

Meteorological Records from Ancient Chronicles of China

Pao-Kuan Wang

Department of Atmospheric Sciences
University of California at Los Angeles
Los Angeles, Calif. 90024

Abstract

Meteorological records extracted from three ancient Chinese chronicles are presented. These records cover a time span from 2187 B.C. to 3 A.D. Some interesting climatological variations are noted.

1. Introduction

Meteorological and astronomical phenomena have attracted the attention of men throughout their history. In particular, thunder and lightning, hail, strong winds, and periods of drought and floods were watched and recorded with great interest. Being unable to understand these phenomena, men in prehistoric times assumed that supernatural forces of their gods must have caused them. It is therefore not surprising that ancient religious books contain numerous records of meteorological and astronomical events.

In most books on the history of meteorology (Frisinger, 1977; Khrgian, 1970; Middleton, 1965; Schneider-Carius, 1955; among others) reference to such ancient records is confined to writings of the Greeks, the Israelites, the Romans, the Egyptians, and the Persians. Little attention has been given to the ancient records of the Chinese, except for a short summary paragraph given by Khrgian (1970). It is the purpose of this short article to add to our knowledge of ancient Chinese weather observations by listing some weather records for the time 2187 B.C. to 3 A.D. as found in three ancient Chinese Chronicles, in the hope that these records may be of use to the historically interested meteorologist, and in particular to the climatologist.

It is not hard to understand why meteorological as well as astronomical events were cited in historical chronicles if one recalls that in ancient China the emperors were considered *Sons of God*. Therefore, only God himself can condemn and punish the Emperor (and along with him his subjects) in case he did evil and did not obey Him. Obviously, thunder, lightning, or the appearance of a comet were signs that God was irritated, and hail, floods, or droughts were expressions of God's punishment. These acts of punishment were carefully recorded as historically important events.

Unfortunately, these Chronicles were written in ancient Chinese grammar which is not used anymore in present-day Chinese language. Due to their grammar the chronicles are extremely difficult to read, and their contents are only accessible to language experts, most of

whom are not interested in the scientific records contained in the Chronicles.

Apart from records in ancient Chronicles, meteorological records are also found in the form of divine inscriptions on animal bones and tortoise shells. Often, these inscriptions are in the form of a question to the Gods, such as: "Will the God give much rain in the eighth month?" Other inscriptions are in the form of actual records, such as: "Rain from day Ting-Yu to the day Chia-Yin (18 days in the 9th month). Wittfogel (1940) analyzed numerous meteorological records on such "oracle bones," of the Shang dynasty (1751-1111 B.C.) and found that the records made numerous references to rain and snow periods, as well as periods of drought. From his analysis he found that during the time of the Shang dynasty the climate was warmer than it is at present. A similar conclusion was reached by Hu (1944) who also studied inscriptions dating from the Shang dynasty. Apart from basing his conclusion on direct meteorological observations during that time, Hu deduced indirectly what the climate was at that time by analyzing inscriptions referring to the cultivation of bamboo and rice, and to the presence of buffalos and elephants.

2. Remarks on the present listing of meteorological records

The records listed in Section 3 are extracted from the following three ancient Chinese Chronicles: *Chu Shu Chi Nien* (Bamboo Album); *Shih Chi* (The Book of History); and *Han Shu* (Chronicles of the Han Dynasty).

The first book was probably written around 300 B.C. by an anonymous author and originally consisted of engraved bamboo pieces bound together by ropes. The book was recovered from the grave of King Shian of Wei who died in 297 B.C. The other two books were written by Shih-Ma Chien (145-86 B.C.) and Pan Ku (32 to 92 A.D.), respectively. The cities, cited in these three records, were located almost entirely in Northern China. Since the names which these cities had are not in use

TABLE 1. Capital cities in China

1. Pu-Pan	2233-2183 B.C.
2. An-Yec	2183-1751 B.C.
3. Po	1751-1398 B.C.
4. Ying (Near (2))	1398-1111 B.C.
5. Hau (Chen-Chou)	1111-770 B.C.
6. Lo-Yang (Chen-Chou)	770-246 B.C.
7. Sian-Yang (near Si'an)	246-206 B.C.
8. Chan-An (Si'an)	206 B.C.-25 A.D.

