

STAR OF BETHLEHEM

HOW TO TELL THE ASTRONOMY CORRECTLY

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Abstract

The star of Bethlehem is a popular and standard topic in many planetaria all over the (Christian) world. Since the production of dome planetariums started in the 1920s, the most common story that is told deals with a great conjunction of Jupiter and Saturn. Alternatives are hardly discussed in the public, although it has long been known amongst researchers that there was no special astronomical phenomenon that coincides exactly. Here, I present a brief discussion of all suggestions, including an analysis of the nova question with my recently developed, data-driven method that was successfully presented to the public. The goal is not to present an explanation, because there is no historical proof that the star existed at all. This paper is dedicated only to the suggestion of a narrative in the planetarium that communicates that this star is a symbol with a function in the story. Additionally, it provides the possibility to demonstrate a huge variety of astronomical objects and their appearance to the naked eye.

INTRODUCTION: THE POPULARLY “KNOWN” EXPLANATION



Figure 1 Morning twilight in 7 BCE: Jupiter, Saturn and the Moon met on the 23rd. Simulation: Stellarium 0.20.3.

In the year -6 (7 BCE), there was a Great conjunction between Jupiter and Saturn: Within seven months, these two planets met three times.

On May 23rd, Jupiter and Saturn were separated by only 1° and the lunar crescent stood close to them (Fig. 1). Yet, the scenario took place in the

morning twilight. Therefore, Jupiter and the Moon were clearly visible but, because it is only as bright as the brightest stars (around +0.5 mag), it was hard to see Saturn. 1° separation means that the two planets (which appear very close in our small picture) had a visible distance of roughly two apparent Moon diameters.

During that summer, the two planets first moved away from each other and then approached again. They re-met at the beginning of October with a minimum separation of $54'$ (almost 1°) on October 5th and had another close approach at the beginning of December with a separation of a bit more than 1° on the 5th to 8th (Fig. 2). The astrological narrative for why this triple conjunction would have led to the voyage of three Babylonian astral scientists is, in most cases, the following: Jupiter is the planet of the king, Saturn is the planet of the Jews, and when they meet, something happens to the king of the Jews. This triple conjunction took place in the constellation of Pisces and, as we know, this constellation shows two fish that are connected by an umbilical cord, thus representing birth. Ferrari d'Occhieppo (1999) combines this story with zodiacal light.

For decades, it has been demonstrated in public talks and planetarium shows (e.g. Letsch, 1953: 62; Mucke, 1967) that the asterism that (according to Matthew's gospel) guided three scholars (magi) from the East (Babylon) to the place where Jesus was born, refers to the above-mentioned conjunction.

CRITICAL POINTS IN THE POPULAR EXPLANATION

2.1 The constellation

In Greek antiquity, the two fish were connected by an unexplained cord that was metaphorical and never explained. Only Aratos (362-370) describes it as the ribbon binding the two fish together, reaching to the comb of the sea monster, and that the two parts meet at an acute angle.

Eratosthenes reports that the two fish are descendants of Pisces Austrinus (PsA), a comment which might have led to the interpretation of the constellation as a sign of birth.

However, the gospel of Matthew reports that it was Babylonian, not Greek, astrologers who travelled to Israel. In Babylonian astrology, the



Figure 2 (Top): Two further conjunctions in October (left) and December (right) 7 BCE, Simulation Stellarium 0.20.3.

Figure 3 (Below): Babylonian constellations in the 2nd millennium (left) and the re-interpretation of the 1st millennium (right). Photos taken in Planetarium Jena (installation and photos: SMH).

constellation was not considered to be two fish. In the 2nd millennium, the astronomical compendium, MUL.APIN, reports that the Great Swallow constellation sits in place of the Greek constellations Pisces and Cetus (Hunger and Pingree, 1989; Hunger and Steele, 2018). Around the time of Jesus' birth, this huge constellation had probably been forgotten and replaced by the constellation of the Swallow-Fish, an unexplained creature that we can see depicted on seals from that time (Fig. 3). It is possible that the term originally designated a certain species of fish but was transformed into a strange image in the sky.

In Babylon, since the 7th century, there were astronomical 'diaries' that were created monthly to record happenings in the sky. Up to fourteen astronomers worked simultaneously on observations, computations of phenomena, and the development of algorithms for those computations.

In the astronomical diaries, the great conjunction is described as occurring in the constellation of "the Tails"

(Hunger and Sachs, 1988-2014). This is an abbreviation of the "Tails of the Swallow," which is the part of the huge constellation that intersects the zodiac (cf. Hoffmann, 2017).

Obviously, the Babylonian constellation did not depict any descendants.

2.2 The planets

It is true that, since the beginning of written astrological records on significance, Jupiter has been considered the King's planet (Hunger and Pingree, 1999).

