

The Star of Bethlehem

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Evidence from the Bible and astronomy suggests that the Star of Bethlehem was a comet which was visible in 5 BC, and described in ancient Chinese records. A comet uniquely fits the description in Matthew of a star which newly appeared, which travelled slowly through the sky against the star background and which 'stood over' Bethlehem. The evidence points to Jesus being born in the period 9 March-4 May, 5 BC, probably around Passover time: 13-27 April, 5 BC. Birth in the spring is consistent with the account in Luke that there were shepherds living out in the fields nearby keeping watch over their flock by night. Birth in 5 BC also throws light upon the problem of the census of Caesar Augustus. A new chronology of the life of Christ is given which is consistent with the available evidence. This chronology suggests that Christ died close to his 37th birthday.

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1. Introduction

What was the star of Bethlehem? Did it really exist? Most modern theologians (e.g. ref. ¹) regard the reference to the star in Matthew's gospel as 'midrash', that is a story made up to satisfy an Old Testament prophecy, in this case that of Numbers 24:17, 'a star shall come forth out of Jacob and a sceptre shall rise out of Israel'. On the other hand, some writers regard the star of Bethlehem as a specially created miraculous object, beyond the bounds of scientific explanation. The question of whether a celestial phenomenon reported in ancient literature in an historical context was a real astronomical object is one which occurs quite frequently. In all such cases it seems best to consider as a working hypothesis that the report is correct, and to investigate whether any astronomical phenomenon exists which fits the report.

The difficulties of treating the star of Bethlehem as a real astronomical object should not be underestimated. For example, the New Testament scholar Brown² states 'a star that rose in the East, appeared over Jerusalem, turned south to Bethlehem, and then came to rest over a house would have constituted a celestial phenomenon unparalleled in astronomical history: yet it received no notice in the records of the times.' Similar sceptical statements abound in modern commentaries. However it will be shown in this paper (see also ref. ²) that this statement of Brown is in fact incorrect: there is an

astronomical object which fits very well the account in Matthew's gospel, and which also received notice in the Chinese records of the times.

If an astronomical object can be identified with the characteristics described in Matthew and other ancient manuscripts, this information may throw light on the long standing problem of the date of the Nativity. In AD 525 a Roman scholar and monk, Dionysius Exiguus, fixed the AD origin of our present calendar (Anno Domini = in the year of our Lord) so that Jesus was circumcised in the year AD 1 on January 1 (8 days, counting inclusively, after his birth on 25th December the previous year). More recently dates ranging from 20 BC to AD 10 have been given for the year of the Nativity.^{3 4} Concerning the day, although 25 December is firmly fixed in our calendar, this is unlikely if the arguments in the present paper are accepted. In this paper we consider a combination of astronomical and historical evidence which may be used to identify the star of Bethlehem and to determine the date of the Nativity.

The earliest known account of the star of Bethlehem is in Matthew 2:1- 12. Most scholars believe that the final text of this gospel was composed in about AD 80 (some scholars give an earlier date, e.g. ref. ⁵) from sources written in earlier times. Presumably one of these sources recorded the star of Bethlehem and the visit of the Magi. The account in Matthew describes how the Magi saw a star which they believed heralded the birth of the Messiah-king of the Jews. They travelled to Jerusalem and informed King Herod of the time when the star appeared, which indicates that the star was not a customary sight. The advisers of Herod told the Magi that, according to the prophesy of Micah, the Messiah should be born in Bethlehem, so the Magi journeyed there. The star moved before them and 'stood over' Bethlehem. The Magi found the place where the child was and presented him with gifts.

2. The Magi

The tradition that the Magi were kings dates from the sixth century AD, and is almost certainly legendary. According to Herodotus (1:101), Magi existed in Persia in the sixth century BC, they were a priestly group among the Medes who performed religious ceremonies and interpreted signs and portents. Persia (now Iran) conquered neighbouring Mesopotamia (now Iraq) and from the fourth century BC onwards Magi were increasingly associated with astronomy and astrology, the observation and the 'interpretation' of the stars being closely related in ancient times. Babylon (in Mesopotamia) was the world centre of astronomy and astrology at that time and Magi were important members of the Babylonian royal court. In about 586 BC the Babylonians sacked Jerusalem and took the Jews into Exile. From the time of the Exile onwards Babylon contained a strong Jewish colony, and the knowledge of the Jewish prophecies of a Saviour-King, the Messiah, may have been well-known to the Babylonians and to the Magi.

In the Hellenistic age some of the Magi left Babylon and travelled to neighbouring countries to teach and practise astronomy/astrology, which was a core educational subject in the ancient world (e.g. Plato, *The Republic*, 529). Thus the first century AD Jewish

scholar Philo of Alexandria stated that the student of astronomy perceives 'timely signs of coming events' since 'the stars were made for signs' (*De Opificio Mundi*, 22). There is a strong tradition that the Magi who visited Jesus came from Arabia (now Saudi Arabia), which lies between Mesopotamia and Palestine. Thus in about AD 160 Justin Martyr wrote 'Magi from Arabia came to him [Herod]' and in about AD 96 Clement of Rome⁶, associated frankincense and myrrh, two of the gifts of the Magi, with 'the East, that is the districts near Arabia'. We conclude that the Magi who saw the star of Bethlehem were astronomers/astrologers, who may have been familiar with the Jewish prophecies of a Saviour-King, and who probably came from Arabia or Mesopotamia, countries to the east of Palestine. Matthew 2:1 simply states 'Magi from the East arrived in Jerusalem'. It is important to realise that there are many references in ancient literature to Magi visiting kings and emperors in other countries. For example, Tiridates, the King of Armenia, led a procession of Magi to pay homage to Nero in Rome in AD 66 (Suetonius, Nero 13 and 30; Tacitus, *Annals*, 16:23; Dio Cassius, *Roman History*, 63:1), and Josephus records that Magi also visited Herod in about 10 BC. Thus a visit by the Magi to pay homage to Jesus, the new King of the Jews, would not have appeared as particularly unusual to readers of Matthew's gospel. However, the Magi must have had an unmistakably clear astronomical/astrological message to start them on their journey.

