1934; Declercq, 2000; Declercq, 2002; Fedalto, 2012; Grumel, 1958; Pedersen, 1983; Richards, 2000).

The Western tradition sets Jesus' birth on December 25 (Christmas), and the Eastern Tradition on January 6. These dates are attested in some ancient sources and have produced many studies (Finegan, 1998: pp. 269-368; Beyer, 1998) whose main concern was to verify their historicity, based on two principal working hypotheses (Nothaf, 2012a), namely the *History of Religions Theory* and the *Calculation Theory*.

According to the *History of Religions Theory*, December 25 is not a historic tradition but could be a Christian replacement to the pagan feast of the birth of Sol Invictus (Usener, 1969). In the year 274 AC the emperor Aurelian allegedly elevated the oriental god Sol Invictus to the supreme deity of the Roman Empire and established his cult on the winter solstice, December 25. The persistent popularity of these rituals among the newly baptized Christians—coming from the Roman pagan world—would have induced the early Church to incorporate December 25 into its own liturgy as the birth feast of Jesus. This theory has enjoyed quite a consensus since its first publication in 1889. However, according to numismatic, archaeological, epigraphic and literary evidence of II - IV centuries, the hypothesis that Christmas was preceded by this pagan feast is based on XIX-century anachronistic interpretation (Hijmans, 2003; Hijmans, 2011), not on historical proofs.

According to the *Calculation Theory* (Roll, 1995), Christmas dating comes from chronological speculations done by ancient Christian chronographers. Following the studies of (Duchesne, 1889) and (Engberding, 1952), Talley (Talley, 1991) proposed that December 25 had been calculated from the day of Jesus' Passion, already established in the late II or early III century. Jesus died after an integer number of years therefore Christian scholars established a chronological parallelism between his conception, occurred on the Annunciation, and his death, both dated March 25. In this way, by adding nine months to March 25, Jesus' birth can be set on December 25. Indeed, an ancient Jewish tradition suggested that biblical people lived for an integer number of years (Kelly, 2004). Moreover, neo-platonic philosophers considered perfect only the integer numbers, therefore the interval between Jesus' conception and crucifixion had to be necessarily an integer number of years.

Similar speculations could have grounded Nativity Day calculations of early Christian scholars. In fact, these dates could be merely related to vernal equinox (March 25) and winter solstice (December 25), without historical background. Nevertheless, early Christian scholars researched historical backgrounds.

For example, according to the treatise *On the Solstices and Equinoxes of the Conception and Birth of our Lord Jesus Christ and John the Baptist*, written probably in Syria (Stökl Ben Ezra, 2003) between III and V centuries, December 25 and March 25 can be established from Luke's Gospel, by assuming that John the Baptist's conception—announced 6 months before Jesus' conception—occurred on the autumn equinox (September 24), coinciding that year with the day of Yom Kippur (Tishri 10). A similar explanation (Talley, 2003) is given in the Eastern tradition for the date of Epiphany (January 6), calculated from Jesus' Passion Day set on April 6. Indeed, Clement of Alexandria (ca. 160-ca. 220) writes that the Gnostic Christian Basilideans considered the feast of Jesus' baptism (Mt 3, 1-17; Mk 1, 2-11; Lk 3, 1-18.21-22; Jn 1: 19-34) on January 6, and this date became also the date of Jesus's birth in the Eastern Mediterranean regions. In synthesis, the Basilideans believed that Jesus had been baptized an integer number of years after his birth, on January 6, because his birth was the first epiphany. This date is attested in more ancient sources than those indicating December 25 of the Western tradition, because dating Jesus' birth on January 6 dates back to the year 200 (Martindale, 1909).

But other scholars (Nothaf, 2012a; Kelly, 2004) relate the Epiphany, the miracle of wine at Cana, the adoration of the Magi, and the date of Jesus' birth—all set on January 6 -, to one or several important pagan feasts, such as the birth of the god Aion (night of January 5/6) or the annual water withdrawal of Nile River.

