THE ABNORMAL PERIODS OF CLIMATE IN CHINA OVER THE PAST 5000 YEARS AND THEIR CAUSES

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ABSTRACT

This paper points out that (1) there were 5 abnormal periods of climate in China over the last 1000 years, in which the frequency, the severity and the influenced area of such calamities as low temperature, drought and flood increased greatly; (2) there were 3 or 4 worse periods of climate over the past 5000 years which were more severe than the above-mentioned climate; (3) the momental effect of the geocentric synods of nine planets is one of the important causes for the formation of the abnormal and worse periods of climate; and (4) from the 1960s to about 2000 A.D. China and the entire Northern Hemisphere would probably undergo another abnormal period of climate.

Historical data have indicated that climatic calamities tend to concentrate in certain historical periods, in which the frequency, the severity and the influenced area of such calamities as low temperature, drought and flood increase greatly. The study of the characteristics of these abnormal periods of climate and the causes of their formation is of importance for the economic activities as well as for the decrease in calamitous losses. In this paper, the abnormal periods of climate in the history of China and their relationship with the astronomic background are analysed.

I. ABNORMAL PERIODS OF CLIMATE OVER THE PAST 1000 YEARS

According to the phenological temperature curve (Fig. 1a) made by Zhu Kezhen (1973), from 1000 A.D to the middle of this century, China underwent 5 periods of low temperature, i.e., the first half of the 12th century; the beginning of the 14th century; the late 15th century; the middle of the 17th century; and the 19th century, which coincide roughly with the low-temperature periods indicated by the growth-ring index of Qilian Mountain Juniper (Sabina Prezewalsii Kom) (Liu et al., 1984) (Fig. 1b) and the winter-temperature index for the lower reaches of the Changjiang River (Zhang et al., 1981) (Fig. 1c). During these abnormal periods of climate, there were many cold winters with severe freezing disasters, and other climatic calamities were also serious. The number of counties suffering from drought over the last 500 years (Fig. 1d) reached its maximum in the last two of those low-temperature periods. Before these, two most serious droughts happened in 1129 A.D. (Shandong) and 1483 A.D., (Shanxi), just coinciding with additional periods of low temperature. Of the four catastrophic floods of the Huanghe River occurring in 1482, 1662, 1761 and 1843 A.D., all within the last 500 years, three appeared in the periods of low temperature with the only exception of 1761 A.D., Three extremely catastrophic floods of the

Changjiang River occurred in the last 1000 years: 1153, 1368 and 1870 A.D., all corresponding with low-temperature periods. The peak values of frequency curve of dust-rain year in China (Zhang, 1984) (Fig. 1f), which had large volume of dust falls in the atmosphere, also coincided with the relevant periods of low temperature.

It follows that the various climatic calamities during the five periods mentioned above were characteristic of cluster, and they tended to be the severest winter or the biggest flood or drought in a century. Such a period can be defined as an abnormal period of climate. From the freezing years of the Changjiang River valley (Fig. 2), one can see that an abnormal period of climate usually lasts for 30 to 50 years, the interval between these periods being about 140 to 180 years. During the abnormal periods of climate, other natural calamities such as strong earthquakes in North China, Yunnan and Sichuan (Ren, 1985) (Fig. 1g) were severe, too. Most of the periods of low temperature indicated by the O^{18} in Greenland (Fig. 1h) coincided with the abnormal periods of climate in China, suggesting that the climate in the Northern Hemisphere as a whole might likewise be abnormal in those periods.