3. Characteristics of the Star of Bethlehem

There are several specific characteristics of the star of Bethlehem recorded in Matthew's gospel which, if accepted, allow the type of astronomical object to be identified uniquely. The characteristics are as follows:

- (i) It was a star which had newly appeared. Matthew 2:7 states 'Then Herod summoned the Magi secretly and ascertained from them the exact time when the star had appeared'.
- (ii) It travelled slowly through the sky against the star background. The Magi 'saw his star in the east' (Matthew 2:2) then they came to Jerusalem where Herod sent them to Bethlehem, then 'they went on their way and the star they had seen in the east went ahead of them' (Matthew 2:9). Since Bethlehem is to the south of Jerusalem the clear implication is that the star of Bethlehem moved slowly through the sky from the east to the south in the time taken for the Magi to travel from their country to Jerusalem, probably about one or two months (see later).
- (iii) The star 'stood over' Bethlehem. Matthew 2:9 records that the star 'went ahead of them and stood over the place where the child was'. Popular tradition has the star pointing out the very stable in which Christ was born, but Matthew neither states nor implies this: according to Matthew, viewed from Jerusalem the star stood over the place where the child was born, i.e. Bethlehem.

If the above textual evidence is accepted then all but one of the astronomical objects suggested in the literature as the star of Bethlehem can be ruled out. For example, the most popular theory, demonstrated in many planetariums, is that the star of Bethlehem refers to a conjunction of Jupiter and Saturn in 7 BC. This planetary conjunction theory

dates back to the 8th century astronomer/astrologer Masha'allah⁷ and has been widely supported in more recent times^{4, 8} but it does not satisfy the description that the star was a single star which appeared at a specific time, nor of a star which 'stood over' Bethlehem. The next most popular theory is that the star was a nova or a supernova. The first suggestion that the star of Bethlehem was a nova was made by Foucquet in 1729, and possibly earlier by Kepler in 1614 (see also Sachs and Walkerg⁹) and it has received considerable recent support.¹⁰ A supernova has also been suggested.¹¹ A nova or supernova satisfies the requirement that the star of Bethlehem was a single star which appeared at a specific time, but cannot account for the star moving through the sky. Similarly, all other suggestions for the star of Bethlehem (e.g. that it was Venus, etc) can be ruled out except one: a comet.

4. Was the Star of Bethlehem a Comet?

Comets probably have the greatest dramatic appearance of all astronomical phenomena. They can be extremely bright and easily visible to the naked eye for weeks or even months. Spectacular comets typically appear only a few times each century. They can move slowly or rapidly across the sky against the backdrop of stars, but visible comets usually move through the star background at about 1 or 2 degrees per day relative to the Earth. They can sometimes be seen twice, once on their way in towards perihelion (the point in their orbit which is closest to the sun) and again on their way out. However, from a given point on the Earth's surface, a comet is often only seen once, either on its way in or its way out, because of its orbit relative to the Earth. Since a comet usually peaks in brightness on its way out, about one week after perihelion, most visible comets are seen on their way out from perihelion.

If the star described in Matthew was a comet, was it seen twice, first in the east on its way in towards perihelion and again in the south on its way out, or was it seen continuously moving from east to south (and then to west) on its way out? Matthew 2:9 states 'the star they had seen in the east went ahead of them [to Bethlehem in the south]'. It was not generally recognised 2000 years ago that a comet seen twice, once on its way in towards perihelion (where it would disappear in the glare of the sun) and again on its way out was one and the same comet. It was normally regarded as two separate comets. Since Matthew 2:9 clearly implies that the star seen in the south was the same star as that originally seen in the east we deduce that the star was continuously visible and suggest that it was a comet on its way out from perihelion travelling east to south (to west). In particular it is suggested that the Magi originally saw the comet in the east in the morning sky (see later). They travelled to Jerusalem, a journey time of 1- 2 months (see section 7), and in this time the comet had moved through about 90°, from the east to the south. In one month the star background would move through 30°, and in two months through 60°. For the comet to have moved through 90° an additional 60° (in one month) or 30° (in two months) motion is required, which is broadly consistent with the 1 or 2 degrees per day typical motion of a comet. In Jerusalem, Herod's advisers suggested the Magi go to Bethlehem, six miles to the south and a journey time of one or two hours. The Magi set off next morning and saw the comet ahead of them in the south in the morning sky. Hence it appeared that the comet 'went ahead of' the Magi on this last lap of their journey.

The curious terminology in Matthew 2:9 that the star 'stood over' Bethlehem will now be considered. Phrases such as 'stood over' and 'hung over' appear to be uniquely applied in ancient literature to describe a comet, and I can find no record of such phrases being used to describe any other astronomical object. The historians Dio Cassius and Josephus were broadly contemporary with the author of Matthew's gospel. Dio Cassius (*Roman History*, 54, 29) describing the comet of 12 BC (Halley's comet) which appeared before the death of Marcus Agrippa writes 'the star called comet stood for several days over the city [Rome]'. Josephus (*Jewish War* 6,5,3) states 'a star, resembling a sword, stood over the city Jerusalem]', probably referring to the comet of AD 64 mentioned by Tacitus (*Annals*, 15,47), comets frequently being described as 'swords' in ancient literature because of their upward tails (in a direction away from the sun). Marcellinus describing a comet of AD 390 writes 'a sign appeared in the sky hanging like a column and blazing for 30 days'.