In contrast with this hypothesis, it is possible to deduce the Nativity Day on January 6 from the ancient Eastern liturgy of Christmas, attested in Jerusalem, through the writings of Egeria (Silvia of Bordeaux), a pilgrim to the Holy Land (Geyer, 1898; Giannarelli, 2000) in the year 385. According to this tradition, Jesus was baptized precisely on his birthday, January 6 not December 25. According to (Förster, 2007), the roots of Christmas found in the IV century Holy Land can be considered a "historicizing" tendency to celebrate the main Christological feasts at the correct place and at the appropriate time, through pilgrimages. Of particular importance, in this regard, was just the annual celebration of Christ's birth at the Nativity Church in Bethlehem, which was later incorporated into the liturgies of other churches, because the practices pilgrims had witnessed in Palestine were brought back home. As Nativity celebrations in Jerusalem and in Bethlehem took place on January 6 until the VI century, Förster assumes that this was the original "Christmas" date, exported to Rome and there changed to December 25 under the influence of the pagan feast of Sol Invictus.

In the Eastern Tradition there are also several relationships between important days of Jesus' life and the Feast of Lights (Encenie, Hannukah). Gregorius Nazianzenus (IV century, in *Patrologia Graeca*, T. XXXVI, Orat. 39, col. 335) relates this feast both to Jesus' baptism—"the saint Day of the Lights gets its principle from the baptism of my Christ"—and to Epiphany. Moreover, a Syrian document of the IV century (*Constitutiones Apostolorum*, V, 13, 1-2) sets the Nativity on day 25 of the ninth month of the year, and Epiphany on day 6 of the

tenth month (Metzger, 1986). The months are not specified but they should refer to the Jewish luni-solar calendar. In fact, later (*Constitutiones Apostolorum*, V, 14, 1) it is said that in the first month of the year the Jews decided to kill Jesus on the cross. The month mentioned is Xanthicus in the Macedonian calendar, corresponding to the month of Nisan in the Jewish calendar. Therefore, according to this source, Nativity Day was on Kislev 25 and Epiphany on 6 Tevet. Kislev 25 was the first day of the Feast of Temple Dedication—called the Feast of lights by Flavius Josephus (I century AD, *Jewish Antiquities*, XII, 319-325), and known as Encenie in Greek, Hanukkah in Hebrew—which lasts eight days, a feast introduced in the II century BC.

It is possible that this source was mistakenly converted in the West, in the Julian calendar, as December 25, because Kislev is the first winter month of the year, thus feeding the Western tradition of December 25. In support of this conclusion, we recall that even at the time (VII - VIII centuries) of the venerable Bede (Wallis, 1999; Mac Carron, 2019), December was associated with Kislev, the ninth Jewish lunar month. Another possibility is that Kislev 25 could just coincide either with December 25 or January 6, for a very specific year of Jesus' birth, therefore setting a common and precise date for the beginning of the Christian Era. This effort could open new research tracks on the origin of the Nativity Day, for which astronomy, conversion between ancient calendars and sources of early Christian chronographers must be considered (Schmidt, 2015; Barthel & van Kooten, 2015; Richards, 2000).

The main aim of this work is to establish if this last conjecture can be verified for at least one of the years in which the Nativity Day can be set.

After this introductory section, in Section 2 we study the astronomical background concerning the Nativity Day set on December 25 (Western tradition) or on January 6 (Eastern tradition), in relation with the beginning of the Hebrew feast of Hanukkah (Kislev 25). In Section 3 we study the historical background of the Nativity Day, by investigating the implicit chronological constraints contained in the Gospels to assess whether it supports the historicity of the dates of Jesus' birth of Western and Eastern traditions, both set at the beginning of the winter. Finally, in Section 4 we conclude with some remarks.

2. Astronomical Backgrounds of the Nativity Day

To establish whether Kislev 25 coincides with December 25 or January 6 it is necessary to convert dates from the luni-solar calendar to the Julian calendar. However, this conversion is not straight, but it requires addressing several arguments: 1) the presence of embolismic years (years of 13 lunar months) in the luni-solar calendar and leap years in the Julian calendar; 2) the beginning of months in the luni-solar calendar; 3) the beginning of the Feast of Temple Dedication. These topics are discussed in the following sub-sections.

2.1. Embolismic Years in the Luni-Solar Calendar

In the Jewish luni-solar calendar of 2000 years ago the beginning of a month was

fixed by direct observation of the first crescent moon, not by looking at a pre-compiled table. The year started with the month of Nisan, at the first new moon after the vernal equinox, which 2000 years ago occurred on March 23 of the Julian calendar. In some years a month was added at the end of the year for realigning astronomically the calendar with the seasons because a lunar month lasts 29.53 days and years are of 12 months of 29 or 30 days, never 31. Now, 12 × 29.5 = 354 days, which is about 11 days less than 365.24 days of the solar year. Therefore, about every 3 years, 3 × 11 = 33 days, a thirteen (intercalary) month was added, although not known when.

