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AN INTERPRETATION OF HISTORICAL RECORDS OF AURORAE AND METEORS IN CHINA DURING THE 11TH AND 12TH CENTURIES A.D.: POSSIBLE INDICATIONS OF ACCRETION OF INTERSTELLAR MEDIUM?

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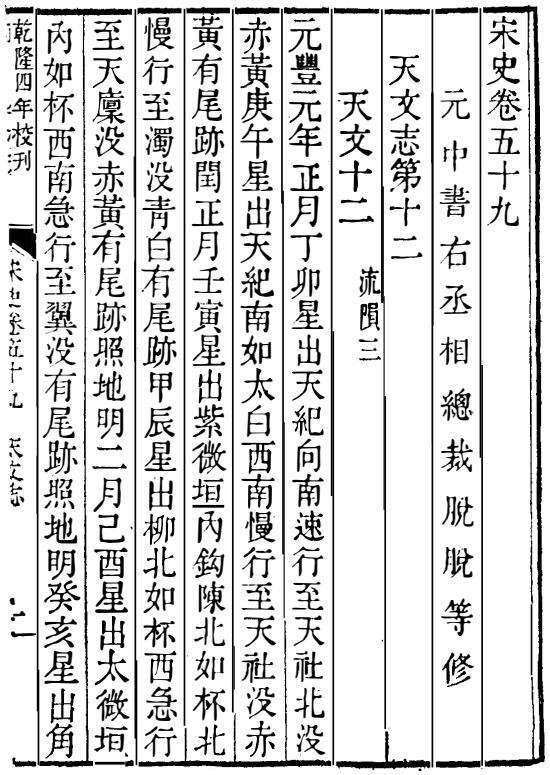
Abstract: More than 5000 meteors were recorded in ancient Chinese chronicles. The frequency of meteor sighting shows an anomalous increase during the 11th century A.D. This seems to be consistent with the inference that the solar system encountered a small molecular cloud, although KEIMATSU *et al.* (J. Geomagn. Geoelectr., **20**, 45, 1968) suggested that the geomagnetic dipole axis could have been inclined towards China around the 11th century based on historical records of aurorae and sunspots.

1. Introduction

One of the authors (MIONO, 1991) recently suggested that the solar system encountered an interstellar molecular cloud around the time of the Jurassic-Triassic boundary. Similar evidences were also found in the lunar soil (LINDSAY and SRNKA, 1975) and in archives of astronomical phenomena in China. The "Table of historical records of astronomical phenomena in China" compiled and published in 1988 by the Beijing Observatory, contains detailed records about sunspots, novae, comets, aurorae, meteors, and solar and lunar eclipses. Studies of solar activity using Chinese records have been extensively carried out (*e.g.*, CLARK and STEPHENSON, 1978; EDDY *et al.*, 1989), and especially many authors (*e.g.*, YU *et al.*, 1983) have endeavored in particular to find the periodicity in astronomical phenomena. In the present paper, we point out the possible presence of an accretional event in the solar system based on the frequency of aurorae and meteors during the 11th and 12th centuries A.D.

2. Records of Meteors and Aurorae during the Sung Dynasty

The Sung dynasty was established in A.D. 960 and lasted until A.D. 1127, when Qui Kang Tzu Bian (the greatest tragedy in Chinese history) occurred, and the capital was transferred to the south. The southern Sung dynasty continued until an invasion by the Mongolian Yuan dynasty in A.D. 1279. The Sung-Shih, a historical chronicle was compiled by the Yuan dynasty. These annals were written like an official gazette, and also compiled a series of biographies written like


宋史卷五十九
元中書右丞相總裁脫脫等修
天文志第十二
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赤黃庚午星出天紀南如太白西南慢行至天社沒赤
黃有尾跡閏正月壬寅星出紫微垣內鉤陳北如杯北
慢行至濁沒青白有尾跡甲辰星出柳北如杯西急行
至天廩沒赤黃有尾跡照地明二月己酉星出太微垣
內如杯西南急行至翼沒有尾跡照地明癸亥星出角
乾隆四年校刊