Celestial objects (including comets) appear to move across the night sky because of the rotation of the earth. In addition, comets move against the backdrop of stars. What did Dio Cassius and Josephus mean when they referred to comets 'standing over' Rome and Jerusalem, respectively? At the time of Christ the prevailing theory of comets was due to Aristotle who had proposed that comets were sub-lunar objects located in the upper atmosphere (see, for example, ref. [12](#)). This theory was consistent with the Aristotelian model of comets lying below the 'heavenly spheres' containing the Sun, Moon, planets and fixed stars, and presumably it also appeared to be consistent with visual observations of bright comets which often seem to be close to the Earth (many paintings and woodcuts of comets depict them as lying close to the Earth). Hence a comet is probably the only astronomical object to appear to be sufficiently low lying to be capable of satisfying the descriptions in Dio Cassius, Josephus and Matthew of a star standing over a particular town or city for part of the night. In addition, the upward tail of the comet would appear to point the head of the comet towards the city. Hence we interpret Matthew's description of a star 'standing over' the place where Jesus was born as meaning that when the Magi left Herod and headed towards Bethlehem, as he had suggested, they looked up and saw the comet in front of them, with a near vertical tail, the head of the comet appearing to stand over Bethlehem.

The use of the characteristic term 'stood over' by Dio Cassius and Josephus to describe a comet would seem to leave little doubt that when Matthew uses the term 'stood over' he is also describing a comet. Thus a comet uniquely fits the description in Matthew that the star was new, it travelled slowly through the star field from the east to the south, it went ahead of the Magi, and 'stood over' Bethlehem, the place where the child was.

The identification of a comet with the star of Bethlehem goes back to Origen in the third century, and this is the earliest known theory for the star. Origen (*Contra Celsum* 1, 58) stated 'The star that was seen in the East we consider to be a new star ... partaking of the nature of those celestial bodies which appear at times such as comets ... If then at the commencement of new dynasties or on the occasion of other important events there arises a comet. . . why should it be a matter of wonder that at the birth of Him who was to introduce a new doctrine ... a star should have arisen? In about AD 1303, Giotto painted a

comet above the head of the infant Jesus in a fresco in the Arena Chapel in Padua, presumably using as a model the AD 1301 appearance of Halley's comet (the European Space Agency mission to Halley's comet in 1985/6 was called 'Giotto' in commemoration of the artist's nativity comet). The possibility that the star of Bethlehem was a comet has also more recently been suggested^{3,13,14,15,16} but without the detailed arguments given here and in my previous paper.²

If the evidence cited above for identifying the star of Bethlehem with a comet is so strong why has it not been previously considered in the detail given here? The main reason seems to be the widespread belief that a comet was regarded as a sign from heaven of impending calamity and divine displeasure. Hence, it is argued, if the star of Bethlehem was a comet, it could not possibly have been interpreted by the Magi as heralding the birth of the Messiah.⁴ However, an examination of historical records shows that although for much of history and in many countries comets were associated with death and disaster, around the time of Christ comets were associated with the birth of great kings and with good news. Thus Origen, following his suggestion that the star of Bethlehem was a comet, refers (Contra Celsum 1, 59) to a book 'Treatise on Comets' by Chaeremon the Stoic (which we no longer possess) which lists occasions comets appeared when 'good was to happen'. The Chinese called comets 'broom stars' on account of their tails, and at least two ancient Chinese references make a pun of the word 'broom': a Chinese description of a comet of 524 BC saw it as a 'new broom' to sweep away traditions and the old order of things,¹⁷ and Tsochhiu (c. 300 BC) stated 'a comet is like a broom, it signals the sweeping away of evil'.

In the second century AD the Roman historian Justinus quoted from an earlier Roman historian, who in turn quoted from the History of Kings of Timagenes of Alexandria (which we no longer possess), as follows: 'Heavenly phenomena had also predicted the greatness of this man [Mithridates, the famous King of Pontus]. For both in the year in which he was born and in the year in which he began to reign a comet shone through both periods for 70 days in such a way that the whole sky seemed to be ablaze' (Justinus, *Pompei Trogi Hist. Phil. Epit.* XXXVII, ii, 1-3). This account was dismissed by many historians as legendary (cf. the star of Bethlehem) but Fotheringham¹⁸ identified comets in Chinese records in 134 BC and 120 BC, precisely the already accepted years of the birth and accession to the kingship of Mithridates, and these comets are now accepted by historians as events confirming his chronology. Pliny (*Natural History* 11, 23) records that Augustus (63 BC to AD 14) dedicated a temple to a comet that appeared during athletic games he sponsored in 44 BC, just after the assassination of Julius Caesar. The common people assumed that the comet was taking the soul of Caesar to the heavens where the gods lived. The emblem of a comet was added to a bust of Caesar that was dedicated in the forum. Augustus then used an emblem of a comet on some of his own coins, presumably as a symbol of his own greatness and possibly as a symbol of his assumed deity. It seems clear therefore that at the time of Christ comets were associated with great kings and with important events.