This extra month was termed "second month of Adar", Adar II, as Adar is the last month of the year, and its insertion was decided by the Sanhedrin (Finegan, 1998: p. 38) according to the following rules: "The rabbis taught, it is stated, that 'a year may be intercalated on three grounds: on account of the premature state of the corn crops; or that of the fruit trees; or on account of the lateness of the tequfah (season). Any two of these reasons can justify intercalation, but not one alone'. (…) The tequfah of Nisan…began at the vernal equinox when the sun enters the constellation of Aries". Therefore, even if the Sun was already in Aries but the ears of corn were not ripe, the liturgy planned on Nisan 16—the offering to the Temple of the first harvested ears of barley or wheat—could not occur and Passover was delayed by introducing the second month of Adar. Also, Flavius Josephus (I century AD; *Jewish Antiquities*, III, 247-248) recalls the same rules on how to determine the date of Passover since Moses established it.

At Moses' times, however, the sun rose exactly in the East (vernal equinox) in the constellation of Aries (La Greca & De Caro, 2017) but in the I century AC the sun rose in the constellation of Pisces, because of equinox precession. Therefore, Passover could not be celebrated near the equinox, about March 23, because the ancient rule of the Sun rising in the constellation of Aries would be violated. Indeed, 2000 years ago the Sun entered the constellation of Aries about 3 days after March 23 (Chevalley, 2006). Therefore, if Nisan 15—day of Passover—occurred before March 26, one of the conditions imposed by Moses' tradition—sun in Aries—was not fulfilled and another month was probably added, making the year embolismic. The studies on the Babylonian calendar (Parker & Dubberstein, 1956), whose series of embolismic years are known—this calendar affected (Finegan, 1998: pp. 33-39) very much the Jewish calendar—also excluded the cases in which Nisan 15 would fall up less than 3 days from the vernal equinox.

2.2. Leap Years in the Julian Calendar

In the first decades of introduction of the Julian calendar, more leap years than necessary were inserted. We don't know what the leap years sequence was. A very likely hypothesis is the following: since 45 BC, first leap year, to 9 BC, leap years—made of 366 days instead of 365—were inserted every 3 years instead of 4 because of a wrong interpretation of the rule to insert 1 leap year after 3 normal years. Caesar Augustus (Fedalto, 2012) corrected the error, probably in 8 BC, by

ordering not to introduce leap years for 15 years. Therefore, only after 8 AC the days in the Julian calendar were correctly calculated, with leap years every 4, and the first correct leap year of the Christian era probably was 8 AC. For example, 5 BC should have been a leap year—but was not so—to reduce the astronomical misalignment of the Julian calendar from 3 to 2 days; similarly, 1 BC should have been a leap year, but it was not so, to reduce the misalignment from 2 to 1 day.

When a date of the Julian calendar is calculated in the years just before and after Christ, with modern astronomical software—which gives astronomically correct dates because it considers a correct series of leap years—we must consider the error in days to determine the (wrong) date of the Julian calendar of those years, because the actual date is shifted few days compared to the correct date. Indeed, when dates are converted to a different calendar, it should be considered that the Julian calendar in its first decades is shifted by 1 or more days with respect to the astronomically correct date, because of the excess leap days introduced. Only in this way we can verify with precision whether, at the turn of the beginning of the Christian era, there was a historical memory about a specific date of the Julian calendar related to a specific date of the Jewish calendar.

2.3. Beginning of the Months in the Luni-Solar Calendar

The beginning of the lunar month was determined by direct observation of the Moon. To convert dates from the Jewish luni-solar calendar to the Julian calendar, we must assume a criterion of visibility of the crescent moon. The Sanhedrin declared (Finegan, 1998: p. 37) the beginning of a new month after two observers, dedicated to observing the moon, agreed to having seen a small crescent moon and answered, in agreement with each other, to some ritual questions.

