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ON ASTRONOMICAL RECORDS OF DANGUN CHOSUN PERIOD

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ABSTRACT

Events of eclipses as well as other major astronomical events observable in the eastern sector of Asian continent are computed and checked with astronomical records of antiquity. Particular attention was given to two types of the events recorded in remaining records of Dangun Chosun Period (DCP): (1) concentration of major planets near the constellation of Nu-Sung (β Aries) and (2) a large ebb-tide. We find them most likely to have occurred in real time. i.e., when the positions of the sun, moon, and planets happen to be aligned in the most appropriate position. For solar eclipses data, however, we find among 10 solar eclipse events recorded, only 6 of them are correct up to months, implying its statistical significance is no less insignificant. We therefore conclude that the remaining history books of DCP indeed contains important astronomical records, thereby the real antiquity of the records of DCP cannot be disproved.

Key Words : astronomical records, computer simulations.

I. INTRODUCTION

Records of astronomical events have been published in royal courts of Korea, China, and Japan. Monarchs of ancient eastern/western history commonly believe that astronomical events influence the fate of earthlings, or at least cast certain premonitions to the political affairs. Therefore, court astronomers have left a vast amount of astronomical records. Indeed, most authentic history books of far eastern countries list ample records of eclipses, and peculiar astronomical phenomena. The Baekje Kingdom (18 B.C?-660A.D) flourished in the southwestern sector of Korea, for example, is known to have had an official administrative department for astronomical observation. It is well known that her neighbor, the Shilla Kingdom (57 B.C?-936A.D) also has constructed the astronomical observatory called Chumsungdae during 6A.D. There still remains a map of constellation alledgedly produced by court astronomers of Goguryo Kingdom (200B.C?-668A.D).

The authenticity of the records during the three Kingdom period is well tested by several numerical astronometric computations carried by several groups, such as the recent work of Stephenson (Stephenson; 1985). The purpose of this paper is to report that we carried out the more accurate astronomical computations for astronomical events of the more antiquity: $2000BC \sim 100BC$. This period roughly coincides with with the DCP (2333BC-108BC). We considered major astronomical events e.g., eclipses, tidal surge, location of planets, and checked numerically whether such phenomena present in remaining history books of DGP are indeed correct records. In order to avoid possible computational errors, we first compared our preliminary results with previously known works such as Stephenson's, and found that our results are in good agreement with theirs. DC Kingdom lacks authentic historical records; only records of the period scattered in the less authentic books are known. Due to such scarcity of records, any remaining records of the DCP have become a subject of controversy; ranging from icy neglection to sizzling interests.

II. DANGUN CHOSUN PERIOD

There are two representative books containing the history of DCP: (1) Dangi-gosa (D1), which is alledgedly to be authored by Dae-yabal (Dae-yabal; 1986) of Balhae Kingdom (698AD-926AD), and later reedited by Hwang Jobok of Koryo Period (936AD-1392AD), and (2) Handangodi (D2), alledged to be written by Lee-Am (Lim Seung Kook; 1991) of Koryo Period. Yet their reliability is under controversy; we do not know how many re-edition process the books have undergone, not to mention detailed contents of the books. Thus, at the present time, most scholars take the more conservative attitude toward the books. This attitute will not change until there are some definite evidences supporting the reliability of the records are found.

We note that one objective way to check the accuracy of atronomical events recorded in the book is via real astronomical computation. Astronomical events, such as eclipses, location of planets, peculiar strength of tidal events, are all physical phenomena. Therefore, there is no doubt that the accuracy of an evidence, if found via the via astrometric computation, will be well-beyond one's doubt. We note such astrometric computation carried out by Japanese (Watanabe ;1962), and later by a British (Stephenson; 1986) group. They catalogued historical eclipse and other events those occurred in the Far Eastern sector of the asian continent. We also note from our computation that the common misconception among western scholars that Korean eclipse records are nothing but an exact copy of Chinese ones is rather groundless. Eclipse records of Samkuk-sagi, the most authentic history book of Korea, are no less accurate as Chineses'.