Fig. 1. From the Sung-Shih, a Sung dynasty (A.D. 960–1279) historical chronicle. A great number of meteors were recorded in the Tien-Wen-Chih chapters 48–60.
"In January 1078, Ding-Mao, a star emerged in Tien-Ji. It travelled south rapidly and vanished north of Tien-She. Its color was reddish yellow..."

personal histories. Tien-Wen-Chih (astronomical treatises) are contained in chapters 48–60, and a great number of meteors are recorded (Fig. 1). Figure 2a shows the frequency distribution of meteor sighting by decade during the Sung dynasty (A.D. 960–1279). Figure 2b shows a similar chart for aurorae during the same period. The main features of Figs. 2a and b can be summarized as follows:

1) The frequency of meteors significantly increases in the period around A.D. 1000.

2) The frequency of aurorae gradually increases about 50 years later. This tendency is similar to the records for sunspots and solar haloes, as shown in Figs. 3a and b, respectively.

3. Accretion of Interstellar Medium by the Solar System

It was suggested by MCCREA (1975) and YABUSHITA (1989) that the solar system encountered an interstellar gas cloud in the past. Recent mm radio observations have revealed the existence of such molecular gas clouds in interstellar space (GRABELSKY *et al.*, 1988). When the sun passes through a dense region of interstellar medium, increased solar activity is a plausible result. Based on the evidence of a large number of meteor sightings and a subsequent increase in solar activity, the possibility that the solar system encountered a small molecular cloud can be strongly inferred.

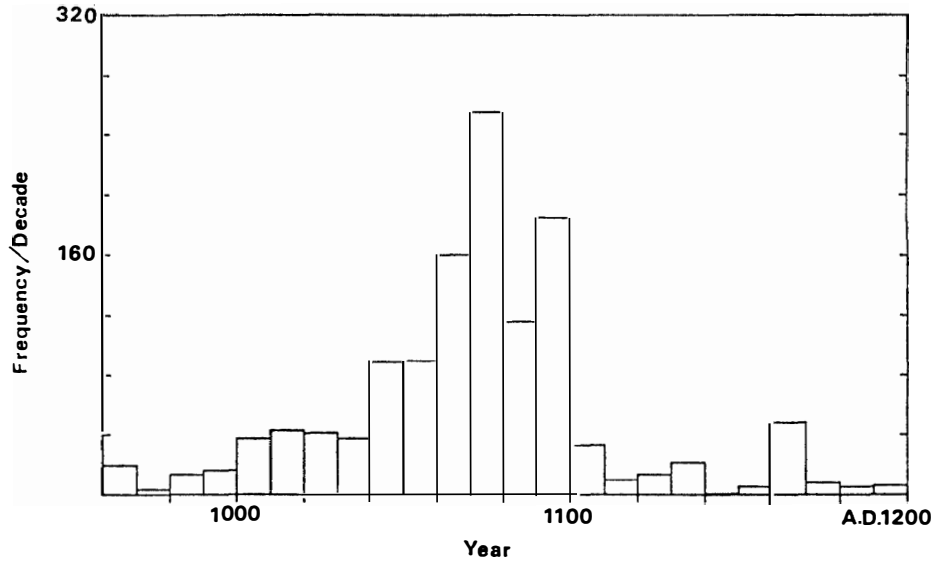

Fig. 2a. Decade distribution of meteors during the Sung dynasty (11–12th centuries).