The interpretation of Saturn as the planet of the Jews seems to not be of ancient origin, but rather modern. Handbooks on omen writing have been preserved from Babylon showing that Saturn was known as the planet that stands for **evil**. It was so evil, in fact, that one should not call it by its name, but rather by the euphemism "the Sun of the Night" (Reiner and Pingree, 1998).

The interpretation of asterisms being associated with certain geographical regions exists in Babylon (Horowitz, 1998), but it is relatively rare in divination and not a concept of zodiac astrology. It was not used to determine the fate of single people.

Result 1: Neither the constellation (Pisces) nor the planet (Saturn) fit Babylonian omens and concepts of divination.

The idea of the Star of Bethlehem as a planet conjunction goes back to Johannes Kepler. He observed Supernova 1604 in an area of the sky where a conjunction of Mars and Jupiter had taken place one year prior. Thus, he suggested that it was possible that planetary conjunctions could create new objects. In his time, the weekday on which the Jews closed their shops and went to the synagogue was the day named after the planet Saturn (since Vettius Valens, +2nd c.). Thus, in the modern era, Saturn may have been considered somehow related to the Jews, but not in Antiquity.

In Kepler's time, Babylonian divination and the omen handbooks we have today were unknown. Cuneiform was only recently decrypted in the 19th century. Afterwards, it took some time before our understanding of Babylonian culture, astral divination, and practise and mathematical astronomy became complete enough to judge whether the suggested interpretation had merit.

WAS IT A NOVA?

Transients are rarely reported in Greco-Roman and Babylonian astrology but there was a strong focus on them in Chinese divination (Pankenier, 2013). There is one record from China, with a copy in Korea, dated 24 April 4 BCE that reports "a fuzzy star in Hegu." A fuzzy star could be anything, e.g. a comet or a stellar transient that is blurred by the atmosphere or that has rays due to its brightness.

To exclude the possibility of a nova or supernova, we probed the area of the Hegu asterism for modern counterparts of such high amplitude stellar transients. Hegu is an asterism of three stars among which the brightest is Altair, α Aql.

The record is listed among the possible "guest stars" in Xu et al. (2000: 130), which strengthens the hypothesis that this could be a stellar transient rather than a comet.

The map in Fig. 4 shows the little asterism surrounded by a circle with a radius of 4° . This is the main search field for possible counterparts. In the whole area, there are a few pulsars but no supernova remnants – not even

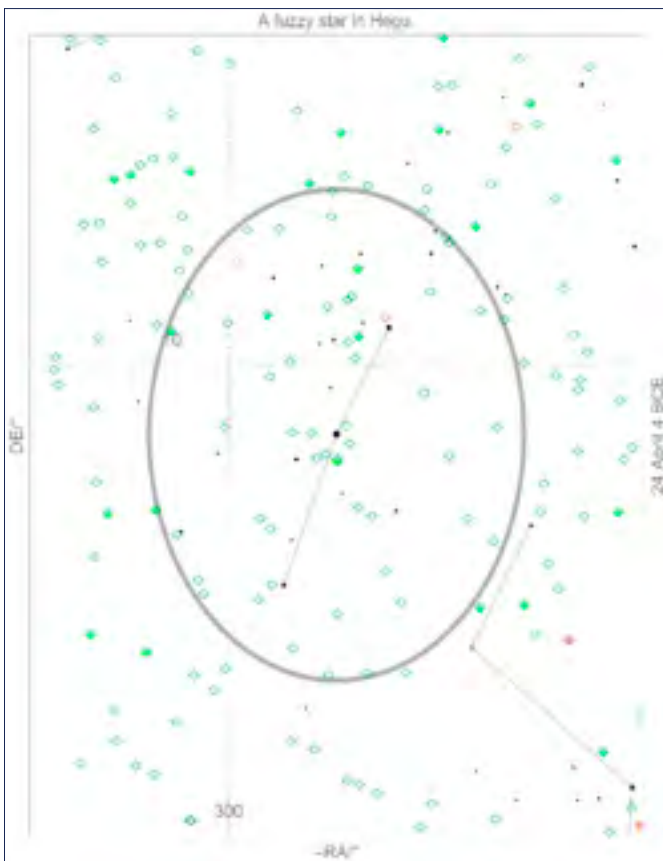


Figure 4 Map of cataclysmic and symbiotic binaries around Altair (coded in Wolfram Language: SMH).

just outside the search circle. This area includes part of the Milky Way, and thus, we expect a possible supernova relatively close (inside our Galaxy). A pulsar without a gaseous supernova remnant was found but appears much older than ~2000 years. Therefore, a supernova observation is not probable in this case.