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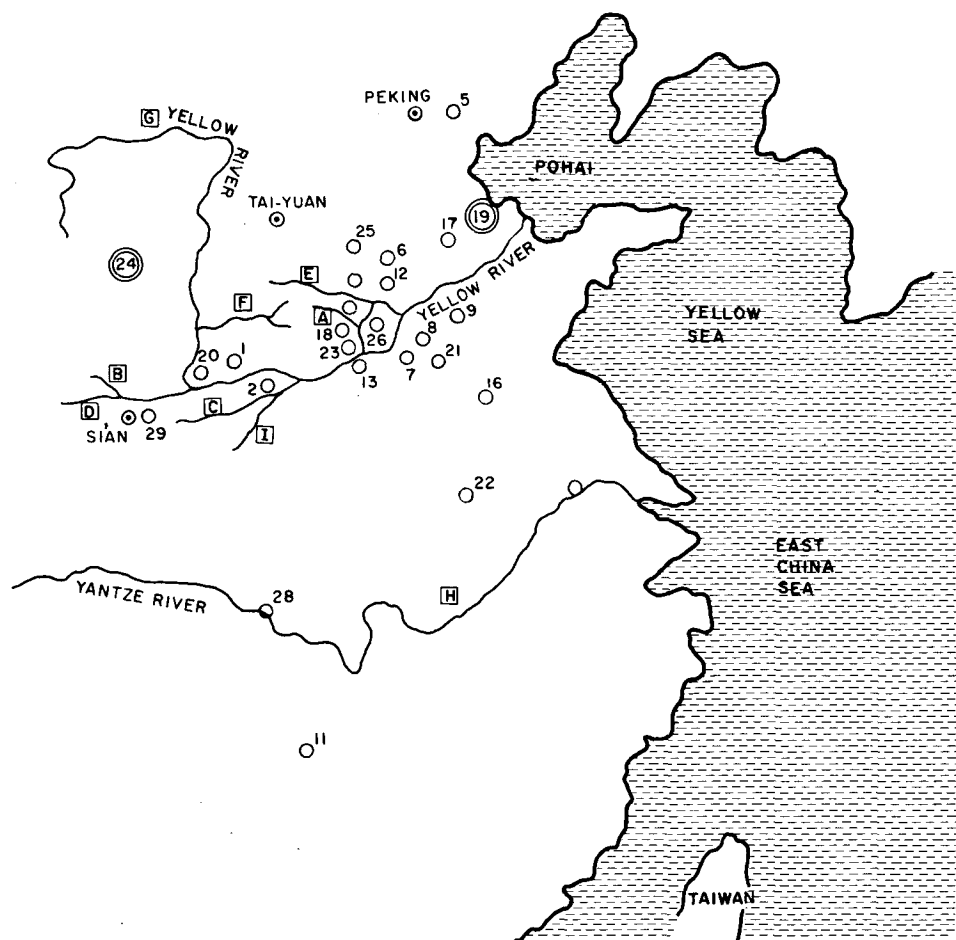


FIG. 1. Map of ancient cities and of rivers in China. Cities: (1) An-Yee, (2) Chen-Chou, (3) Chin-Ti, (4) Chian-Tu, (5) Chi, (6) Chin-Ho, (7) Chi-Yin, (8) Chu-Ye, (9) Chu-Fu, (10) Hu-Tze, (11) Hen-San, (12) Kuan-Tao, (13) Liang, (14) Min-Tiau, (15) Nan-Chun, (16) Pen-Chen, (17) Ping-Yuan, (18) Po, (19) Po-Hai, (20) Pu-Pan, (21) San-Yang, (22) Shou-Ch'un, (23) Suan-Chao, (24) San-Fu, (25) Shin-Tu, (26) Tong-Chun, (27) Yuan-Tu, (28) Yin, (29) Lan-Tien. Rivers: (A) Chi River, (B) Chin River, (C) Lo River, (D) Wei River, (E) Huan River, (F) Huci River, (G) Yellow River, (H) Yantz River, (I) Yee River.

any more, a map is given in Fig. 1, identifying the location and names. The capital cities for periods from 2233 B.C. to 25 A.D. are listed in Table 1.

All dates given in these Chinese Chronicles are given in terms of ancient Chinese calendars, which varied from dynasty to dynasty. In order to transform the Chinese calendar dates into dates based on the Roman calendar we followed the work of Tung (1960). Most of the Chinese calendar years consisted of 12 months. Thus, any Chinese calendar month referenced in the subsequent list of meteorological records corresponds to the same calendar month of the Roman calendar, with possible deviations of at the most 1 to 2 months.