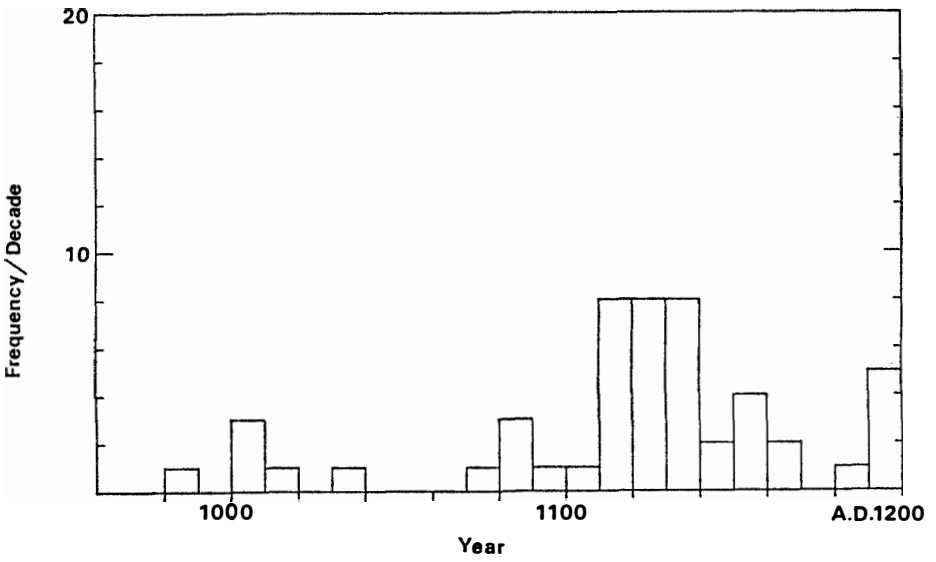

Fig. 2b. Decade distribution of aurorae. The frequency peak appears about 50 years after the meteor peak in Fig. 2a.

4. Discussions

F. R. STEPHENSON (1990) of Durham University, while analyzing astronomical records from the 11–12th centuries A.D., pointed out a change in attitude to celestial portents and varying degrees of preservation of observer's reports. However, we were not able to detect any evidence of a change in attitude to celestial portents. Moreover, K'e-Hsing (guest stars) of A.D. 1006, 1054, and 1182 in nine well known historical supernovae were fully recorded. The accounts of these phenomena in the Sung-Shih are correct and faithful with no embellishments. Also no distinct peak

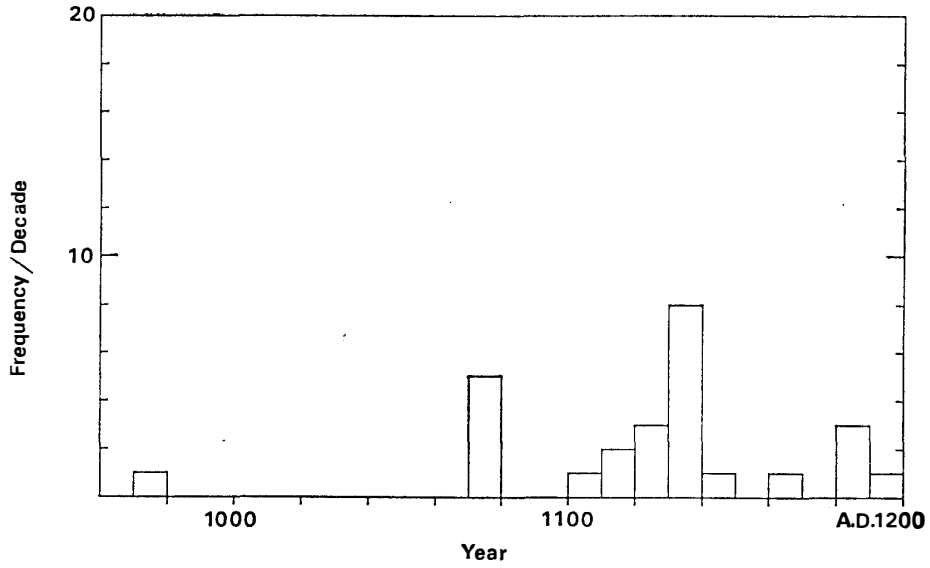

Fig. 3a. Decade distribution of sunspots.