The Chinese kept careful astronomical records of visible comets, novae etc, and used different terms to describe them.¹⁹ A tailed comet was called a sui-hsing, meaning a

broom star, the 'broom' referring to the tail of the comet (traditionally the Chinese character read as sui has been read as hui, but sui is probably more correct, M. Loewe, private communication). A comet without a tail is called a po-hsing, and a nova is called a k'o-hsing, meaning guest-star. A clear distinction is not always made between novae and comets without a tail. Ho Peng-Yoke²⁰ lists and translates ancient Chinese records of comets and novae. Those appearing within the period 20 BC to AD 10 are all described as comets and are given in Table 1. These objects are the only recorded astronomical phenomena appearing near the birth of Christ which satisfy the description in Matthew's gospel of a star that moved through the sky and that 'stood over' a place.

The earliest possible date for the birth of Christ can be deduced from Luke 3:23, which states that he was 'about 30' when he started his ministry, which commenced with his baptism by John the Baptist. Luke 3:1-2 carefully states that the ministry of John the Baptist started in the fifteenth year of Tiberius Caesar. Depending on whether Luke used the Julian calendar or the Roman regnal year calendar, the fifteenth year of Tiberius was Jan. 1-Dec. 31, AD 29 or autumn AD 28-29, respectively. The Lucan term 'about 30' is a broad term covering any actual age ranging from 26 to 34,²¹ thus the earliest possible year for the birth of Christ is obtained by subtracting 34 years from AD 28, giving 7 BC. Hence we can rule out as being too early for the star of Bethlehem the comet of 12 BC (Halley's comet) in Table 1, although the 12 BC comet has recently been revived as the star of Bethlehem. [14](#),[15](#),[16](#)

The latest possible year for the birth of Christ is given by the date of the death of king Herod the Great, since Matthew 2:1 states that Herod was king when the star was seen by the Magi. The generally accepted date for the death of Herod the Great is the spring of 4 BC²² although other dates have also been suggested (e.g. 5 BC,²³ 1 BC^{24,25,26,27} and 1 AD²⁸). The evidence that Herod died in 4 BC is strong, and the accounts in Josephus of the reigns of his three sons, Archelaus, Antipas and Philip, all correlate perfectly with a 4 BC date. ^{21,29} Josephus (Antiquities 17:167) records that Herod died between an eclipse of the moon (usually taken to be that of 12/13 March 4 BC and the following Passover (on 11 April 4 BC). Josephus also describes that following the death of Herod his funeral occurred, then a seven-day mourning period, then demonstrations against his son Archelaus and then the Passover. Thus the latest date for the death of Herod is the end of March 4 BC and hence the comet that appeared in April 4 BC is too late to be the star of Bethlehem. In addition, the Chinese records give no details of the 4 BC comet (e.g. its duration) hence it was probably short-lived and insignificant.

5. The Star of Bethlehem-a Comet in 5 BC

Having effectively eliminated the comets of 12 BC and 4 BC as possible candidates for the star of Bethlehem, we note from Table 1 that the only possibility is the comet of 5 BC. The description of this in the Chinese *Han shu*, the official history of the former Han dynasty (206 BC-AD 9), on which Ho Peng-Yoke depends, is as follows:

'Second year of the Chien-p'ing reign period, second month (5 BC, March 9-April 6), a suibsing appeared at Ch'ien-niu for over 70 days.'

The passage in the Han shu also includes what is termed a traditional comment relating to this 5 BC comet which indicates that this comet was regarded as being of particular significance (see ref. 2 for further details).

Table 1 Comets and novae appearing from 20 BC to AD 10

Ho Peng-Yoke 20 catalogue number	Date (<i>Julian calendar</i>)	Description
61	26 August 12 BC (for 56 days, Halley's comet)	po (comet)
63 comet)	9 March-6 April 5 BC (for over 70 days)	sui (tailed
64	April 4 BC	po (comet)

Note: (1) the catalogue of Ho Peng-Yoke20 also has a 10 BC po comet as catalogue number 62. However, C. Cullen (to be published) has shown that there is no record of an appearance of a comet in that year but simply references to the one which had been seen in 12 BC.

(2) the term sui (tailed comet) has traditionally been read as hui: see text.

Since the comet was observed for over 70 days it was almost certainly very bright for part of this time, as suggested in various ancient references to the star of Bethlehem. For example, the New Testament Apocryphal book³⁰ the Protoevangelium of St James, possibly written in about AD 150, states that the wise men said 'we saw how an indescribably greater star shone among these stars and dimmed them'. The first reference identifying the 5 BC object with the star of Bethlehem appears to be that of Foucquet in 1729, however he referred to the object as a nova, as did Lundmark³¹ and Clark et al.¹⁰ As we have argued earlier, the description in Matthew that the star moved from East to South is inconsistent with a nova. In addition, since the 5 BC object was clearly described in the ancient Chinese records as a sui-hsing, and since the use of the term sui implies that the star had a definite tail, we should accept the Chinese description of this object as a tailed comet (Ho Peng- Yoke, private communication, see also Cullen³²).

Would this 5 BC comet observed by the Chinese have been visible to Magi living in Arabia, Mesopotamia or Persia? The Chinese records state that the comet appeared at Ch'ien-niu, and from ancient Chinese star maps Ch'ien-niu is the area of the sky including the constellation Capricornus. In March/April Capricornus rose above the Eastern horizon as seen from Arabia and neighbouring countries and was first visible in the morning twilight. Hence this comet would have been seen by the Magi rising in the East in the morning sky. This is consistent with Matthew 2:2 which states that the Magi first saw 'his star in the East'. (An alternative translation of 'in the East' in Matthew 2:2 is 'at its rising'.⁴ If this alternative translation is adopted the 5 BC comet again fits the description, since according to the Chinese records it would be first seen at its rising in the East in the morning sky).