In order to keep the records as original as possible all statements given in the following sections pertain to direct translation. Any interpretations of the data are left to the user.

It is noted from the following list that meteorological events of short duration and confined to relatively small areal extent are given as well as reference to extended

periods of drought and flood. Both types of events are of interest. Thus, records of dust falls with hints as to the type and shape of particles falling (13, 45, 82) are of interest to the aerosol physicist, records of hailstorms with indications as to the shape and size of hailstone falling (16, 17, 48, 109, 134, 148) are of interest to the cloud physicist, and records of thunderstorms with mention of the type of thunder and type of lightning observed at a particular time of the year are of interest to the specialist in atmospheric electricity and cloud physics.

Although duststorms, hailstorms, and thunderstorms are indeed events of short time duration and small areal extent, records pertaining to heavy rain and snow may be taken to indicate a wet season of relatively wide areal extent, and therefore of climatological importance, as in ancient times only events of great impact were noted. Records of drought pertain to widespread dryness of large areal extent, and therefore are climatologically highly significant. Also, records of floods generally per-

tain to widespread wetness of large areal extent (e.g., 33, 36-39, 54, 56, 60, 93). These events would not have been labelled as such if they were only caused by localized storms. In addition, many records pertaining to floods appeared crowded in time without mention of drought periods in between (e.g., 687-666 B.C., 185-180 B.C.) indicating long lasting wet periods of climatological significance. In fact, Wittfogel (1940) and Hu (1944) analyzed ancient Chinese records on heavy or continuous precipitation and compared these periods with paleontological records for the same time period. They found that the meteorological records indicating wet periods generally were well supported by the meteorological conditions implied by the paleontological records.

3. List of meteorological records

Emperior Shun

- 1) 47th year, winter. Frost. Plants were not killed. (2187 B.C.)

King Che of Hsia Dynasty

- 2) 10th year. Yee and Lo Rivers dried out. (1793 B.C.)
- 3) 31st year. (The army) fought at Min-Tiau during a severe thunderstorm. (1772 B.C.)

King Tan of Shan Dynasty

- 4) 19th year. Severe drought. (1733 B.C.)
- 5) 20th year. Severe drought. (1732 B.C.)
- 6) 21st year. Severe drought. (1731 B.C.)
- 7) 22nd year. Severe drought. (1730 B.C.)
- 8) 23rd year. Severe drought. (1729 B.C.)
- 9) 24th year. Severe drought. The King prayed at San-Lin, and then it started to rain. (1728 B.C.)

King Tai-Wu of Shan Dynasty

- 10) 46th year. Good Harvest. (1598 B.C.)

King Wu-Yee of Shan Dynasty

- 11) 3rd year. The King was hunting on Wei River. He was killed by a sudden thunder. (1224 B.C.)

King Wen-Tin of Shan Dynasty

- 12) 3rd year. Hen River dried out three times in a day. (1220 B.C.)

King Tsou of Shan Dynasty

- 13) 5th year. It precipitated dust in Po City (1170 B.C.)
- 14) 35th year. Severe famine in Chou area. (1140 B.C.)

King Chao of Chou Dynasty

- 15) 6th year, 12 month, winter. Peach and prune trees blossomed. (1036 B.C.)

King Hsiao of Chou Dynasty

- 16) 7th year, winter. Heavy hail killed cattle and horses. Yantz and Han Rivers were frozen. (948 B.C.)

King Yee of Chou Dynasty

- 17) 7th year, winter. Hail. The hailstones were as big as a knife-sharpener stone. (918 B.C.)
- 18) 14th year, (early part of year), severe drought; fall, severe drought again. (865 B.C.)

King Lee of Chou Dynasty

- 19) 22nd year. Severe drought (857 B.C.)

- 20) 23rd year. Severe drought. (856 B.C.)

- 21) 24th year. Severe drought. (855 B.C.)

- 22) 25th year. Severe drought. (854 B.C.)

- 23) 26th year. Severe drought. Duke Kong returned to his country, then it was raining heavily. (853 B.C.)

King Shuan of Chou Dynasty

- 24) 25th year. Severe drought. The King prayed in the temple. It then started to rain. (803 B.C.)