A nova should also have produced a remnant in the shape of a nebula, but it is unknown on which timescales these objects evolve and vanish and if it would still be visible. There is no suspicious nebula in the field. Thus, we checked the field for all cataclysmic variables and symbiotic stars, which are depicted in green and orange, respectively, in our figure. Most of them are much too faint to flare up to naked-eye visibility, according to predictive methods and criteria defined in Hoffmann, Vogt and Protte (2020).

The five cataclysmic variables in our figure (highlighted with filled diamonds) passed our brightness filter of first instance and could,

theoretically, become visible to the naked eye. They are PS1-3PI J195042.77+082545.3, MASTER OT J194850.95+102828.1, MGAB-V850, V0725 Aql and MGAB-V1275. The Master optical transient has been detected only one time and is, thus, assumed a dwarf nova at peak. The quiescence magnitude is unknown. Both MGAB objects and the PS1 have quiescence brightness of ~20 mag and, thus, turn out to be too faint in this area of bright celestial background (within the Milky Way) to become visible.

V725 Aql is the only remaining candidate

for a nova in Hugu. Its quiescence magnitude is 16.2 mag and typical nova amplitudes are 11 to 13 mag. If this system permits a classical nova, it could become 5 or even 3 mag. In case of a fast nova, the time of decline by 2 mag would be a few days, in which time it would fade to invisibility for naked eye observers.

However, a “new” 5 mag star could likely be overlooked, and a “new” 3 mag star would be easily visible, but not really bright in, or next to, a crowded star field.

Result 2a: It is demonstrated that there are no convincing candidates. A nova in Aquila in 4 BCE is not excluded, but highly unlikely.

There is one further possibility for a nova. In 5 BCE (year -4) a transient is reported in the Chinese asterism of Qianniu (the Draught Ox), 6 stars with β Cap as the principal star (western most). Only the records from the month of its appearance, March, is preserved and the duration of visibility of 70 days (Ho, 1962). The terminology “broom star” and the duration of more than two

months suggest a comet in preference of a nova, which is why Pankenier et al. (2008) and Xu et al. (2000) did not include it in their list of potential guest stars. However, since the list by Clark and Stephenson (1977) included it, we are sometimes asked to discuss it as well in public presentations.

As terminology in chronicles could be wrong or misleading, we did search for possible nova remnants in this field. No further records are preserved, i.e. no movement is reported. A stellar transient with the duration of 70 days could have been a slowly declining classical nova (Hoffmann, Vogt and Protte 2020; Hoffmann and Vogt 2020a, Hoffmann and Vogt 2020b). In the zodiac (Capricorn), it would likely be observed by any astronomer - in Rome and Alexandria as well as in Jerusalem or Babylon. Whatever this was, a nova in this area of the sky appears unlikely regarding the possible counterparts that are known from surveys on cataclysmic variables.

Result 2b: The suggested transient in 5 BCE was likely a comet.

IS AN ALTERNATIVE SUGGESTION MORE LIKELY?

There is another suggestion of a possible conjunction of two planets that makes more sense in the thinking style of Antiquity: a close conjunction of Venus and Jupiter. Both planets have generally positive connotations in Babylonian astrology and are therefore more likely to serve as a good omen.

For instance, the clay tablet BM 75228 from the British Museum preserves a list of Venus omens with the schema ‘If Venus ..., then ...’. Of particular note is sentence number 9, which reads:

dDil-bat u dGAL it-te-mi-du LUGAL
BE-ma BALA KUR2-ir dSAG,ME.GAR
dDilbat ina iti [...]

“If Venus and the Great Star meet: the king will die, the dynasty will change – Jupiter Venus in month [...]”

Citations: Reiner and Pingree (1998:68,69). It should be mentioned that dGAL designates an asterism (the Great God). This shows that there are omens of the required type that announce a change of dynasty in connection with Venus and others.

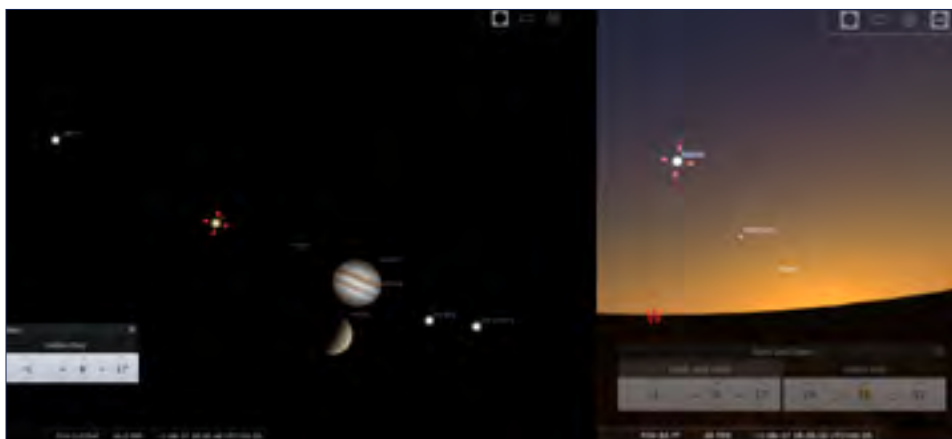


Figure 5 Apparent merger of the two brightest planets, Venus and Jupiter, in -1 (2 BCE) next to Regulus, the king's star. Simulation with Stellarium 0.20.3.