Today, one of the most accepted criterions, among several ones proposed by scholars (Doggett & Schaefer, 1994), states that, to be visible with naked eyes, the lunar disc must be illuminated for at least 2% at the sunset. However, even if so, the moon might not be seen because of clouds. Now, as months in the luni-solar calendar could be only of 29 or 30 days—never 31—it was common practice, in this case, to delay the beginning of the month by 1 day. Therefore, to set the beginning of lunar months, in case of allowed delay, we have considered an illuminated fraction 2.5% at maximum, because larger values very likely correspond to a month, just finished, of maximum duration of 30 days. Indeed, astronomical calculations show that adding a further delay of one day to a new moon phase corresponding to an illuminated fraction already of 2.5% would lead to a fraction of about 7.5%, corresponding to more than 48 hours, i.e., 2 days from the conjunction with the sun (Chevalley, 2006). Moreover, in particularly favorable meteorological conditions, such as a clear sky, and in some periods of the year, the moon could have been visible with fractions smaller than 2%, but reasonably never smaller than 1%. For these reasons, it is prudent to convert a date from the luni-solar calendar to the Julian calendar by associating a small interval to it. In

this way, the calendar reconstruction, based on astronomical analysis, does not depend on the criterion of visibility of the crescent moon.

2.4. The Beginning of the Feast of Temple Dedication in the Julian Calendar

After the important issues on converting dates between the two calendars discussed above, in **Table 1** we summarize the results obtained in the conversion (Chevalley, 2006). **Table 1** reports the beginning of the month of Kislev and the beginning of the Feast of Temple Dedication (25 Kislev) for the years from 6 BC to 1 AC.

Table 1. Beginning of the month of Kislev and the Feast of Dedication (Kislev 25), Hanukkah, in the years from 1 AC to 6 BC, determined by the astronomical calculation of moon phases (Chevalley, 2006). E = embolismic year. In bold the dates particularly close to those of the Nativity of the Eastern tradition (January 6) and Western (December 25). The first day of Nisan started the new year of the Jewish lunar-solar calendar of 2000 years ago. In round brackets the dates of the current calendar of that time, influenced by the incorrect calculation of leap days.

Year	1 Nisan	Interval (days) for 1 Kislev	Interval (days) for Kislev 25: begins after the sunset of the first day indicated in the column
1 AC	15-16 March (14-15 March)	5-7 November (4-6 November)	29 November-1 December (28-30 November)
1 AC (E)	*13-14 April* *(12-13 April)*	*5-7 December* *(4-6 December)*	*29-31 December* *(28-30 December)*
1 BC	25-26 March (24-25 March)	16-18 November (15-17 November)	10-12 December (9-11 December)
1 BC (E)	*24-25 April* *(23-24 April)*	*15-17 December* *(14-16 December)*	*8-10 January 1 AD* ***(7-9 January 1 AD)***
2 BC	6-7 April (4-5 April)	27-29 November (25-27 November)	21-23 December (19-21 December)
3 BC	18-19 March (16-17 March)	8-10 November (6-8 November)	2-4 December (30 November-2 December)
3 BC (E)	*16-17 April* *(14-15 April)*	*9-10 December* *(7-8 December)*	*2-3 January 2 BC* *(31 December-1 January 2 BC)*
4 BC	28-29 March (26-27 March)	20-21 November (18-19 November)	14-15 December (12-13 December)
5 BC	8-9 April (6-7 April)	29-31 November (27-29 November)	23-25 December **(21-23 December)**
6 BC	21-22 March (18-19 March)	12-13 November (9-10 November)	6-7 December (3-4 December
6 BC (E)	*20-21 April* *(17-18 April)*	*11-13 December* *(8-10 December)*	*4-6 January 5 BC* *(1-3 January 5 BC)*

Because it is not known which year was embolismic, we report also dates delayed by 1 lunar month when Nisan 15 (Passover) fell too near March 23, vernal equinox. Indeed, after the studies (Parker & Dubberstein, 1956) on the Babylonian calendar, for which the series of embolismic years is known, we have excluded the cases in which Nisan 15 would fall up less than 3 days from the vernal equinox because 2000 years ago before 26 March the Sun was not already in Aries. The dates of Kislev 1 and Kislev 25, in case of embolismic years, are also reported. Besides the (correct) date of the calendar calculated today, we have also indicated the (astronomically wrong) date of the Julian calendar of the epoch, shifted few days, according to the year, because of the excessive insertion of leap years, discussed in Section 2.2.

