

## THE CHRISTMAS STAR, NOVAE, AND PULSARS

DORRIT HOFFLEIT  
Yale University Observatory  
New Haven, CT 06511

### Abstract

A ceiling painting in the Priscilla catacomb in Rome appears to represent a star map showing the Christmas Star. If so, this might be a portrait of the nova or comet of 5 B.C., or it could be Venus in 6 B.C.. It could not represent the conjunction of Jupiter and Saturn in 7 B.C., which occurred in a different part of the sky.

\* \* \* \* \*

### 1. Introduction

Over the ages, many hypotheses have been advanced to account for the "Christmas Star" (Clark *et al.* 1977; Hughes 1976), but none of the suggested identifications has been found completely satisfactory (Armstrong 1978; Cullen 1979; Trimble 1980). Recently, Carolyn Murphy Beehler (1980), after visiting the Priscilla catacomb in Rome (presumably the oldest of the Christian catacombs), made a remarkable discovery which appears to have a bearing on the problem. The ceiling painting in the catacomb shows a pastoral scene of shepherds with their sheep among apple trees. See Figure 1. On closer inspection Mrs. Beehler noticed that this picture was painted over an older one with a madonna and child and a man (Joseph?) pointing to one of the "apples." It occurred to Mrs. Beehler that in the days of the persecution of Christians in Rome, the stars in the original painting had been changed to apples which had no religious significance as stellar configurations might. Assuming that all of the apples were stars, Mrs. Beehler succeeded in matching the highly distorted star field to a modern constellation chart, basing her first hunch on the constellation Aquila, since Aquila was the name of Priscilla's husband, and possibly also of her grandson the astronomer Aquila. See Figure 2. However, one star, the one to which the man is pointing, does not occur on any modern chart. Mrs. Beehler then asked my aid in identifying this presumably first portrait of the Christmas Star.

### 2. Investigation

The General Catalogue of Variable Stars (Kukarkin *et al.* 1971) (GCVS) lists two objects recorded by Chinese and Korean astronomers (c.f. Yoke 1962), one in 4 B.C. and the other in 5 B.C.. From the available records it is uncertain if either is a comet or a nova. The 4 B.C. object is described as close to the position of Altair and hence is not the unidentified catacomb star. The 5 B.C. object is located within an accuracy of ostensibly  $5^\circ$ . While it is some  $20^\circ$  distant from the crude position inferred from the painting (near the constellation Scutum), this clue is still the best, and is a reasonable one. There are many reasons why the painting of a star field on a semi-cylindrical ceiling in a dimly lit catacomb would be distorted. Moreover, it is not known precisely when and by whom the painting was executed. In any case, the artist would have painted the picture many years after the event and could possibly have based the star position on hearsay rather than personal observation, or even placed the star in the best position for a symbolic picture not necessarily close to its real position relative to the "fixed" stars.

If the catacomb picture is really an authentic representation of the Star of Bethlehem, the oft-quoted conjunction of Jupiter and Saturn

in 7 B.C. would definitely have to be ruled out. It occurred in Pisces much too remote from the constellations represented here, to say nothing of the fact that the closest approach of the two planets to one another was about one degree (Tuckerman 1962), so that they could not have been seen as a single and brighter star.

The planet Venus has also been considered as a candidate for the Christmas Star. From January to March of 6 B.C. it was in approximately the correct position to match the painting. However, it is scarcely plausible that the wise men (now considered to have been astrologers) who paradoxically followed "the star in the east" while first traveling westward from Persia and then due south from Jerusalem to Bethlehem, would not have recognized Venus from its appearances in previous years.

Thus, the object of 5 B.C., interpreted as a nova, remains the most likely candidate for the Star of Bethlehem. That the 5 B.C. object was a comet seems unlikely, despite the Chinese description to that effect, because no motion was indicated although the object was visible over 76 days and according to some, even over two years (Armstrong 1978). Was it then an ordinary nova or a supernova?