Thus far, remaining astronomical events of DCP are (1) 10 eclipse events, (2) the concentration of 5 major planets in the constellation of β Aries, and (3) large ebb-tide reaching $\sim 1m$. We find that the eclipse events are marginally correct, but the latter two peculiar astronomical events, the planetary and the tidal event, occurred at epochs very close to the real time when it had happen. Considering the rare probability of random coincidence, we note that the coincidence is quite suggestive, which may support the antiquity of the astronomical records. In the following, this paper is organized as follows. In chapter (3), we list 12 major astronomical events recorded in DCPs; in chapter (4), we compared the events with our numerical computation and chapter (5) is devoted to the conclusion.

III. ASTRONOMICAL RECORDS IN DCPs

We classified all astronomical records present in records of DCPs: (1) eclipse events (2) location of planets and (3) tidal events. All are listed and tabulated in Table 1. For the dates and time, we took the chronology of Lim Seung Kook's research on the DCPs (Lim Seung Kook; 1991). According to the chronology, there was an eclipse in 2183BC, which much preceds the first chinese astronomical event (776BC) recorded. We first find a tendency that the number of astronomical events increases as it closer to the later period. This sharply contrast with those present in Samkuksagi, where the number of records decreases as the Three Kingdoms Period nears its end. Note that the period between adjacent events of table 1 is approximately 550 years roughly corresponding to the total duration of the three kingdom.

IV. DETAILS OF COMPUTATION

(a) The Event of the Concentration of 5 Planet

In the record of DCP, in the year 1733BC, 5 planets concentrated within a very narrow angular scale. The five planets mentioned are of course Mercury, Venus, Mars, Jupiter and Saturn. The location of the event is identified as β Aries. β Aries at the present time is located at $(RA, DEC) = (1h54m15s, +20°46'27")$. In 1733BC, due to corrections from the precession of the earth, and the proper motion of the star, the β-Aries was located at $(22h41m51s, +0°0'38")$. In order to check this phenomenon via realistic astronomical computation, we first computed the distances between five planets in the period preceding/following 150 years of 1733BC. The average

Table 1. Astronomical Events of TCPs (All in Julian Dates)

	YEAR/(MONTH)	TYPE	SOURCE
1	2183BC	eclipse	D1, D2
2	1733BC	concentration of planets	D1, D2
3	1533BC	eclipse	D2
4	935BC	maximum tide	D1, D2
5	918BC	eclipse	D2
6	837BC	eclipse	D1, D2
7	765BC	eclipse	D2
8	579BC	eclipse	D2
9	525BC	eclipse	D2
10	423BC	eclipse	D2
11	248BC	eclipse	D1
12	241BC	eclipse	D2

relative distances is computed from the formula

$$D = \sqrt{\Sigma_{i \neq j} d_{i,j}^2 / 10},$$

where $d_{i,j}$ denotes the angular distance between the planets; the number 10 in the denominator is originated from the 10 possible relative distances $(n(n-1)/2)$. In order to minimize the error, we limit the average distance to fall within 3", which normally falls within .5" (Meeus; 1991). In computation, we find the quantity D quite sensitive to the relative locations of the planets. We find the variation of D over the period 150 years, and the five planets approache toward each other every 20 years. [This phenomenon can be explained by the following reason: the orbital period of Jupiter and Saturn is $11.8622 yrs$ and $29.457 yrs$, respectively. Therefore, they approche each other every 19.9 years.] How long the concentration of the planets last? Once it happens, the maximum duration is determined by planets of minimum (mean) orbital radius, *e.g.*, Mercury and Venus. Their small orbital distance implies the faster angular speed, which works to scatter the concentration. Therefore, intuitively, one may reason that their concentration, if once occurs, cannot last more than $\sim$ 20 days.

We find over a period of 150 years the 5 planets once concentrated in the evening of July 13th, 1734BC. The quantity D at this time is takes a value 10.26^o. After sunset, this day, observers of DCP would had seen a spectacular view of Venus, Jupiter, Saturn, Mars (and cresent moon), all aligned parallel. Unfortunatly, we find this event occurs not in the location of β Aries, as records of DCPs suggest, but in the constellation of Serpent. This constellation is is about 130^o away from the β Aries. Despite this, we note that the event of concentration of the planets is a quite rare event, but the alignment of the five planets and the moon really occurred just one year off from the historical record DCPs. This is quite surprising. (In the period from 2000BC to 1450BC, similar event occurred only once at the dawn of Feburary 25, 1953BC.) Therefore, the probability that the event of DCP is correct just by a coincident is only $2 \times 2/550 = .007$. (Here, 2 comes from the one year preceding/following the records of the DCPs; and the second 2 comes from the two real events occurred during the period of 550years).