King Yu of Chou Dynasty

- 25) 2nd year. Rivers Gin, Wei and Lo were dried out. (780 B.C.)

- 26) 3rd year, winter. Severe lightning and thunder. (779 B.C.)

- 27) 4th year, 6th month, summer. Frost (778 B.C.)

- 28) 10th year, 9th month, fall. Peach and Almond trees fruited. (772 B.C.)

King Ping of Chou Dynasty

- 29) 1st year (of Count Chuan of Gin). No snow. (731 B.C.)

- 30) 41st year, spring, heavy snow. (730 B.C.)

- 31) 48th year. Thunder without cloud (723 B.C.)

Duke Yin of Lu

- 32) 9th year, 3rd month, (the day of) Kwei-Yu, heavy rain, thunder and flash. (The day of) Gen-Chen, heavy snow. (714 B.C.)

Duke Huan of Lu

- 33) 1st year, fall. Flood. (711 B.C.)

- 34) 8th year, 10th month. Snow. (704 B.C.)

- 35) 15th year, spring. No ice. (697 B.C.)

Duke Chuan of Lu

- 36) 7th year, fall. Flood. Destroyed wheat seedlings. (687 B.C.)

- 37) 11th year, fall. Flood in Sung area. (683 B.C.)

- 38) 24th year, Flood. (670 B.C.)

- 39) 25th year. Flood. (669 B.C.)

- 40) 28th year, winter. Flood. Destroyed rice seedlings. (666 B.C.)

- 41) 31st year, winter. No rain. (663 B.C.)

Duke Si of Lu

- 42) 2nd year, winter, 10th month. No rain. (658 B.C.)

- 43) 3rd year, 1st month, no rain. Summer, 4th month, no rain, 6th month, rain. (657 B.C.)

- 44) 10th year, winter, heavy snow. (650 B.C.)

- 45) 2nd year (of Duke Huei of Gin). It precipitated gold. (649 B.C.)

- 46) 15th year, 9th month, (the day of) Chi-Mao. Thunder struck the temple of Yee-Po. (645 B.C.)

- 47) 21st year summer. Severe drought. (639 B.C.)

- 48) 29th year, fall. Heavy hail. (631 B.C.)

- 49) 33rd year, 12th month. Frost. Plants were not killed. Prune and Plum trees fruited. (629 B.C.)

Duke Wen of Lu

- 50) 2nd year. No rain from 12th month of the previous year to 7th month in fall. (625 B.C.)

- 51) 10th year. No rain from 1st month to 7th month in fall. (617 B.C.)

- 52) 13th year. No rain from 1st month to 7th month in fall. (614 B.C.)

Duke Shaun of Lu

- 53) 7th year, fall. Severe drought. (602 B.C.)
54) 10th year, fall. Flood, famine. (599 B.C.)

Duke Chen of Lu

- 55) 1st year, 2nd month. No ice. (590 B.C.)
56) 5th year, fall. Flood. (586 B.C.)
57) 16th year, 1st month. Rain. Trees were frozen (575 B.C.)

Duke Sian of Lu

- 58) 5th year, fall. Severe drought. (568 B.C.)
59) 8th year, 9th month. Severe drought. (565 B.C.)
60) 24th year, fall. Flood. . . . Famine. (549 B.C.)
61) 28th year, Spring. No ice. (545 B.C.)
62) 28th year, 8th month. Severe drought. (545 B.C.)

Duke Chao of Lu

- 63) 3rd year, 8th month. Severe drought. (539 B.C.)
64) 3rd year. Heavy hail. (539 B.C.)
65) 4th year, 1st month. Heavy snow. (538 B.C.)
66) 6th year, 9th month. Severe drought. (536 B.C.)
67) 16th year, 9th month. Severe drought. (526 B.C.)
68) 19th year (of King Gin of Chou), winter, 12th month. Peach and almond trees blossomed. (526 B.C.)
69) 24th year, 8th month. Severe drought. (518 B.C.)

Duke Ding of Lu

- 70) 1st year, 10th month. Frost killed crops. (509 B.C.)
71) 7th year. 9th month. Severe drought. (503 B.C.)

Duke Ding of Jin

- 72) 18th year. Blue rainbow. Chi River dried out at old Wei area. (494 B.C.)
73) 20th year. Lo River dried out at Chou area. (492 B.C.)