Recently Mrs. Beehler (an artist and biblical historian) expressed the opinion that a pulsar may be in the correct position. The possibility that the nova of 5 B.C. might be a pulsar was based on the analogy of a previous identification of Nova 4 B.C. as pulsar PSR 1929+10. This identification was subsequently disproved when it could be ascertained that the age of the pulsar is much greater than the time elapsed since the appearance of the nova. A pulsar identification would have meant that the Christmas Star was a supernova, provided both that the positional coincidence of the two objects could be substantiated and that the age of the pulsar was consistent with the time of the supernova explosion. Unfortunately I have been unable to confirm such a conclusion for the nova of 5 B.C.

In Figure 3 I have plotted on a Norton Star Atlas chart the path of Venus from January 17 to March 1, 6 B.C. (Tuckerman 1962); all the novae (open circles) listed in the GCVS and its Supplements (Kukarkin et al. 1971; 1976), including all those known through 1975; and all the pulsars (squares) listed by Manchester and Taylor in their catalogue (1981). The positions tabulated in the GCVS for "Ancient and Medieval Supernovae and Novae" (of which 15 occur in the area of Figure 3) are given only to the nearest hour of R.A. and 5° of Dec. However, descriptions of the Chinese-named constellations in which the novae flared, configurations differing from those in current Western usage, enable us to plot some of them slightly more accurately. In particular, Nova 5 B.C. is tabulated at 20<sup>h</sup> -20°, but the constellation Chhien-Niu in which it appeared includes  $\alpha$ ,  $\beta$ ,  $\xi$ ,  $\pi$ ,  $\rho$ , and  $\circ$  Cap, an area defined by the oval within the dashed line with center close to Cap. This oval represents the range of uncertainty in the position of the object seen in 5 B.C.. The 4 B.C. object is described simply as near Altair; but for the one in Aquarius in 532 B.C., the area of the Chinese constellation Hsu-Nu, including  $\epsilon$ ,  $\mu$ ,  $\zeta$ , and  $\delta$  Aqr, is comparable with that for Nova 5 B.C. (Yoke 1962). The more modern novae, some 60 in number within the area of Figure 3, have relatively unambiguous positions, as do the pulsars.

The number of coincidences between novae and pulsars is not impressive, which is not surprising since remnants of ordinary novae are not pulsars. The one known supernova in this part of the sky appeared in 1962 in the distant galaxy NGC 6835; it is represented by the star in Figure 3, to the right of the 5 B.C. object. The pulsars nearest to SN 1962 and the 5 B.C. object are too far separated to be considered.

Manchester and Taylor (1981) give ages for nearly all of the pulsars. To match the Star of Bethlehem the age of the pulsar should be approximately 2000 years. Except for the Crab Nebula pulsar at about 1200 years, all the other pulsars among the 330 in their catalogue are considered older than 10,000 years.

The compilation for Figure 3 yielded some extraneous items of interest. Could the object of 5 B.C. possibly be a recurrent nova? The same, but equally uncertain, position is given for the novae recorded in 131 A.D. and 588 A.D.. If Ponticus Aquila (who translated the Old Testament into Greek, in about 130 A.D.) is responsible for the painting, would he have observed the nova of 131 A.D. and based the painting on it? Similarly, the novae of 154 A.D. and 1661 A.D. share the uncertain position of nova 532 B.C.. The object near Altair in 4 B.C. has already been suspected (and rejected, GCVS) as being the recurrent nova V500 Aql 1943. In the Chinese constellation Nan-Tau the GCVS lists six objects seen between 48 B.C. and 1415 A.D.; however, this constellation, comprising more than the area of the "Milk Dipper" in Sagittarius, is too large and the area too rich in novae to warrant any speculation on possible coincidence.

### 3. Conclusion

If indeed the painting in the Priscilla catacomb represents a valid observation of the "Star of Bethlehem," then this definitely rules out its identification with the 7 B.C. conjunction of Jupiter and Saturn. It would also rule out the interesting conjecture (Banos 1980) that the Christmas Star was an early discovery of Uranus, which would have been in Pisces in 6 B.C. It leaves open the possibility that the "star" was either the planet Venus seen in 6 B.C., or more likely the object (probably a nova, possibly but less likely a comet) seen in Capricornus in 5 B.C.. It is unlikely that the star was a supernova with a pulsar remnant, as all of the pulsars in the relevant part of the sky are more than five times too old to be the possible remnant of the Christmas star.