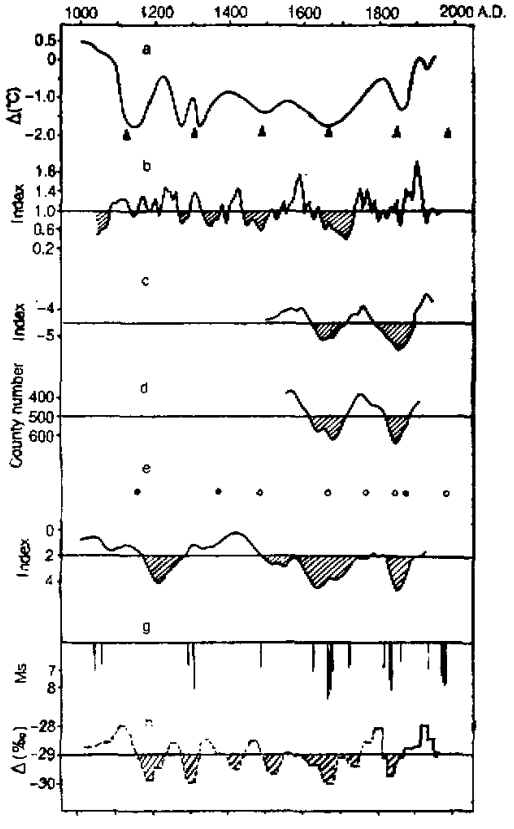

Fig. 1. The climatic changes over the past 1000 years.
a—the phenological temperature in China;
▲, the planetary synods in the winter half of a year;
b—the growth ring index of Qilian Mountain Juniper;
c—the winter temperature index at the lower reaches of the Changjiang River;
d—the number of counties suffering from droughts;
e—O, the catastrophic floods of the Huanghe River;
●, the exceptionally catastrophic floods of the Changjiang River;
f—the frequency curve of dust-rain year in China;
g—the strong earthquakes in North China, Yunnan and Sichuan;
h—the temperature curve obtained from the O^{18} content of glaciers in Greenland.
b, c, d and f are all running means values.

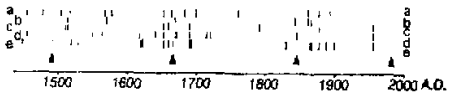

Fig. 2. The freezing years of three lakes in the Changjiang River valley, the Hanshui River and the Huaihe River from 1440 to 1956 A.D.
a—Taihu Lake;
b—poyang Lake;
c—Dongting Lake;
d—the Huaihe River;
e—the Hanshui River.

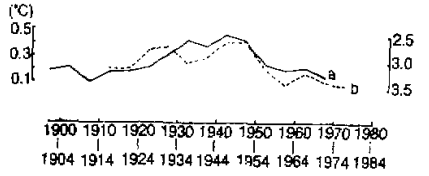

Fig. 3. Average temperature over the whole earth and China since 1900 A.D.
a—over the whole earth;
b—over China (the grades of temperature).

According to the geocentric synods of nine planets it was predicted (Ren and Li, 1980) that, from the 1960s to about 2000 A.D., China and the entire Northern Hemisphere would probably undergo a period of low temperature, in which natural calamities would occur more frequently. Since the 1960s, the temperature has markedly dropped in China (Zhang and Zhang, 1979) (Fig. 3b). The freeze damage to rubber and the damage due to low temperature in summer in Northeast China are increasingly severe. The record floods in a century occurred in the upper reaches of the Huanghe River in 1981 and the Huaihe River in 1975. Also floods occurred in the case of Changjiang River in 1980, 1981 and 1983. Droughts appeared in successive years in the northern part of North China. North and Southwest China is undergoing a period of active earthquakes (Fig. 1g). The global average temperature decreased markedly in the 1960s (Fig. 3a), and decreased once more in 1983 although it went up in the 1970s. The lowest temperature in a century appeared in North Europe in the winter of 1984. After the severe drought in 1972, a more serious one appeared in Sahara, Africa, which caused 150 million victims. In short, it might be considered that the climate in China and even in the entire Northern Hemisphere over the past 25 years has been in a new abnormal period. The temperature has not reached the minimum that appeared in the 19th century, probably due to the fact that the atmosphere has been warmed by the increasing CO_2 content.

II. THE WORSE PERIODS OF CLIMATE OVER THE PAST 5000 YEARS

Over the past 5000 years, there have been 3 or 4 periods of climate more severe than the above-mentioned climate.