Duke Chu of Jin

- 74) 5th year. Huei River dried out at Liang area. Dan River dried out, no flowing for three days. (469 B.C.)
75) 12th year. Yellow River dried out at Hu area. (462 B.C.)

Duke Yu of Jin

- 76) 7th year. Severe drought. Salt was formed on earth. (431 B.C.)
77) 9th year. The branches of Dan River merged into each other. (429 B.C.)
78) 10th year, 9th month. Peach and almond trees fruited. (428 B.C.)
79) 12th year. Thunder without cloud. (426 B.C.)

King Huei-Chen of Liang

- 80) 1st year. Dark in day. (370 B.C.)
81) 7th year. It precipitated green jade at Yin. (364 B.C.)
82) 8th year. It precipitated grain at Chi, bones at Chi-Pi. (363 B.C.)

King Yiu of Chou

- 83) 5th year. Lo River flooded into Chen-Chou. Heavy flood in mountain areas. (310 B.C.)
84) 6th year, 10th month. Heavy rain, strong wind. Yellow River flooded at Suan-Chao. (309 B.C.)

First Emperor of Chin Dynasty (Chin Shih Huan)

- 85) 5th year. Thunder in winter. (242 B.C.)
86) 8th year, 4th month. Freezing cold. Many people died. (239 B.C.)
87) 12th year, fall. Severe drought in whole country from 6th month to 8th month. (235 B.C.)
88) 21st year. Heavy snow, 2 Che 5 Chun (roughly 74 cm) in depth. (226 B.C.)
89) 1st year (of Second Emperor of Chin, or Emperor Er-Shih). Thunder without cloud. (209 B.C.)

Emperor Huei of Han Dynasty

- 90) 2nd year. Thunder in winter. Peach and plum trees blossomed. (193 B.C.)
91) 5th year, summer. Severe drought. (190 B.C.)
92) 5th year, 10th month. Peach and plum trees blossomed. Date trees fruited. (190 B.C.)

Empress Kao of Han Dynasty

- 93) 3rd year, summer. Flood in Nan-Chun and Han-Chung. More than 4000 families were flushed. (185 B.C.)
94) 4th year, fall. Flood in Ho-Nan. (184 B.C.)
95) 8th year, summer. Flood again in Nan-Chun and Han-Chung. (180 B.C.)

Emperor Wen of Han Dynasty

- 96) 2nd year, 6th month, at Shou-Ch'un, the capital city of King Huai-Nan. Strong wind destroyed houses, killed people. (178 B.C.)
97) 3rd year, fall. Severe drought in whole country. (177 B.C.)
98) 4th year, 6th month. Heavy snow. (176 B.C.)
99) 5th year. Thunderstorm at Wu area. (175 B.C.)
100) 5th year, 10th month, at the capital city Pen-Chen of King Chu. Strong wind from southeast destroyed the city gate, killed people. (175 B.C.)
101) 12th year. Yellow River flooded at Suan-Chao, also destroyed Chin-Ti. (168 B.C.)
102) 3rd year of the last period, fall. Heavy rain continued day and night for 35 days. Flood in Lan-Tien Mountain. Han River flooded. (161 B.C.)
103) 6th year of the last period, spring. Severe drought in whole country. (158 B.C.)

Emperor Gin of Han Dynasty

- 104) 2nd year, fall. Hail in Hen-San. 5 Chun (about 13 cm) in diameter, 2 Che (about 60 cm) in depth. (155 B.C.)
105) 5th year, 5th month. Thunderstorm in Chian-Tu. The storm was from west, destroyed the city wall 12 Chan (about 4 m). (152 B.C.)
106) 1st year of middle period, 4th month. Hail in Hen-San and Yuan-Tu. 1 Che and 8 Chun (about 51 cm) in diameter. (149 B.C.)
107) 3rd year of middle period, fall. Severe drought. (147 B.C.)
108) 4th year of middle period, 6th month. Flood in whole country. (146 B.C.)
109) 6th year of middle period, 3rd month, hail. (144 B.C.)
110) 2nd year of last period, 10th month. Severe drought. (142 B.C.)

