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I THE SUN WORSHIP IN ANCIENT CHINA

In Chinese ancient times the Sun worship was in vogue. Mainly there were two sorts of the worship rites: 1) for rising and setting Sun; 2) for solar eclipses. Many evidences for Sun worship have been found in Chinese ancient books and bone inscriptions (Xu Zhentao et al. 1985).

The everyday worship to the Sun certainly caused spontaneous observations for solar phenomena. Since the ancients only had a limited knowledge they could not understand what were these phenomena and they, however, created many wonderful myths to describe them. These myths about Solar phenomena have vividly been expressed in the works of art of the Han Dynasty recently unearthed. So analysing the works of art we may trace the original phenomena of solar activity.

II THE UNEARTHED WORKS OF ART OF THE HAN DYNASTY

A lot of tombs of the Han Dynasty have been excavated in China. For example, a famous one is the tomb at Ma Wang Dui near Changsha in Hunan province. Many works of art have been found from these tombs. They have three main sorts: 1) silk paintings; 2) stone reliefs; 3) mural paintings. Since times of these tombs are very long ago, silk and mural paintings are little in a good state of preservation. But a lot of stone reliefs are very well preserved. In these works of art there are many expressions on Sun's myths. In this paper we regard them as analysing bases.

III THE MYTH ON "Ri Zhong Wu" AND SUNSPOTS

In Chinese ancient books "Tian Wen" and "Huai Nan Zi" a myth has been noted. It said that a crow or a three-leg crow was in the Sun. More literary statement was that a famous shooter Houyi shot down nine Sun while there were ten Sun in the sky at that time and the feathers of crow in the Sun were fallen on the ground. Fig.1 is pictographical expression of this myth. The man who is bending a bow is just the ancient hero Houyi and he is aiming at seventh crow, the embodiment of the Sun. Fig.2 and Fig.3 means respectively "the three-leg crow in the Sun" and "the crow in the Sun". The latter is part of the famous silk painting unearthed at Ma Wang Dui. Still many similar works of art on the crow in the Sun were preserved on silk or stone. On the basis of our examinations, these works of art on Ri Zhong Wu have perfectly reproduced concrete figures of solar phenomena which the ancients saw in the sacri-



Fig.1 The myth on Houyi shooting Sun.
(Wu Zhende 1984)

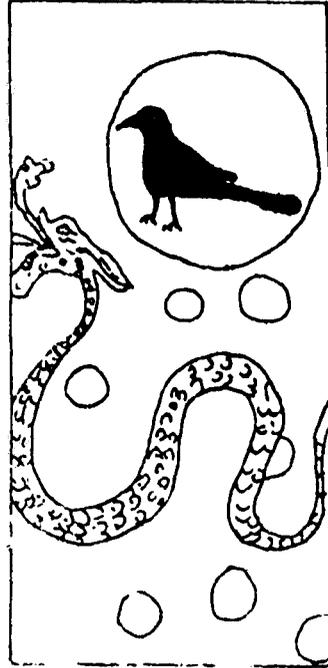


Fig.3 The crow in the Sun.
(Hanan Museum 1974)



Fig.2 The three-leg crow in the Sun.
(Wu Zhende 1984)

ficial rites and the so-called "the crow" or "the three leg crow" really stand for Sunspots(Xu Zhentao et al.1985).

IV THE MYTH ON "Yong Wu Zai Ri" AND SOLAR CORONA AND PROMINENCES

A myth in book "Shan Hai Jing" said that one Sun will rise while another Sun comes here and all of the Sun are carried by crows i.e. so-called "Yang Wu Zai Ri". Fig.4 from a stone relief of the Han Dynasty just is a vivid display of this myth. The big bird called "Yang Wu" stands for one crow and the large circle on the back of the crow means the Sun. On principle mentioned before we can consider this figure as the image of celestial phenomena seen in sacrificial offering to solar eclipses. A convincing evidence of this view point is Fig.5 in which there are a bird "Yang Wu" and a toad in solar disk. As everyone knows, in ancient China a circle with a toad stood for the Moon. So Fig.5 means the coincidence of the Sun and the Moon, i.e. the total solar eclipse. Thus, it is very possible that the head and tail of the "Yang Wu" stand for the equatorial type corona seen in minimum of solar activity and the wings stand for prominences. The total eclipse of May 28th, 1900 (Fig.6) had a bird shape corona similar with Fig.5. It shows that the ancients considered solar corona as the bird "Yang Wu" and this is rather natural.