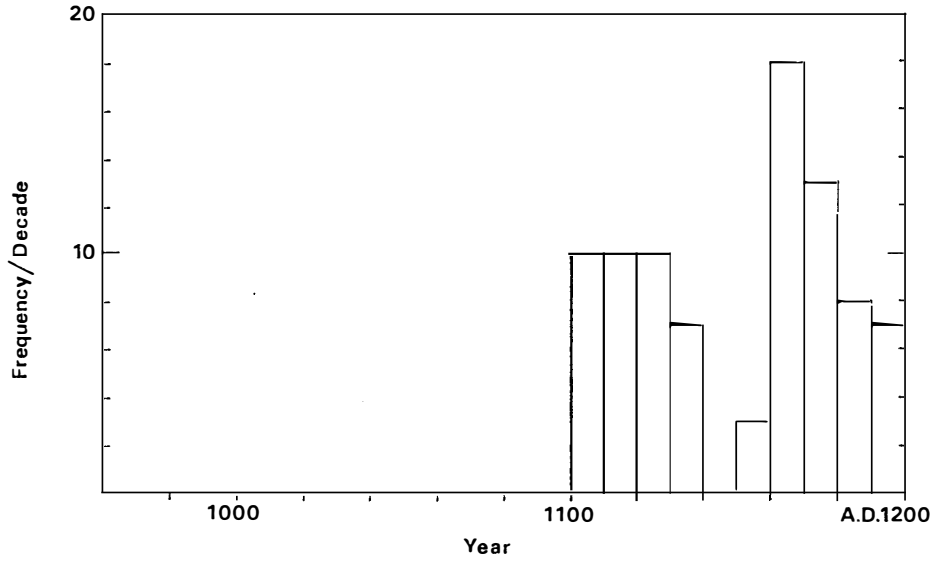

Fig. 3b. Decade distribution of solar haloes. This figure is modified after YAU (1988).

in the frequency of comets during the same period is detected, as shown in Fig. 4. This clearly shows that the meteor peak around A.D. 1000 was not caused by comets.

The criteria for meteors and aurorae are complicated, and the Tien-Kau (celestial dog) and Wang-Shi (bent arrow) are especially difficult to classify. For example, KEIMATSU *et al.* (1968) classified them as aurorae but the Beijin Observatory classified them as meteors. Nevertheless, when the entire record is considered, the variation amounts to only a few percent. The important point is that a lot of extraordinary phenomena occurred in the celestial environment during the 11–12th centuries A.D. and were recorded, although there is still no definitive classification.

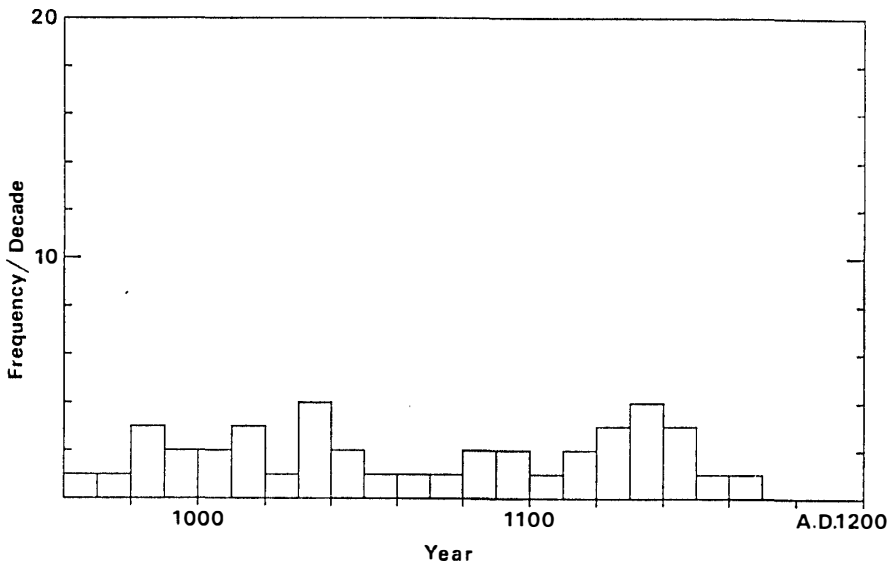

Fig. 4. Decade distribution of comets.

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