(b) Tidal Events of 935BC

In 935BC, DCPs record show that there was a peculiar tidal phenomon. We aware that terrestial tidal events are the consequence of the gravitational interaction between moon, sun and the earth. The tidal force exerting on the earth is of course caused by the finite size of the earth. We do observe a correlation between the tidal force on the earth vs observed tidal height. (The maximum and minimum heights of tides depend on the geological feature and wind pattern as well.) Normally the real tidal maximum/minimum always follow 2-3 days after the maximum/minimum tidal force. Now we state key results of our computation: among greatest tidal events which had occurred during the period of 200 years following/preceding the year of 935BC, we find that in the year 935BC, we do not see any interesting (stronger) tidal event; instead, in November 22 of the year 931BC, we find that there had been the greatest tidal event in the period of 200 years. The next largest tidal event occurs in years of 975BC and 913BC. Now, it is quite remarkable that the records of DCPs show that there were great tidal event just only 4

Table 2. Results of Computation

RECORDED DATE	COMPUTED DATE	CORRECT UP TO
2183BC	2184BC October 31	1 year
1533BC (summer)	1532BC April 29	1 year
918BC (July)	914BC August 3	4 years
837BC (March)	833BC March 13	4 years
765BC (April)	765BC February 10	1 year
579BC (Spring)	579BC July 29	1 year
525BC (August)	525BC August 21	month
423BC (February)	423BC March 10	month
248BC (October)	248BC April 24	1 year
241BC	242BC June 15	1 year

years off from the real event. It was the greatest tidal event over the period of 200 years. The scarcity of the event implies that the proxy-coincident is quite suggestive. Indeed, probability that one can predict this event occurs merely by chance is only $1 \times 8/200 = .04$.

(c) Eclipses

Eclipse records of TCPs are, comparing to the previous two events, are relatively abundant. In TCPs, there are 10 eclipse events in the period 2183BC-241BC. We compared the recorded events with the real dates computed: In computing the real time events, we followed the method of Meeus (1991). Unfortunately though, despite such abundance, the records lack credibility than the previous two events. This is due to the fact that eclipse events occur rather frequently. Thus even a forged records can possess a rather higher probability of displaying coincidence with real events. (Computation shows that eclipse occurs approximately once per every 1.4 year.) Therefore, if we assume that one forges a series of false eclipse events, it is quite probable that the records coincides with the real events coincidentally. This situation becomes worse for DCPs, since the period of the DCP itself is quite unclear, and we we do not know where the location of recorder. One can be the more precise. Statistically, we know that on the average, there are 2-5 eclipses per year. The statistical nature of the events is the most conveniently revealed by two parameters: (1) the altitude of the sun when the eclipse is at its peak (A), (2) the distance from the center of the earth to the shadow of the moon, which is devided by the radius of the earth (γ). However, we directly run into difficulty if we directly apply this scheme for events of the DCP. The main problems are: (1) one cannot pinpoint where the capital had been. Thus the two parameter space ought to take a wider dispersion. Even though one can plot the 10 eclipse events of the DCP assuming an observer in the far eastern sector of asian continent in this way, these points in in (A, γ) space are swamped by real events, which marks more than 1500 numbers. Solar eclipse is really a frequently occurring events. Very bad news indeed. Unlike the tidal, or planetary concentration event aforementioned, the eclipse events are just too many, the records of the DCP are just too scanty; and the location of the observer is too uncertain.

To summarize, we numerically computed events of eclipses as well as other major astronomical events observable in the eastern sector of Asian continent during the period 2000BC-2000AD. Astronomical records of DCP now available are then compared with our computation. We find that the recorded solar eclipse events are not a viable indicator which determines the real antiquity of the records of the DCP. However, we find that two events recorded in history books of DCP: (1) concentration of major planets near the constellation of Nu-Sung (β Aries) and (2) a large ebb-tide are indeed rare events: and found the recorded dates are very close to computed real time events. Thus we conclude that the remaining history books of the DCP do contains important astronomical records, thereby supporting the antiquity of the remaining records of the DCP.

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