The Chinese records also describe the 5 BC comet as being visible for over 70 days. The implication is that the comet was continuously visible, rather than being seen twice, once going in towards perihelion and again going out (see Section 4). The visibility for over 70 days is consistent with the probable journey time of the Magi (1-2 months, see later) and the probable time for the comet to move from east to south (also 1-2 months, see Section 4). Thus a consistent picture emerges: the Magi first saw the comet soon after perihelion in the east, in Capricornus, in the morning sky. They travelled to Jerusalem, a journey time of 1-2 months, and saw the comet in the south in the morning sky as they travelled from Jerusalem to Bethlehem. The comet continued to move to the west and became invisible after 70+ days.

6. The Three Signs in the Sky

Why should this particular comet have caused the Magi to make their journey? It is suggested that a combination of three astronomical events was involved: the triple conjunction of Saturn and Jupiter in 7 BC, the massing of three planets in 6 BC and finally the appearance of the comet in Capricornus in 5 BC. The eighth century AD astrological world history 'On Conjunctions, Religions and Peoples' by Masha'allah was based on an earlier Babylonian theory that important religious and political changes are predicted by conjunctions of the planets Saturn and Jupiter.⁷ Thus Masha'allah used Iranian astronomical computations to claim that the flood, the birth of Christ and the birth of Muhammad were all predicted by conjunctions of Saturn and Jupiter in the appropriate astrological circumstances. Rosenberg,³³ following the medieval Jewish writer Abarbanal,³⁴ has explained how in Magian astrology the planet Saturn represented the divine Father and Jupiter was his son. The constellation Pisces was astrologically associated with Israel. Thus it is suggested that the astrological message of the conjunction of Saturn and Jupiter in Pisces in 7 BC was this: a Messiah-king will be born in Israel. The fact that the conjunction happened three times in 7 BC (in May, October and December) probably served to reinforce this message. Thus it is suggested that the 7 BC triple conjunction alerted the Magi to the coming of the Messiah. We know that this 7 BC triple conjunction was important to Babylonian astronomers since a clay tablet, the star almanac of Sippar, has been found about 30 miles north of Babylon which refers in detail to this triple conjunction, and the tablet has been positively dated to 7 BC.⁴

Shortly after the triple conjunction of Saturn and Jupiter in 7 BC, Mars joined Jupiter and Saturn in the sky so that in February 6 BC the three planets (still in Pisces) were separated by only about eight degrees. There is a tradition that the massing of these three planets preceded the birth of Christ. In 1465 Jakob von Speyer, the Court Astronomer for Prince Frederic d'Urbino asked Regiomontanus 'Given that the appearance of Christ is regarded as a consequence of the Grand Conjunction of the three superior planets, find the year of his birth', a question that Regiomontanus was unable to answer.³⁵ Both Jakob von Speyer and Regiomontanus were familiar with ancient Greek, Latin and Persian books on astronomy/ astrology,³⁵ many of which have been lost, and the tradition that the massing of the three planets preceded the birth of Christ may be very early.

A similar massing was observed by Kepler in AD 1504 and, unlike Regiomontanus, he calculated that such massings of Jupiter, Saturn and Mars occurred only every 805 years, and suggested that they coincided with great events in history (his assumed dates were Moses 1617 BC, Isaiah 812 BC, Christ 6/7 BC, Charlemagne AD 799 and the Reformation AD 1604).

For Kepler, the massing of the three planets was astrologically important than the triple conjunction of Saturn and Jupiter, tentatively suggested that the supernova of AD 1604, and BC might have resulted from these massings.³⁶ To the represented the king of war, to the Persians the celestial is suggested that the massing of the three planets in 6 BC triple conjunction in 7 BC confirmed to the Magi that Messiah-king to be born in Israel would be a mighty king. The scene was set: expectations were aroused for a third sign which would indicate birth of the king was imminent.

7. The Significance of the 5 BC Comet

In the spring of 5 BC a comet blazed forth in Capricornus. This been rich in significance for the Magi. Not only - associated with great kings (see section 4), but Ptolemy stated that the appearance of a comet in the orient (east) approaching events and in the occident (west) those that slowly. The significance of the Magi seeing 'his star in the east' 2:2) was therefore that it clearly provided the awaited sign that the king was imminent. It may also be relevant to note that the Emperor Augustus had a silver coin issued which bore the BC17 and Manilius extolled the greatness of Capricorn as Augustus' sign (*Astronomica* 2.507). " - - symbolised kings. The writings of the Old Testament prophet have been known to the Magi, since he wrote while in exile i (Daniel 1:1) and he refers frequently to the Babylonian astrologers 1:19; 2:2; 4:5; 5:7). Daniel had a vision of a horned goat ' - whole earth without touching the ground and which fought overcame a ram (Daniel 8:5-21).' this vision may allude to Capricorn and Aries (the ram), and the goat, which Daniel identified with a mighty king of Greece, to be the powerful king Alexander the Great. It is suggested that the remarkable sequence of the triple conjunction in 7 BC, the massing of the three planets in 6 BC and the comet in Capricornus in 5 BC provided a very clear message to the Magi that a very great king was to be born in Israel.

The Magi therefore set off and went to Jerusalem to King Herod and asked 'where is the one who has been born king of the Jews' (Matthew 2:2) The legend that the star guided them to Jerusalem is not required (and Matthew neither states nor implies this): it is suggested that the Magi went to Jerusalem because their interpretation of the 7 BC conjunction and the 6 BC planetary massing was that a Messiah-king would be born in Israel and the appearance of the 5 BC comet told them this had happened. The advisers of Herod told them where: in Bethlehem, according to the prophet Micah. Again, they did not need guidance from the star, but were, 'overjoyed' when, on this last lap of their journey, the star 'went before them' in the morning sky and when it 'stood over' Bethlehem, where Jesus was born. Bethlehem was a small town, and a few enquiries may have quickly revealed the location of the child recently visited by the shepherds.