1. *The Worse Period of Climate in the 17th Century*

Many researches have shown that the period of climate in the 17th century is the worst of climate in the Northern Hemisphere as well as in China over the past 3000 years. In this period, Little Ice Age appeared in Europe and the snow line in Norway reached its lowest value for the past 5000 years. The global average temperature was about 2°C lower than that in the 1950s. In the same period, there were most frequent and severe winter (Zhu, 1973), extremely catastrophic drought (1637—1641), biggest flood in the Huanghe

River valley in 1662, and a few severe earthquakes in 1654, 1668, 1679 and 1695 (earthquake magnitude $M_s \geqslant 8$) in China (Ren, 1985).

2. *The Worse Period of Climate around 2000 B. C.*

There were no archaeological data in the study of Zhu Kezhen (1973). According to the calculations for the planetary synods, it was pointed out (Ren and Li, 1980) that "there should be a period of low temperature about 4000 years ago". Nowadays, more and more archaeological data show that there was indeed a period of low temperature and worse climate 4000 years ago. An analysis of the spore in Shanghai area shows that the average temperature during that period was 1—2°C lower than that of the present time, and 3—5°C lower than that of 5500 years ago (Wang et al., 1978) (Fig. 4). The ruins of animals in Xichuan County, Henan Province showed that there was a cooling tendency at the time a little earlier than 2000 B.C. (Jia and Zhang, 1977). About 4000 years ago, in the geological section in the western part of Netherlands there was a layer of peats (Jelgersma, 1961) (Fig. 5).

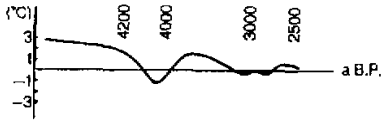

Fig. 4. The climatic changes in Shanghai from 5460 (±110) to 2500 years ago. 0°C—the temperature of the present age.

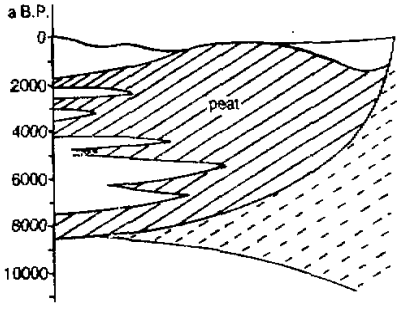

Fig. 5. Schematical section in the western part of Netherlands.

The sea-level in Florida, U.S.A. was 2 m lower than the present (Fairbridge, 1961) (Fig. 6), and the rate of carbonate deposition in the Atlantic Ocean had a significant low value (Wiseman, 1966) (Fig. 7). All these show that the climate at that time was in a cold period. The frequency of radioactive carbons in Sahara, Africa (Lamb, 1977) (Fig. 8) shows a dry period about 4200 years ago when the grassland changed into desert (Hare, 1979). The climate in Tal Desert of India had changed into aridity from damp since 2000 B.C. (Bryson and Murray, 1977). In 1831 B.C., a strong earthquake was recorded in China for the first time. Around 2000 B.C., several strong earthquakes, which were severely destructive, occurred in Greece, Egypt, west Tukuman of the Soviet Union and the Indus River valley (Ren, 1984). Thus the evidence for the worse period of climate around 2000 B. C. is ample. Its severity was at least the same as that in the 17th century.

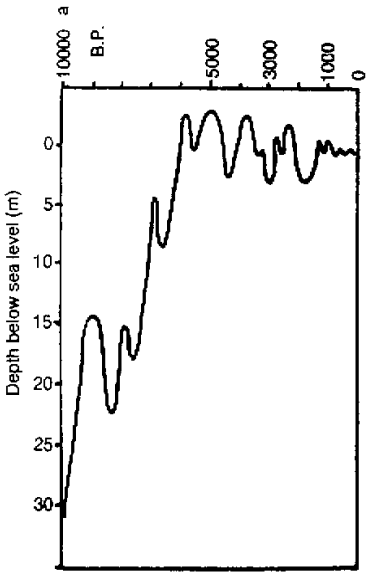

Fig. 6. Curve of sea-level changes.
A—Australia;
NZ—New Zealand;
Alg—Algeria;
NY—New York;
FL—Florida;
OR—Oregon;
MR—Morocco.