Interestingly, there had been two extraordinarily close conjunctions of Venus and Jupiter in the years -1 and -2 (2 and 3 BCE), both in northern summer, which does not fit the time of celebration of Christmas. Both conjunctions took place in the constellation of Leo the Lion, whose brightest star, Regulus, had been considered the king's star since the early times of Mesopotamian astrology (Hunger and Pringree, 1999). Its Sumerian name, LUGAL, the King, was also used later in Akkadian.

We can conclude that a conjunction of Jupiter and Regulus is a meeting of the king's star with the king's planet, and a conjunction (apparent merger) of Venus and Jupiter means something really good and strong for the king – at least in Babylonian astrology.

Result 3: The conjunctions of Jupiter and Venus appear more attractive to explain the “Star of Bethlehem” in regard to i) visibility, ii) concepts of divination in Babylon.

4.1 Astrology in the epoch of Jesus' birth

Jesus' birth falls in the era of Caesar Augustus in Rome. As he, Octavian, was only a nephew of the earlier Caesar Gaius Julius, he systematically built a case to legitimize his claim as the rightful ruler of the Roman empire. In the biography of Augustus, ancient historian Sueton reports that Octavian, at age 18 a year before Gaius Julius' murder, had been in Apollonia with his friend Agrippa and visited the astrologer Theogenes (Augustus, 8,

94). Because Theogenes predicted an extraordinarily great fate for him, and a comet appeared a year later during the funeral games of Gaius Julius, Augustus put strong focus on astral signs. In contrast to the normal concept of comets as a bad omen, Caesar's comet was commonly connected with the deification of the dead dictator and a sign of hope. During this period, astrology flourished in the Roman empire and Augustus was a master at using this in his propaganda.

Augustus' sign: According to the oracle of Theogenes, Caesar Augustus, who was born in September, considered the sign where the Sun stood during his conception (in January) as “his” sign (Schumacher, 1988: 324). Thus, the strange creature of Capricorn decorated many coins, seals, art and official documents during the whole epoch of Caesar Augustus (Schütz, 1991). Capricorn is a Babylonian figure, a so-called Goat-Fish that was not understandable in Greek culture but had always been considered a good and helpful daemon in Mesopotamia. It is often depicted above Augustus's head (e.g. on the Gemma Augustea, cf. Zanker, 2009: Fig.182, p.233), or holding the globe of the Earth between his front legs (on several coins).

Augustus' goddess ancestor. Gaius Julius had already established a myth around his legitimacy as ruler of Rome due to his family's patrons. The Julian family was considered to be founded by the goddess Venus herself (Zanker, 2009: 46). This tradition was continued by Augustus when he also imprinted

images of this Venus Genetrix as his own ancestor on coins. In his old age, Augustus again applied these images to his designated heirs to the throne (Zanker, 2009: 218-227).

Augustus' usage of Caesar's comet. Since 42 BCE, Octavian had already started to promote himself as the *divi filius* (son of a god or of the deified dictator) and the newly appeared comet as sign of the *saeculum aureum* (the golden age) that was subsequently dawning. Therefore, he also used images of the Julian comet on temple walls and on his helmet, as it was considered extraordinarily positive by the public.

Augustus in Alexander's tradition. In Hellenism, it had always been tradition to depict a successful warrior king as Zeus/Jupiter. This tradition started with Alexander the Great when he was considered deified in Egypt and his own entourage adopted this view. The depiction of Augustus as Jupiter on the Gemma Augustea is most famously known, but the tradition was widespread (Zanker, 2009: 232-239).

In summary, Caesar Augustus was equated with the god Jupiter and legitimized himself by claiming the goddess Venus as his ancestor. An apparent merger of the planets of Venus and Jupiter was, therefore, yet another great propaganda tool for him, demonstrating his legitimate claim of autocratic rule.

As it was visible all over the empire and easily recognisable by everybody, this was a welcome ‘confirmation’ by the gods of Augustus's claim.

Result 4: The conjunction of Venus and Jupiter suits Caesar Augustus's propaganda perfectly.

4.2 The context of Matthew's story

Jesus was murdered ~30 years later and Matthew wanted to convince people of the deification of Jesus. As explained in the literature, the Jewish religion requires the messiah to appear together with a star – as is the case in many cultures. Furthermore, there is a strong legitimacy lent by the family tradition

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