Montefiore,¹³ Finegan³ and Hughes³⁷ have previously suggested that the 'star' may have involved both the 7 BC conjunction and the 5 BC or 4 BC comets, with the Magi setting out in 7 BC and arriving in Jerusalem in 5/4 BC. Hughes⁴ has rightly criticised this theory (and withdrawn his own earlier theory, Hughes³⁷) as having the 'almost insurmountable difficulty' that the star the Magi saw when they set out, and the star they saw in Jerusalem, should have been one and the same star not a conjunction and a star, since Matthew 2:9 states 'the star, which they saw in the East, went before them' on the final leg of their journey to Bethlehem. We agree: the proposal here is that two events, the conjunction of 7 BC and the planetary massing of 6 BC, alerted the Magi to the coming birth, but they did not set out until the 5 BC comet appeared in the east, indicating that the birth was imminent.

How long did their journey take? Hughes⁴ has noted that Lawrence of Arabia in *The Seven Pillars of Wisdom* states that in 24 hours a fully loaded camel can cover 100 miles if hard pressed and 50 miles comfortably. The furthest the Magi are likely to have travelled is from Babylon to Jerusalem, a distance of about 550 miles going directly across the Arabian desert and about 900 miles travelling via the Fertile Crescent. Wiseman³⁸ has shown that as crown-prince, Nebuchadrezzar took 23 days to travel from north of Jerusalem to Babylon in a rapid return to take up the throne in Babylon in 605 BC. Hence allowing one or two months for the journey, including preparation time, seems not unreasonable, so that if the Magi commenced their journey soon after the comet appeared in March/April 5 BC, they would have arrived in Jerusalem in April 4-June 5 BC. As noted in Section 5, this journey time for the Magi is consistent with the probable time for the comet to move from east to south and with the 70+ days visibility of the 5 BC comet noted in the Chinese records.

The theory proposed here fits well with Herod giving orders to kill all the boys in Bethlehem who were two years old and under 'according with the time he had learned from the Magi' (Matthew 2:16). Earlier Herod had asked the Magi 'the exact time the star had appeared' (Matthew 2:7). It is suggested that the Magi spoke with Herod when they arrived in Jerusalem in April/June 5 BC and recounted not only the appearance of the comet about one month previously but also described the significance of the planetary massing in 6 BC and the triple conjunction of Jupiter and Saturn in May, October and

December 7 BC. Herod, leaving nothing to chance, decided to kill all boys born since the first stage of the triple conjunction in May 7 BC, two years previously.

The 5 BC date for the star of Bethlehem also fits well with the textual evidence for the length of stay of Jesus and his family in Egypt. According to Matthew 2:13-15, after the Magi had left Bethlehem, Joseph was warned that Herod planned to kill Jesus, so the family left for Egypt (a classic refuge for those trying to flee the tyranny of Palestine) and returned after Herod died. Both Origen and Eusebius state that Jesus and his family were in Egypt for two years, and they returned in the first year of the reign of Archelaus. Archelaus, one of Herod's sons, started his reign when Herod died. Thus if Herod died at the end of March, 4 BC, the first year of the reign of Archelaus was from April 4 BC to April 3 BC. Jesus and his family probably left for Egypt shortly after the Magi left Bethlehem, in about April- June 5 BC. If they stayed in Egypt a reasonable time after the death of Herod, to be absolutely sure of the news, they could have returned to Israel in, say, March 3 BC, when travelling conditions would be good, in the first year of Archelaus and having spent about two years in Egypt. Thus the 5 BC comet is consistent chronologically with both Herod's massacre of the infants and the two year stay in Egypt.

8. The Problem of the Census

According to Luke 2:1-5, a census was taken by Emperor Caesar Augustus around the time of the birth of Christ, and Joseph travelled with Mary from Nazareth to his home town of Bethlehem in order to register. This census is one of the thorny problems of the New Testament about which much has been written. There are three well-documented censuses conducted by Augustus: in 28 BC, 8 BC and AD 14, but these were apparently only for Roman citizens. In addition, there are various records of provincial censuses under Augustus for non-citizens for purposes of taxation, for example in AD 6, a decade after the death of Herod the Great, Josephus refers to a census in Judea administered by Quirinius the governor of Syria, and Luke also refers to this census (Acts 5:37). However, there is no record of a census for taxation purposes in Judea around the time of the birth of Christ, hence the problem in interpreting Luke 2:1-5.

The problem can be resolved if the census was not for taxation purposes but was instead a census of allegiance to Caesar Augustus (some translations of Luke 2:1-5 refer to taxation, but this is not implied in the Greek text). The fifth century historian Orosius (*Adv. Pag.* VI.22.7, VII.2.16) states '[Augustus] ordered that a census be taken of each province everywhere and that all men be enrolled. So at that time, Christ was born and was entered on the Roman census list as soon as he was born. . . . In this one name of Caesar all the peoples of the great nations took oath, and through the participation in the census, were made part of one society'. Josephus (*Ant.* XVII, ii, 4) appears to refer to the same event: 'when all the people of the Jews gave assurance of their goodwill to Caesar, and to the king's government, these very men [the Pharisees] did not swear, being above six thousand.' From the context of these words in Josephus, this census of allegiance to Caesar Augustus occurred about one year before the death of Herod the Great.