I wish to thank Carolyn Murphy Beehler for permission to use her photograph and map (Figures 1 and 2) and for stimulating discussions.

#### REFERENCES

- Armstrong, H. L. 1978, Quart. Journ. Roy. Astron. Soc. **19**, 359.
- Banos, G. 1980, Astron. Quart. **3**, 165.
- Beehler, C. M. 1980, Archaeoastronomy **3**, No. 3, 14.
- \_\_\_\_\_ 1980, Smithsonian **11**, 158.
- \_\_\_\_\_ 1980, A. D. **9**, Dec., 24.
- Clark, D. H., Parkinson, J. H., and Stephenson, F. R. 1977, Quart. Journ. Roy. Astron. Soc. **18**, 443.
- Cullen, C. 1979, Quart. Journ. Roy. Astron. Soc. **20**, 153.
- Hughes, D. W. 1976, Nature **264**, 513.
- Kukarkin, B. V. et al. 1971, General Catalogue of Variable Stars, **III**, 19-73, 3rd Edition, Moscow.
- \_\_\_\_\_ 1971, First Supplement to General Catalogue of Variable Stars, Moscow.
- \_\_\_\_\_ 1974, Second Supplement to General Catalogue of Variable Stars, Moscow.

- \_\_\_\_\_ 1976, Third Supplement to General Catalogue of Variable Stars, Moscow.
- Manchester, R. N. and Taylor, J. H. 1981, Astron. Journ. 86, 1953.
- Stephenson, F. R. 1976, Quart. Journ. Roy. Astron. Soc. 17, 121.
- Trimble, V. 1980, Archaeoastronomy 3, No. 3, 26.
- Tuckerman, B. 1962, Mem. Amer. Philosoph. Soc. Philadelphia 56.
- Yoke Ho Peng. 1962, Vistas in Astron. 5, 127.