The Japanese scientist Saito(1979) investigated a lot of figures of the Sun engraved in ancient structures of the Middle East and demonstrated that the two wings beside the solar disk stand for the equatorial type corona while the tail represents a polar plume. It is very interesting that the ancients of the Middle East also considered the Sun as a bird and this just coincides with the Chinese views.

V THE MYTH ON "Yang Li" AND SOLAR FLARES

The book "Tian Wen" said that the big bird Yang Li died and revived. According to literature examinations Yang Li was another divine bird in the Sun different from the crow in the Sun and someone has proved that the story about Yang Li probably means that the Phoenix died in raging fire and revived(XiaoBin 1979). This myth seems to have spread not far and wide, so work of art on it is hardly discovered. Fortunately, a mural painting of tomb of the Western Han Dynasty has been found in 1957 (Xia Nai 1965). It is one of twelve paintings. From Fig.7 we can see that besides a dark crow there also is another light bird in the centre of solar disk. It is very possible that the light bird just is Yang Li (Xiao Bin 1979).

From Fig.7 we knew: 1) the light bird located near the dark crow which means a big sunspot group as above; 2) the bird Yaing Li is brighter than the crow and even solar disk. In the light of solar physics, it is very possible and very reasonable that the bird Yang Li represents a strong solar eruption, that is a white-light solar flare.

As far as we know that more 60 white-light flares have been discovered since Carritong's sighting. Thus during the long historical years an

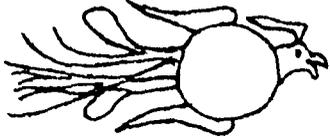


Fig.4 The Sun is carried by crow.

(Wu Zhende 1984)



Fig.5 The coincidence of the Sun and moon.

(Wu Zhende 1984)

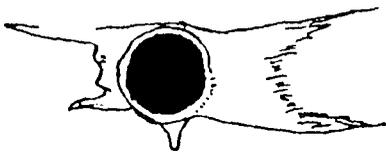


Fig.6 Corona in total solar eclipse of May 28, 1900.

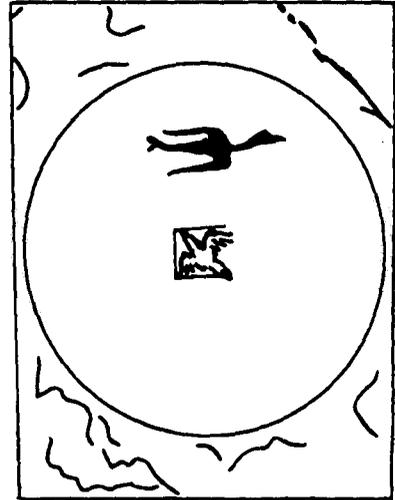


Fig.7 Yang Li and crow in the Sun.

(Xia Nai 1965)

occasional sighting of flare was quite possible. According to excavation report the date of the tomb was about BC48 to BC7 year (Henan 1964). During this period the solar activity had high level corresponding to the Roman Maximum termed by Eddy (Eddy 1976), so easier sightings of solar flares seem to be quite natural. Therefore we can consider Fig.7 as art description of solar flare that the Chinese ancients observed once in a while.

In fact, some descriptions of solar flare observed by naked eye were mentioned in Chinese ancient literatures. For example, "Kai Yuan Zhan Jing"said "there is flame-like gas in the sun" and "one sees red gas as big as a squash jumping in the Sun". Here "flame-like gas" and "red gas" were, in all reason, considered as solar flares witnessed by diligent solar observers (Wang & Siscoe 1980).

VI SUMMARY

The Sun worship led the Chinese ancestors to observe the Sun for a long time. Several phenomena of solar activity were not only offered grand sacrifices but also invented into the wide spread myths which had some reflections in the ancient works of art. Tracing these cultural remains engraved the effects of solar phenomena, we have found that their original embryonic forms right were natural images of the sunspots, solar corona, prominences and even solar flares. Therefore we may affirm that these phenomena of solar activity were initially discovered before the Han Dynasty and their occurrences were so common that the astrologers used them to divine.

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DISCUSSION**J.A. Eddy**

: On some occasions sunspots seen with naked eye in ancient China were described as appearing 'like the foot of a crow'. Do you think that this description was an indication of the actual shape of a sunspot group, or, in view of the crow legend, a more allegorical (or poetic) reference ?

Xu Zhentao

: I think this is a description of the actual sunspot group. But it is a very complicated problem. I have a paper presented at the International Workshop on Solar Physics (1983), Kunming China, where I reported this problem. I will discuss it with Dr. Eddy in detail.