There is one further problem with this census. Luke 2:2 is usually translated 'This census was first made when Quirinius was governor of Syria', but Quirinius did not become governor of Syria until AD 6. However, the Greek sentence construction of Luke 2:2 is unusual and an alternative translation is^{1,39}: 'This census took place before the one when Quirinius was governor of Syria'. As noted above, from Josephus this latter census can be dated to AD 6, and Luke (Acts 5:37) was well aware of it. Thus the earlier census reference by Luke in Luke 2:1-5 provides a chronological clue to the birth of Christ, and from the context in Josephus (*Ant.* XVII, ii, 4) this census of allegiance occurred about 1 year before the death of Herod the Great, which is consistent with our placing the birth of Christ in the spring of 5 BC.

9. A New Chronology for the Life of Christ

What is the earliest date for the birth of Jesus? It would seem that the Magi expected Jesus to be born shortly after the time the 5 BC comet appeared since a comet appearing in the east signified an imminent event, and when they arrived in Jerusalem they asked Herod 'Where is the one who has been born king of the Jews?' (Matthew 2:2). Hence it would seem that the earliest possible date for the birth of Jesus is when the comet first appeared, and the earliest date for this according to the Chinese records is 9 March 5 BC. This is consistent with Luke 2:8 which states that at the time of the birth of Jesus 'there were shepherds living out in the fields nearby, keeping watch over their flock by night'. Bethlehem is cold and very wet during December, January and February and flocks of sheep were not normally kept in the fields in these months (see, for example, Hughes⁴). Sheep were usually put out to grass between March and November, the shepherds being with the flocks at night particularly during the spring lambing season (March-April).

An approximate latest date for the birth of Jesus can be deduced as follows. According to Luke 2:22, after the birth of Jesus and following a time of purification, Joseph and Mary took Jesus to the temple in Jerusalem. Lev. 12:2-4 specifies that the time of purification for the mother of a male child is 40 days, after which she can come to the temple. Assuming one day for travel from Bethlehem to Jerusalem (a distance of 6 miles), Jesus would have been born not less than six weeks before the visit of the Magi (since Jesus and his family left for Egypt shortly after the visit of the Magi the most probable sequence of events in the Matthew-Luke birth narratives is birth, visitation of the shepherds, presentation at the temple in Jerusalem, return to Bethlehem, visit of the Magi). There was no point in Joseph and Mary staying in Bethlehem after the purification and visit to the temple since they had originally only gone to Bethlehem for the census. Hence it is reasonable to assume the Magi visited Jesus very shortly after his return from the temple to Bethlehem. This is consistent with the comet being visible for 70 days and the one to two month journey time of the Magi.

The Chinese records state that the comet first appeared sometime in the period 9 March to 6 April 5 BC and lasted over 70 days. Thus the latest date for the Magi to have seen the 'star' at Bethlehem was 6 April plus 70 days, i.e. 15 June, and the latest date for the birth of Jesus is this date minus six weeks, i.e. 4 May. If this evidence is accepted, Jesus was born sometime in the period 9 March-4 May, 5 BC, which is consistent with the

Lucan shepherd reference. It is worth noting that many theologians (e.g. ref. 1) claim that the birth narratives in Matthew and Luke are inconsistent. This is incorrect. The birth narratives are complementary and easily reconcilable.

Table 2 Chronology of the Life of Jesus

Date in Julian Calendar	Event
9 March-4 May, 5 BC (13-27 April, 5 BC)	Birth of Jesus in Bethlehem. Matthew 2:1, Luke 2:1-7
9 March-4 May, 5 BC (13-27 April, 5 BC) inclusively). Luke 2:21.	Visit of the Shepherds Luke 2:8-20 Circumcision on the eighth day (counting
16 March-1 I May, 5 BC 40 days from birth. Luke 2:22-24.	Presentation of Jesus at the Temple in Jerusalem after
(20 April-4 May, 5 BC) 924 May-8 June, 5 BC)	Visit of the Magi. Matthew 2:2-12.
late April/mid June, 5 BC (late May/mid June, 5 BC)	Flight to Egypt from Bethlehem. Matthew 2:13-15.
~ end March, 4 BC	Death of Herod. Matthew 2:20-23.
? March, 3 BC	Return from Egypt to Nazareth. Matthew 2:20-2
? Autumn AD 29	Baptism of Jesus when he was 33.
Friday, 3 April, AD 33 birthday. All four gospels.	Crucifixion on 14 Nisan when Jesus was near his 37th

Note: The dates given in brackets are narrower date ranges based on Jesus being born around Passover time (see text).

The most likely date for the Baptism of Jesus is autumn AD 29.^{3,21} If Jesus was born in the Spring of 5 BC then he would have been 33 when he commenced his ministry. This is consistent with Luke 3:23 that he was 'about thirty' at this time. (As noted above, the Greek translated 'about thirty' means any age between 26 and 34). If the crucifixion was on 3 April AD33,^{27,29,40,41} then Jesus was around his 37th birthday when he died. We have deduced that Jesus was born in the spring of 5 BC. We note that in 5 BC the first day of the feast of Passover (Nisan 15 in the Jewish calendar) fell on 20 April and we tentatively give several reasons which suggest that Jesus may have been born around Passover time. At Passover time all adult males were required to come to Jerusalem, hence Jerusalem and its neighbourhood were extremely crowded and nearby Bethlehem would be very crowded too. Censuses were not held on a particular day but were spread over a period of time and it is suggested that Joseph chose to visit Bethlehem for the census at the same time as Passover to save an extra journey. Thus the guest-room (kataluma, mistakenly translated 'inn' in some translations) of the house was full (Luke 2:7) because it was the time of a feast⁴² in particular the feast of Passover (see also Pratt,²⁸ who dates the Nativity to Passover, 1 BC). Josephus (*Jewish War*, 1, 229 and 6, 270) states that pilgrims came up to Jerusalem about a week before the Passover to undergo the appropriate purificatory rites, and the feast itself lasted for one week. Thus it is tentatively suggested that the birth of Jesus may have occurred in the week before or after Passover in 5 BC, i.e. in the period 13-27 April, 5 BC.