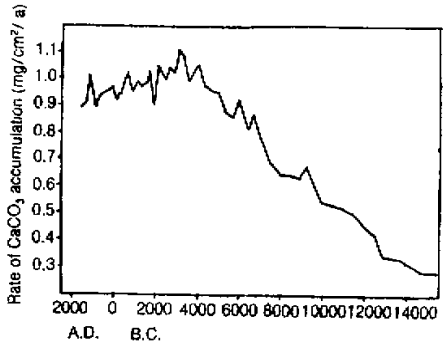

Fig. 7. The changing rates of $CaCO_3$ ($mg \cdot cm^{-2} \cdot yr^{-1}$) deposition of an Equatorial Atlantic gravity core. 1°10′N,19°50′W, 4350 m.

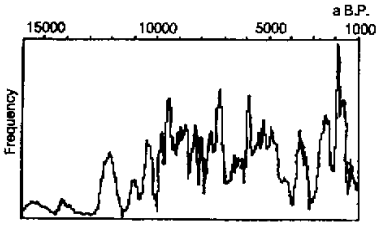

Fig. 8. Frequency distribution of radiocarbons from 16000 to 1000 years ago for North Africa 15—30°N,5°W–30°E, taken as an indicator for the amount of moisture available to produce organic material.

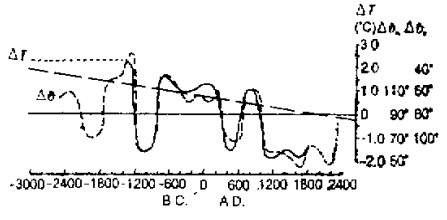

Fig. 9. The coinciding curves of the subtending angles of planetary synods and temperature fluctuations in China over the past 5000 years.
——curve of the temperature fluctuations in the past 5000 years;
----curve of the subtending angles of planetary synods;
- · -slope correction of long term climatic changes.

3. *The Worse Period of Climate around* 1000 *B. C.*

In this period, there was a period of cold climate in China, too (Fig. 9). The

catastrophic flood of the Changjiang River occurred from 966 to 948 B.C. and a strong earthguake in Hewei in 1129 B. C.. The sea-level in New York, USA was lower in the cold period (Fig. 6). A dry period appeared once again in Sahara, Africa (Fig. 8).

In addition, another abnormal period of climate appeared in the 5th century. But it might not be as bad as those periods mentioned above. In this period, there was still a period of low temperature in China (Fig. 9). An extremely catastrophic flood of the Changjiang River occurred in 399 A. D.. A strong earthquake (M_s 7.5) in Shanxi occurred in 512 A.D.. Around this period, the sea-level of the Netherlands, Oregon and Florida U.S.A (Fig. 5—6) was lower.

It can be concluded that the calamities occurring in the worse periods of climate were worse than those in the abnormal periods of climate. The interval between two worse periods is at least 1100 years. The average temperature in the worse period is about 2°C lower than that in the 1950s.

III. DISCUSSIONS ON THE ASTRONOMICAL CAUSES

The earth's atmosphere is an open system. Should the energy from the solar radiation and earth rotation be cut off, the internal energy of the earth's atmosphere would be exhausted in only a week. In the discussions of causes for the formation of the abnormal and worse periods of climate, the changes of astronomic background must be considered. It is now well known that the formation of ice ages, with a cycle of about 100,000 years for each is due to the changes of the earth's orbital parameters which change the total incoming solar radiation, in addition to the feedback from the earth surface. We have found that (Ren and Li, 1980), over the past 5000 years, the temperature fluctuations in China coincide quite well with the season of planetary synods and the subtending angles in a geocentric coordinates (Fig. 9). Its physical implication is that the geocentric synods of the nine planets change the duration of winter and summer of the earth, lead to the difference of total solar radiation in the Northern Hemisphere. It is noted that the direct effect of planetary synods is the momental effect rather than the gravitational perturbation or tide-forming force. The planetary gravitation effect is very small, but its momental effect is very large. The nine planets including the earth revolve all around the mass centre of the solar system (not the solar centre). Following the definition of mass centre