Emperor Wu of Han Dynasty

- 111) (3rd year) of Yuan-Kuan Period. Yellow River flooded at Hu-Tze, and flow southeastward into Chu-Ye area. (132 B.C.)
- 112) 4th year of Yuan-Kuan period, 4th month. Frost killed plants. (131 B.C.)
- 113) 6th year of Yuan-Kan period, summer. Severe drought. (129 B.C.)
- 114) 1st year of Yuan-Suo period, 12th month. Heavy snow. Many people were frozen to death. (128 B.C.)
- 115) 5th year of Yuan-Suo period, spring. Severe drought. (124 B.C.)
- 116) 3rd year of Yuan-So period, summer. Severe drought. (120 B.C.)
- 117) 6th year of Yuan-So period, winter. No ice. (117 B.C.)
- 118) 2nd year of Yuan-Tin period, 3rd month. Snow. 5 che (~1.5 m) in depth on plains. (115 B.C.)
- 119) 3rd year of Yuan-Tin period, 3rd month. Water frozen. 4th month. Rain and thunder. (114 B.C.)
- 120) 1st year of Yuan-Fong period. Severe drought. (110 B.C.)
- 121) 2nd year of Yuan-Fong period. Severe drought. (109 B.C.)
- 122) 3rd year of Yuan-Fong period. Thunderstorm and hail. Hailstones were as big as horse heads. (108 B.C.)
- 123) 5th year of Yuan-Fong period. Yellow River flooded at Kuan-Tao and Chin-Ti of Tong-Chun. (106 B.C.)
- 124) 1st year of Tien-Han period, summer. Severe drought. (100 B.C.)
- 125) 3rd year of Tien-Han period, summer. Severe drought. (98 B.C.)
- 126) 1st year of Chen-Ho period, summer. Severe drought. (92 B.C.)
- 127) 2nd year of last period. Yellow River flooded again at Ping-Yuan. (87 B.C.)
- Emperor Chao of Han Dynasty
- 128) 1st year of Shih-Luan period, 7th month. Heavy rain and flood from 7th month to 10th month. (86 B.C.)
- 129) 2nd year of Shih-Yuan period, winter. No ice. (85 B.C.)
- 130) 6th year of Shih-Yuan period. Severe drought. (81 B.C.)
- 131) 1st year of Yuan-Feng period, at the capitol city Chi of Yen. Severe storm. It uprooted 16 trees of 7 Wei in the palace ("Wei" means "surrounded"; 7 Wei means that the perimeters of the trees were as big as 7 men holding hands together), destroyed city gate. (80 B.C.)
- 132) 1st year of Yuan-Ping period, 4th month. (The Emperor) died. . . . Cloudy sky for long period but no rain. (74 B.C.)
- Emperor Shuan of Han Dynasty
- 133) 3rd year, summer. Severe drought in several thousand li (1 li ~0.57 km) from east to west. (71 B.C.)
- 134) 4th year, 5th month of Ti-Che period. Hail at Chi-Yin of San-Yang area, as big as chicken eggs, 2 che 5 chun (~74 cm) deep. It killed 20 people. Many birds also died. (66 B.C.)
- 135) 1st year of Shin-Chi period, fall. Severe drought. (61 B.C.)
- Emperor Yuan of Han Dynasty
- 136) 1st year of Chu-Yuan period, 5th month. Flood at Po-Hai. (48 B.C.)
- 137) 1st year of Yung-Kwan period, 3rd month. Frost killed mulberry trees. (43 B.C.)
- 138) 1st year of Yung-Kwan period, 4th month. The color of sun was bluish white, no glare. At noon, the sun had glare but was not bright. This summer was cold. In 9th month, the sun recovered its brightness. (43 B.C.)
- 139) 2nd year of Yung-Kwan period, 8th month. It precipitated grass. (42 B.C.)
- 140) 5th year of Yung-Kwan period, summer and fall. Heavy flood. (39 B.C.)
- 141) 2nd year of Chien-Chao period, 11th month. Heavy snow in Chi and Chu area, 5 che (~1.5 m) deep. (37 B.C.)
- 142) 4th year of Chin-Chao period, 3rd month. Snow. Many swallows died. . . . Ku Yung said, ". . . Right at this day strong wind came from north-west. It was very cold and snowing." (35 B.C.)
- Emperor Chen of Han Dynasty
- 143) 1st year of Chien-Shih period, 4th month, the day of Sin-Nu, night. Northwestern sky was as red as fire. The morning of Jen-Yin (the next day), strong wind came from northwest with yellow clouds covering everywhere. All day and night it precipitated yellow dust. (32 B.C.)
- 144) 1st year of Chien-Shih period, 9th month, the day of Wu-Tzu. A flowing star showed at Wen-Chan (near Ursa Minor), white in color. It shone on the ground, 4 tsan in length (~12 m) and one Wei (~1.5 m) wide. It moved and swung like a dragon or snake. After a while, it extended to 5 or 6 tsan long and 4 wei wide. Twisted and curved, it penetrated the west of Tzu-Kung (Ursa Minor), and stayed at the position between Tzu and Hai of the northwestern part of Dou (Ursa Major). Later it curved into a ring shape with its northern end spread apart. It stayed for about one Ker (~15 min). (32 B.C.)
- 145) 3rd year of Chien-Shih period, summer. Flood. Heavy rain for more than 30 days in San-Fu area. 90% of the surrounding areas also had heavy rain. (30 B.C.)
- 146) 3rd year of Chien-Shih period, fall. Heavy rain for more than 30 days (30 B.C.)
- 147) 4th year of Chien-Shih period. Heavy rain for more than 10 days. (29 B.C.)
- 148) 2nd year of Ho-Ping period, 4th month. Hail in Chu, as big as an ax. (27 B.C.)
- 149) 4th year of Yang-Suo period, 4th month. Snow. Swallows and sparrows died. (21 B.C.)