Birth at Passover time is consistent with Jewish expectations for the birth of the Messiah. For example, the Jewish scholar Abarbanal,³⁴ writing in 1497 AD and still expecting the Messiah, states that the messianic redemption will come in the month Nisan since the 'cup of Elijah' at the Passover meal preserves the symbolism that the new redemption will come during the same season as the Exodus from Egypt. A further clue may be provided by the words of John the Baptist near the time of the baptism of Christ. John twice greets Jesus with the words 'The Lamb of God' (John 1: 29 and 36) and many commentators have discussed the background of this strange phraseology. If Jesus was born at Passover time, particularly if he were born on 10 Nisan (sunset Sunday 14 April to sunset Monday 15 April in 5 BC) when the Passover lambs were chosen, without spot or blemish, or on Nisan 14, when the lambs were sacrificed, John would have a clear reason to call him the Lamb of God. Some key dates and date ranges in the chronology of the Life of Jesus are listed in Table 2.

10. The Date of Christmas

The traditional Western date of Christmas, December 25, first occurs in the Roman calendar *Chronographus Anni CCCLIXII* (*Chronographer of the Year 354*). In the calendar the sequence of festivals in the church year begins with the festival of the birth of Christ on 25 December. The original version of this calendar may date back to AD 336, hence it is not particularly early.³ The pagan feast of the sol invictus (the invincible sun) was observed on 25 December since it was the date accepted at the time for the winter solstice. The Christian festival of Christmas essentially replaced this pagan festival. The traditional eastern date of the birth of Christ is January 6. Epiphanius

(Panarion haer. 51, 22, 9-11) states that this was the date of the pagan festival of Kore which the Christian festival then replaced.

However the actual birth of Christ was unlikely to have been in winter if we accept Luke 2:8 'there were shepherds living out in the fields nearby, keeping watch over their flock at night'. We very tentatively suggest how 25 December and 6 January might have been chosen for the birth of Christ. According to the present paper, Christ was born in the Spring. We suggest that this birth date may have been confused with the date of the conception (and Epiphanius comments on such a confusion in the early church). Adding nine months for the pregnancy leads to a date range close to the existing pagan festivals of Kore and the sol invictus which were then taken to be Christmas.

11. Summary and Conclusions There are four key questions arising from the account in Matthew's gospel, and other ancient literature, of the star of Bethlehem: (i) who were the Magi; (ii) is there a known astronomical phenomenon which fits the account; (iii) what induced the Magi to embark on their journey; (iv) can astronomy be used to solve the long-standing problem of the date of the birth of Christ. This paper attempts to answer these questions.

The Magi are well known in classical literature as a religious group who were skilled in the observation and 'interpretation' of the stars. At the time of Christ they lived mainly in Persia, Mesopotamia and Arabia (now Iran, Iraq and Saudi Arabia, respectively) and they are known to have visited kings in other countries. It is therefore consistent with our knowledge of the Magi that an astronomical sign could have led them to visit a new king.

There are three main characteristics of the star of Bethlehem recorded in Matthew: it was a star which had newly appeared, it travelled slowly through the sky against the star background, and it stood over Bethlehem. It is suggested in this paper that one, and only one, astronomical object satisfies this description: a comet. It is proposed that the Magi originally saw this comet in the east in the morning sky. They travelled to Jerusalem, journey time of 1-2 months, and in this time the comet had moved to the south in the morning sky, hence it appeared ahead of them as they travelled from Jerusalem to Bethlehem on the last lap of their journey. The comet appeared to stand over Bethlehem with a near vertical tail. It is shown that the description 'stand over' is uniquely applied in ancient literature to refer to a comet.

From ancient Chinese astronomical records three comets are possible candidates for the star of Bethlehem, those of 12 BC, 5 BC and 4 BC. It is shown from historical and biblical evidence that the comets of 12 BC and of 4 BC were too early and too late, respectively, to be the star of Bethlehem. Hence the comet of 5 BC may uniquely be identified as the star of Bethlehem. The Chinese description of this comet, particularly its appearance in the east and its visibility for over 70 days, is consistent with the description in Matthew.

It is suggested that a combination of three unusual and significant astronomical events caused the Magi to set off on their journey. First there was a triple conjunction of Saturn

and Jupiter in the constellation Pisces in 7 BC. Such an event occurs only every 800 years. The probable astrological significance of this event to the Magi was that a divine king would be born in Israel. Second, in 6 BC there was a massing of the three planets Mars, Saturn and Jupiter in Pisces. Such a massing only occurs every 800 years (and very much more infrequently in Pisces) and it would have confirmed to the Magi that the king to be born in Israel would be a mighty king. Third, a comet appeared in 5 BC in the east in the constellation Capricornus. In the astrology of the times a comet in the east signified a rapidly approaching event. The comet was therefore the third and final sign which caused the Magi to set off on their journey. It is shown that the probable significance of the comet in Capricornus to the Magi was also that a very great king was about to be born.

Further analysis suggests that the birth of Christ was in the Spring, in the period 9 March-4 May, 5 BC. Tentatively the period around Passover time is suggested (13-27 April, 5 BC). This date is consistent with the available evidence including a reference in Luke to there being shepherds out in the fields at night. Although today Christmas is celebrated on December 25 in the west and on January 8 in the east, we suggest that the evidence of astronomy, the bible and other ancient literature points to the Spring of 5 BC as being the time of the first Christmas.

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