The dates concerning Nisan 1 are reported by indicating 2 days of the Julian calendar because the new day started after sunset and finished at the beginning of the sunset of next day. According to the Gospels, Jesus was born in the night, therefore after sunset of Kislev 24, at the first hours of Kislev 25. To the dates of Kislev, we have associated an interval of possible days in the Julian calendar, because moon visibility depends on the criterion of visibility about the fraction of surface illuminated. Making it ranging from 1% to 2.5% we get the intervals reported in **Table 1**. The most interesting date is the lower value of the interval, corresponding to the transition from Kislev 24 to Kislev 25. In the rightmost column we have evidenced the dates of Kislev 25 nearest to the Nativity Day of Western and Eastern traditions. In 1 AC, they are January 7-9 with its lower limit just 1 day after the East tradition (January 6). In 5 BC the interval is December 21-23, with its upper value just 2 days before December 25, Western tradition, therefore, in this case the night of Kislev 25 is 3 days before December 25.

It is interesting to notice that in the Jewish calendar of 1 BC (embolismic year), Kislev 25—7 January 1 AC—corresponds almost with the Nativity Day of the Eastern tradition, just at the beginning of the Christian era calculated by Dionysius Exiguus, whose possible correctness has been recently revalued (La Greca & De Caro, 2017; La Greca & De Caro, 2019; La Greca & De Caro, 2020a; La Greca & De Caro, 2020b; De Caro et al., 2021). Therefore, this year is the only one in which Kislev 25 very likely coincided with the date of Nativity and the calculation of Dionysius Exiguus.

Let us note that in the last raw of **Table 1**, namely 6 BC, if the year had been embolismic, Kislev 25 falls on January 6 of 5 BC. However, this was the date of the corrected Julian calendar. But, as already clarified, the wrong insertion of leap years very likely caused a shift of this date to January 3 for the calendar in use that year. Therefore, also this date can be considered more distant from the Eastern tradition of January 6, than what could have happened in 1 AC.

In summary, in this section we have verified that the Nativity Day of the Christian tradition could coincide with Kislev 25, first day of the Hebrew feast Hanukkah. Indeed, astronomical software allows to reconstruct ancient luni-solar calendars. However, in the conversion of the Nativity Day set in the Julian ca-

lendar to that set in the Hebrew luni-solar calendar, several points must be considered: the introduction of embolismic years in the luni-solar calendar; the introduction of more leap years in the first decades of the Julian calendar; the flexibility of at least one day on the beginning of the lunar months. In synthesis, because the interval between Western (December 25, 1 BC) and Eastern tradition (January 6, 1 AC) of the Nativity Day is only 2 weeks, the conversion of Kislev 25 into Julian calendar dates shows that the more ancient Eastern tradition of January 6 better correlates with the beginning of the Hanukkah, Feast of Temple Dedication.

In the next Section we discuss the historical backgrounds of the traditional Nativity Day.

3. Historical Backgrounds of the Nativity Day

Both Western and Eastern traditions set the birth of Jesus at the beginning of the winter, within a difference of two weeks, December 25 or January 6. What is the origin of this information? Has it some historical background? These are the open questions to which scholars aim to answer, as summarized in Section 1. However, it is worth noting that this information could be also partially deduced directly from the canonical Gospels, as we show in this section.

According to Luke, Elizabeth—Mary's relative and wife of the priest Zechariah—was pregnant in the sixth month at the time of the Annunciation to Mary. Now, according to the Mosaic Law, three annual pilgrimages to Jerusalem were required during three feasts: the first was at Passover (15-22 Nisan, first month of the luni-solar calendar), the second was at Pentecost (50 days after Passover) and the third was at the Tabernacles (15-22 Tishri, seventh month). Therefore, the maximum period elapsed between two successive pilgrimages was 6 months —from the Tabernacles to the following Passover—or 7 months in case of an embolismic year. Luke notes that Joseph and Mary strictly followed the Mosaic Law (Lk 2, 41); therefore, it is plausible to assume that if there had been a pilgrimage between the annunciation to Zechariah—Elizabeth would give birth to a son—and the annunciation to Mary, Joseph—Mary's husband—would have been in Jerusalem and would have already heard from Zechariah, or from other family members, about the unexpected pregnancy of his wife Elizabeth, an aged woman.