- 150) 4th year of Hong-Chia period, . . . Flood at Po-Hai, Chin Ho and Shin-Tu. (17 B.C.)
- 151) 4th year of Hong-Chia period, . . . Flood at Po-Hai, Chin-Ho, and Shin-Tu, all smaller than 5 chun (~13 cm) in length. (17 B.C.) (Result of a water spout?)
- 152) 3rd year of Yung-Shih period, summer. Severe drought. (14 B.C.)
- 153) 4th year of Yung-Shih period, summer. Severe drought. (13 B.C.)

Emperor Ping of Han Dynasty

- 154) 3rd year of Yuan-Shih period, 1st month. It precipitated grass, just like Yung-Kwan period. (3 A.D.)

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announcements continued from page 312

NBS film catalog

A catalog of 16 mm/color/sound films available for loan free from the National Bureau of Standards (NBS) lists three films that may be of interest to BULLETIN readers. A 4 min film, *Measures for Air Quality*, describes the use of a laser scattering technique to detect airborne particles, including cigarette smoke. A sulfur dioxide detector, based on fluorescence measurements, and a permeation tube that supplies known amounts of sulfur dioxide for instrument calibration are also described. An 8 min technical film on *Critical Phenomena in Carbon Dioxide* demonstrates the formation and disappearance of separate gas and liquid phases, as well as the anomalous light scattering (critical opalescence) due to the large density fluctuations near the critical point. The film is intended as illustration material for lectures on phase transitions. The third film is called *Extreme Wind Study* and runs for 18 min. Noting that low-rise buildings are particularly susceptible to damage by hurricanes, typhoons, and cyclones, the NBS Center for Building Technology collected wind data from full scale buildings in the Philippines in order to develop criteria for these buildings. With their frequent severe storms, these islands served as a natural laboratory. The field data were applied to creating experimental procedures in a wind tunnel for improving building construction. The project was sponsored by the Agency for International Development.

All films listed in the catalog have been reviewed by NBS researchers, and the information presented is "accurate and useful to the target audience." The films are available on free loan to scientific and professional organizations, educational institutions, and nonprofit community organizations. To obtain the catalog and information on ordering films write: National Bureau of Standards, U.S. Dept. of Commerce, Washington, D.C. 20234.

New solar energy magazine

Sunworld, which recently began publication, is intended as a forum for presenting information and ideas relating to the worldwide development and use of solar energy. Articles in a recent issue of the magazine included: Performance Testing of Solar Collectors; Why Study the Sun?; Sun Spots; Solar Energy Activities in Thailand; and Future of Solar Energy. *Sunworld* is published quarterly by the International Solar Energy Society (ISES). Subscriptions for nonmembers (of the ISES) are \$13.20 per year and single issues cost \$3.50 each; they may be obtained from Pergamon Press, which now handles all nonmember subscriptions to *Sunworld*, at: Maxwell House, Fairview Park, Elmsford, N.Y. 10523. Those interested in becoming members of the ISEF or in obtaining more information about the Society and/or the magazine, should write the Secretary-Treasurer at: International Solar Energy Society, P.O. Box 26, Highett, Victoria 3190, Australia.

Continued on page 326