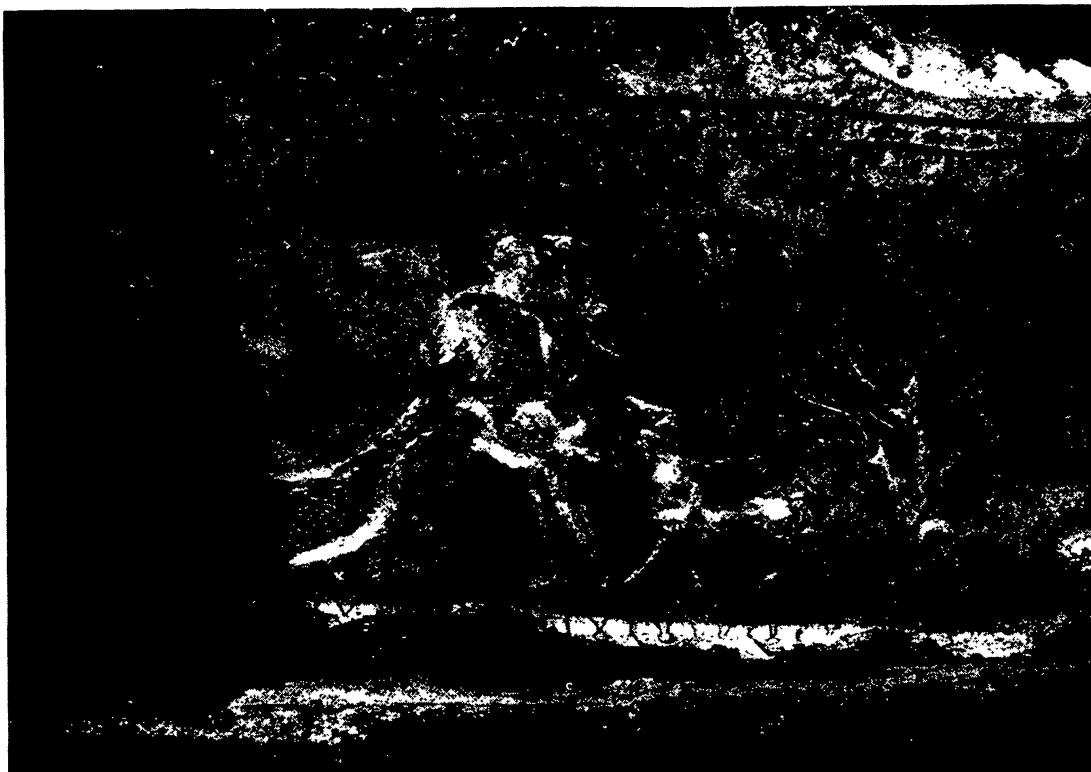


Figure 1. The Priscilla Catacomb painting.

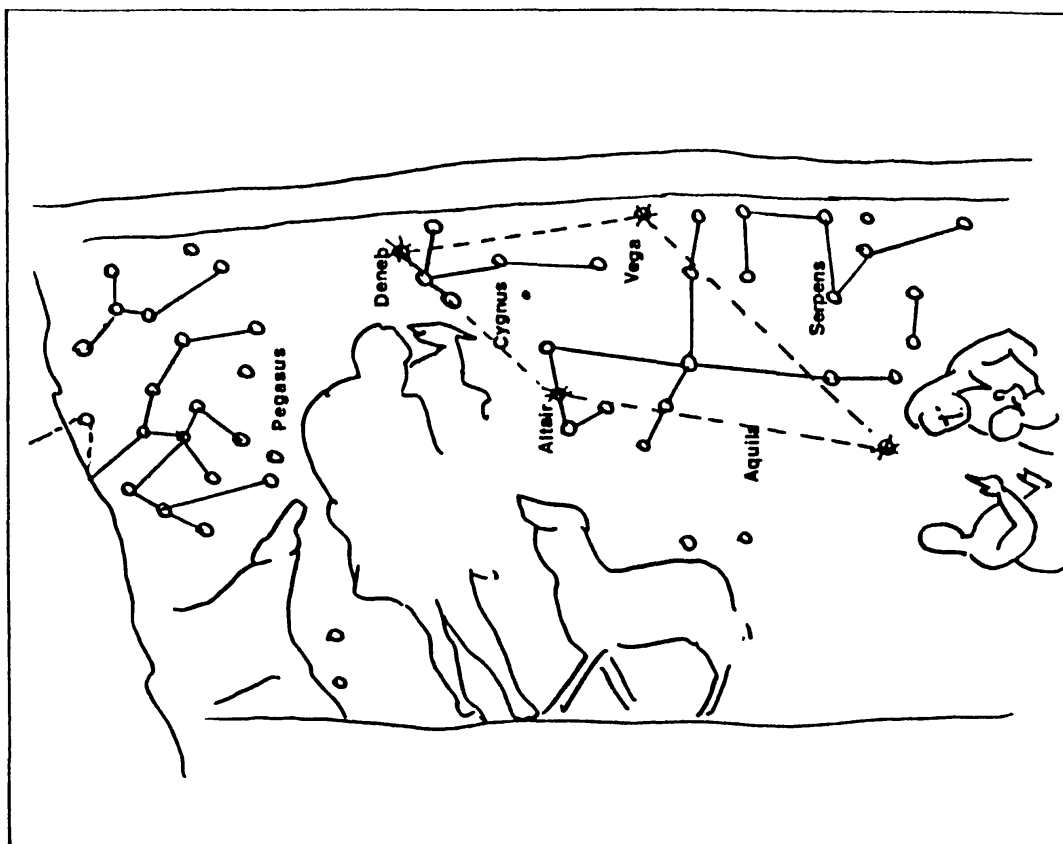


Figure 2. Mrs. Beehler's interpretation of the constellations.