Now, according to Luke, at the time of the Annunciation, Mary did not know Elizabeth was pregnant; therefore, at least in the previous 5 months there had been no pilgrimages, because Elizabeth was already in the sixth month of pregnancy. As the intervals between Passover and Pentecost, and between Pentecost and the Tabernacles are less than 5 months, it follows that the Annunciation occurred between the Tabernacles of the previous year and Passover of the following year, separated by at least 6 months, and necessarily very near the Passover. The liturgical year started 15 days before Passover, always at the vernal first full moon, usually at the end of March or the beginning of April. Therefore, if we

add 9 months of a pregnancy we end up to the end of December or beginning of January. Consequently, the Nativity Day should have occurred in the interval defined by Western and Eastern traditions (beginning of the winter).

3.1. The Constraint of the Turnover of the Priest Classes

Let us discuss this issue with greater details. If we subtract 9 months from Kislev 25, the date of Annunciation occurs in the month of Adar, or Adar II in case of embolismic year, i.e., at the end of the previous year of the luni-solar calendar. According to Luke, the annunciation to Zechariah of the birth of his son, takes place in the Temple, while the priest class of Abiah was officing. If we subtract 5 or 6 months respectively from Adar or from Adar II, Zechariah should have been serving during the Feast of Tabernacles (15-22 di Tishri), or during another Abiah-class service turn, near this feast, but not during Yom Kippur because in its liturgy only the high priest could access the most sacred part of the Temple—accessible to all other priests in the rest of the year—and Zechariah was not the high priest. Moreover, Luke clarifies that at the end of his turn, Zechariah went home (Luke 1, 23); therefore, his service lasted several days. Very likely, he returned home after the Tabernacles, at the end of Tishri, seventh month of the ancient Jewish calendar. Therefore, the first month of Elisabeth's pregnancy should have been the eighth month of the luni-solar calendar, so that the sixth month of pregnancy coincides with the end of the year or the beginning of the next. Now, since 7 + 6 = 13, it must have been the month Adar II or Nisan.

However, under the hypothesis that Jesus was born on Kislev 25, ninth month, we must exclude that the Annunciation occurred in the month of Nisan—first month of the calendar—because 9 − 1 = 8 months not 9, i.e., the duration of the pregnancy. Therefore, we must conclude that the Annunciation occurred necessarily at the end of a year of 13 months, a year with Adar II.

In Table 1, whose dates have been calculated under the hypothesis that Jesus was born on Kislev 25, the year 1 BC might have been embolismic, and the beginning of the Feast of Temple Dedication would have fallen very near January 6. On the contrary, in the year 5 BC, when the Feast falls near December 25 it is not possible to introduce a month Adar II because in that year the crescent moon was already visible between April 8 and 9, and a thirteen month would have implied a month of Nisan extended to June, full summer. Moreover, the anticipation of the beginning of the year by 1 month is not possible, because Passover would have occurred during the vernal equinox, with the Sun in Pisces not in Aries, therefore violating the ancient Mosaic rule. Thus, we must conclude that setting the Nativity Day on Kislev 25 is compatible only with the Eastern tradition.

3.2. The Perfect Age of an Integer Number of Years

These calculations might have been at the base of the efforts of early Christians to establish the Nativity Day. Thus, the birth of Jesus at the beginning of the

winter could be also historically rooted. Moreover, it is also worth noting that the Nativity Day set on January 6 long pre-dated December 25. The Gnostic followers of Basilides (Kraabel, 1982) were celebrating the birth of Jesus on January 6 as early as the end of the II century.

Thus, the Nativity Day set on January 6, celebrated throughout the Eastern Roman Empire, including Palestine, could be related to Kislev 25, because the beginning of the new day, according to the convention used in the Roman Empire 2000 years ago, was set just after the sunset of the previous day, i.e., at the sunset of January 7 of the Julian calendar currently in use in that time, astronomically misaligned of one day, due to an excessive insertion of leaps days, during the first decades of use of the new calendar.