$$M_{\odot} R_B = M_n (Y_n - R_B), \tag{1}$$

we have

$$R_B = \frac{1}{M_{\odot} + \sum M_n} \sum M_n \vec{Y}_n \cdot \vec{R}_B / |\vec{R}_B|, \tag{2}$$

where $M_{\odot}$ and M_n are the masses of the sun and the planets respectively; R_B and Y_n are respectively the distances from the solar centre to the mass centre of the solar system and to the planets. It follows that the longer Y_n is, the larger R_B will be. According to (2). the momental effect of planetary synods makes the distance from the solar centre to the mass centre of the solar system reach a maximum of 1.5×10^6km. This is equal to 1% of the distance from the sun to the earth. When the planetary synod occurs in the winter half of the year (i. e., the earth is alone on one side of the sun and the others are on the other side), the radius of the earth orbit would increase by about 1%. Immediately, the revolution of the earth would decelerate and the winter half of the year would be longer. In the summer half of the year the radius of the earth orbit would decrease by about 1%,

because the revolution speed of giant planets is very low, and so the revolution of the earth would accelerate and the summer half of the year would be shorter. The total effect over several years (in the years before and after the planetary synods, the subtending angles are generally smaller) would result in a general tendency that the climate in the Northern Hemisphere gets colder. Moreover, in the years before and after the synods of nine planets, the effect of non-classical gravitation at three celestial bodies (the earth, the planet and the moon or the sun along a line) (Ren, 1982) sometimes is very intensive. When it satisfies specific combination, there might be more chances to trigger the occurrence of calamitous weather.

The synod of nine planets is a rare phenomenon. It appears even more hardly in the winter half of a year, or when the subtending angles are not larger than 70° to the earth. Over the past 5000 years, there have been only 13 times when the planetary synods happened under the above conditions (Table 1). Except the one in 631 A.D., whose climate state has not been known, all the other 12 took place with corresponding abnormal periods of climate. Among them, there were 5 times when the subtending angles were not larger than 47° (1953, 1774, 1099, 918 B. C. and 1665 A. D.), all coinciding with worse periods of climate. It may be seen that, over the past 5000 years, there is a close relationship between the parameters of the planetary synod and the abnormal periods or the worse periods of climate.

According to the calculation for the planetary synods and angles, we have inferred (Ren and Li, 1980) that there was a period of low temperature about 4000 years ago and the present climate is in a period in which the calamities occur frequently. This inference has been confirmed. On the basis of the fact that the catastrophic flood of the Huanghe River occurred in 1 to 3 years before planetary synods, we had prophesied that there was a

Table 1. The Synods of Nine Planets Appearing in Winter Half of the Year and at the Subtending Angles to the Earth not Larger Than 70° since 2900 B.C.

Date of Synod	Angles to the Earth	Season of Synod	Warm or Cold in History
−2133, Dec. 26	58°	W	c
−1953, Jan. 30	40	W	c
−1774, Feb. 28	47	W	c
−1099, Mar. 3	34	W	c
−918, Mar. 21	40	W	c
450, Sept. 25	69	W	c
631, Oct. 26	60	W	uncertain
1126, Sept. 21	52	W	c
1304, Oct. 21	54	W	c
1483, Nov. 16	51	W	c
1665, Jan. 6	43	W	c
1844, Jan. 24	63	W	c
1982, Nov. 2	68	W	

posibility that a catastrophic flood of the Huanghe River might occur from 1980 to 1981, especially in 1981. Indeed, a catastrophic flood occurred in the upper reaches of the Huanghe River in 1981.

The momental effect of planetary synod depends on the season of its occurrence, so that its effect on the climatic tendency of the Southern Hemisphere must be contrary to the Northern Hemisphere. It has to be proved further.

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