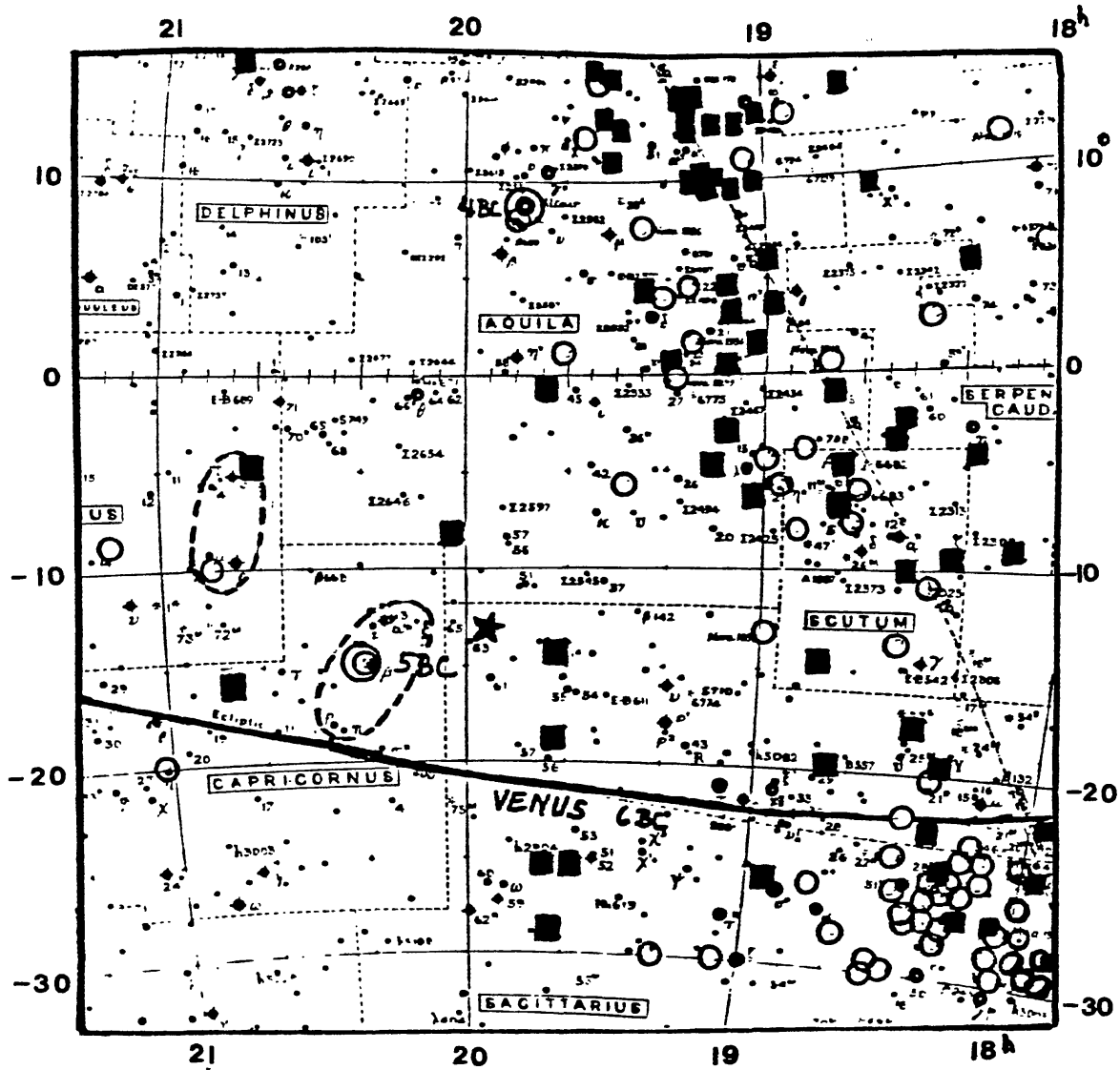


Figure 3. The distribution of novae (open circles) and pulsars (squares) in the general area of sky in which the "Christmas Star" probably occurred. The two larger circles indicate the objects of 4 B.C. (near Altair) and 5 B.C., recorded in Chinese and Korean sources at times closest to that of Christ's birth. The two areas bounded by dashed lines show the probable range in uncertainty of the positions given in the Chinese records for the objects of 5 B.C. and 532 B.C.. The object represented by the star is the supernova of 1962 in NGC 6835. The path of Venus in 6 B.C. is also shown, as Venus has often been cited as a possible candidate for the Christmas Star.