Going back to the hypotheses assumed by the proponents of the *Calculation Theory*, such as Hippolytus of Rome (III century), although some scholars think his writings were later interpolated. Under the influence of neo-Platonic philosophy, which indicated as perfect only integer numbers, Hippolytus (Nothaf, 2012b: p. 47; Ginzel, 1914: p. 179) would have linked the date of conception of Jesus to the date of his death, Friday March 25. Astronomical calculations show that this was not possible because in the years when Pontius Pilatus was in Palestine, there never was such a coincidence, because Passover fell on Friday—day of Jesus' death—always in April (La Greca & De Caro, 2017; Nothaf, 2012b). However, an integer number of years from Jesus' conception to crucifixion could have a historical foundation if the Nativity Day is set on Kislev 25—likely known by early Christians, at least in the East—and his death at Passover (Nisan 15), or at Passover Eve (Nisan 14), as reported by the Gospels. Indeed, from the beginning of the winter (Feast of Temple Dedication) to the beginning of spring (Passover) there are about 3 months which, added to 9 months of pregnancy, give a full year.

In summary, early chronographers could have reconstructed some chronological information about the Nativity Day, using calendar constrains directly derived by Gospels, as discussed in this section.

4. Conclusion

We have investigated and researched the still controversial dates of birth of Jesus of Nazareth, by considering historical traditions, ancient calendars, and astronomical calculations, which have allowed us to reach some convincing, unitary, and reliable conjectures we propose in the paper.

First, we have researched the astronomical background of the traditional Nativity Day, December 25 for the Western tradition, and January 6 for the Eastern Tradition. We have started our research by assuming that Jesus was born on Kislev 25, a date reported in an ancient Christian Syrian source of the IV century.

Now, to establish whether Kislev 25 coincides with December 25 or January 6, for any of the years in which it is possible to set the birth of Jesus, we have con-

verted dates from the luni-solar calendar to the Julian calendar. This conversion, not straight, has required addressing several arguments such as the presence of embolismic years in the luni-solar calendar and wrong leap years in the Julian calendar, the beginning of months in the luni-solar calendar, the beginning of the Feast of Temple Dedication (Kislev 25) converted into the Julian calendar. We have investigated these topics and our findings indicate that Kislev 25 correlates very well with January 6, 1 AC, as the day of birth, indirectly confirming the calculations made by Dionysius Exiguus, because from December 25, 1 BC, to 6 January, 1 AC, there are only about two weeks.

Moreover, the Syrian document of the IV century (*Constitutiones Apostolorum*, V, 13, 1-2)—mentioned in Section 1—besides setting the Nativity Day on Kislev 25, sets also the Epiphany—i.e., the adoration of Jesus by the Magi, described in Matthew, chapter 2—on Tevet 6 (Metzger, 1986). For Matthew, the adoration should not have occurred few days after Jesus' birth because he refers to him with the word παιδίον, a word only suitable for a child 1 or 2 years old (La Greca & De Caro, 2020b; Barthel & van Kooten, 2015). A lunar month lasts 29.53 days (Carrol & Ostlie, 2007), therefore, 12 lunar months last 354.4 days. From Kislev 25 to Tevet 6 there are further 10 - 11 days, which added to the duration of 12 lunar months gives just the solar year of 365 days. This implies that if the Nativity Day is set on Kislev 25 and falls on January 6 in the Julian calendar, then Tevet 6 of the following non-embolismic luni-solar year will fall just after 365 days, i.e., on January 6. Thus, the ancient Eastern tradition of setting both the Nativity Day and the Epiphany on January 6 can be strictly correlated with the ancient Syrian document (Metzger, 1986). This can occur if the year of Jesus' birth is just that calculated by Dionysius Exiguus and the Epiphany is set exactly 1 year later, on 6 January 2 AC. This unexpected double coincidence allows us to conclude that the Eastern tradition of setting the Nativity Day and the Epiphany on January 6 is historically grounded.

Finally, we have also searched in the Gospels the historical background of the traditional Nativity Day, December 25 or January 6, i.e., the birth of Jesus at the beginning of the winter. According to Luke, Elizabeth was pregnant in the sixth month at the time of the Annunciation to Mary. But Mary was not aware of the sixth month's pregnancy of Elizabeth, therefore implying that Joseph had not gone on pilgrimage to Jerusalem in the last six months. Because three annual pilgrimages to Jerusalem were required—namely at Passover, at Pentecost and the Tabernacles—we have shown that the Annunciation occurred necessarily after about 6 months since the Tabernacles, therefore, just before the Passover of the following new year, i.e., at the beginning of the spring. Consequently, the Nativity Day, after 9 months, should have occurred at the beginning of winter, just as indicated in the Western and Eastern traditions.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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