The *Ch'i-yao jang-tsai-chüeh* and its Ephemerides

by

MICHIO YANO*

The Chinese text of the *Ch'i-yao jang-tsai-chüeh* (七曜攘災決 'formulas to prevent the disasters caused by the seven luminaries') was compiled in the early 9th century by a Brāhmaṇa priest who hailed from Western India. His name is written as Chin chu cha (金倶吒), but I have been unable to identify its Sanskrit equivalent. The translator was probably Chinese, but his name is not known. The text was introduced to Japan in 865 by a Buddhist monk Shuei (宗叡)[1]. All versions of the text uncovered to date have survived in Japan. The Taisho Tripitaka edition[2] is based on a manuscript which was preserved in the Buddhist temple Hase-dera. Since the Taisho edition was obviously corrupt I attempted to obtain this manuscript. Unfortunately the manuscript was missing from the archive of the temple. It was only in the summer of 1985 that I managed to obtain a photocopy of another manuscript of the text through the kindness of Prof. Momo.[3] According to the colophon of the manuscript, it was copied in the 3rd year of Hoan (A. D. 1122). There has not yet been time to do character by character examination of the manuscript, but the excellent condition of the text can be well illustrated by a comparison of the ephemerides. In the Taisho edition the lines are completely distorted and the reconstruction of the tables is not easy, while in the manuscript the entries are neatly lined up.

The main body of the text of the *Ch'i-yao jang-tsai-chüeh* consists of tables of the monthly positions of the five planets and Rāhu and Ketu.[4] What is remarkable is that the month used as temporal coordi-

* International Institute for Linguistic Sciences, Kyoto Sangyo University, Kamigamo, Kita-ku, Kyoto 603, Japan.

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	Y	A	R
Jupiter	83	76	7
Mars	79	37	42
Saturn	59	57	2
Venus	8	5	–
Mercury	33	104	–

Table 1.

nate is not a synodic month but a solar month (corresponding to *saura-māsa* in Indian astronomy). Thus each ephemeris has twelve lines. The beginning of the first month of the year can probably be equated with *yu-shui* (雨水, one of the 24 chieh-ch'i 節氣, when the solar longitude is 330°). The epoch of the ephemerides of the five planets is the 10th year of Chen-yüan (A. D. 794).

Each ephemeris is preceded by a brief list of constants, viz. the complete integer number of sidereal rotations (R) of the superior planets along the ecliptic, and the complete integer number of synodic periods (A) of the inferior (as well as superior) planets, in an integer number (Y) of years. The ephemeris thus consists of Y columns. Our text gives these numbers as in Table 1. The text also gives the mean length of so called Greek-letter phenomena.[5] Prof. Yabuuti[6] once compared the synodic period of Jupiter in this text with those recorded in the Chinese official calendars; he demonstrated that the constants of the former were almost identical with those in the *Wu-chih li* (五紀曆), a calendar used from A. D. 762 to 783.

The planetary positions are given within the 28 unequally spaced *hsiu* (*lunar mansions*). In order to analyze the table, therefore, one has to know what kind of coordinate system was employed and how many degrees each *hsiu* covered. The text does not contain a list of the extension of each *hsiu,* but we can reconstruct it almost completely using a table added at the end of the ephemerides, namely, the table for the 'daily' solar positions. 'Day' here is not the civil but the solar day, because each solar month is divided into 30 days, 360 'days' comprising a solar year. The coordinate system I reconstructed for the *Ch'i-yao jang-tsai-chüeh* (Table 2) is essentially that of the polar longitude,[7] system such as was used in China since the Former Han Dynasty

No.	Hsiu	A. D. 800								T	Ch
				α	δ	λ	λ^{*}	$\lambda^{*\circ\circ}$	$\Delta\lambda^{*\circ\circ}$		
1.	K'uei (奎)	ζ	And	356.35	+17.63	3.95	356.01	361.21	17.88	$17\frac{1}{2}$	17
2.	Lou (婁)	β	Ari	12.54	+14.60	17.26	13.64	13.84	12.32	$12\frac{3}{4}$	13
3.	Wei (胃)	35	Ari	23.87	+22.07	30.24	25.78	26.16	16.45	$14\frac{3}{4}$	14
4.	Mao (昴)	η	Tau	39.53	+19.66	43.28	42.00	42.61	10.58	11	11
5.	Pi (畢)	ε	Tau	49.99	+15.71	51.71	52.43	53.19	16.94	$16\frac{1}{4}$	16
6.	Tzu (觜)	λ	Ori	67.41	+ 8.27	66.98	69.13	70.13	0.37	1	1
7.	Shên (参)	δ	Ori	67.79	− 1.99	65.63	69.49	70.50	9.30	$9\frac{1}{4}$	10
8.	Ching (井)	μ	Gem	77.64	+22.16	78.56	78.65	79.80	30.69	30	30
9.	Kuei (鬼)	θ	Cnc	110.49	+21.38	109.03	108.90	110.49	2.73	$2\frac{3}{4}$	3
10.	Liu (柳)	δ	Hya	113.36	+ 9.19	113.63	111.59	113.22	13.32	$14\frac{1}{4}$	14
11.	Hsing (星)	α	Hya	127.10	− 3.99	130.63	124.72	126.54	6.33	$6\frac{3}{4}$	7
12.	Chang (張)	υ	Hya	133.45	− 9.67	139.04	130.96	132.87	17.56	$18\frac{3}{4}$	19
13.	I (翼)	α	Crt	150.46	−12.16	157.21	148.27	150.43	19.80	$19\frac{1}{4}$	19
14.	Chên (軫)	γ	Crv	168.78	−10.89	174.10	167.79	170.23	18.77	$18\frac{3}{4}$	19
15.	Chiao (角)	α	Vir	185.76	− 4.65	187.14	186.28	189.00	12.92	13	13
16.	K'ang (亢)	κ	Vir	197.53	− 4.28	197.79	199.02	201.92	9.70	$9\frac{1}{2}$	9
17.	Ti (氐)	α	Lib	206.53	−10.52	208.40	208.58	211.62	16.22	$15\frac{3}{4}$	16
18.	Fang (房)	π	Sco	222.07	−21.89	226.23	224.57	227.84	5.51	5	5
19.	Hsin (心)	σ	Sco	227.52	−21.88	231.09	230.00	233.35	5.68	$4\frac{3}{4}$	5
20.	Wei (尾)	μ	Sco	233.22	−35.01	239.45	235.59	239.03	18.41	17	17
21.	Ch'i (箕)	γ	Sgr	252.34	−29.41	254.57	253.74	257.44	9.65	$10\frac{1}{4}$	10
22.	Tou (斗)	φ	Sgr	262.64	−27.22	263.44	263.25	267.09	23.83	$23\frac{1}{2}$	23
23.	Niu (牛)	β	Cap	288.17	−17.78	287.34	286.74	290.92	6.93	$7\frac{1}{2}$	8
24.	Nu (女)	ε	Aqr	295.46	−13.19	295.02	293.57	297.85	11.11	$11\frac{1}{4}$	11
25.	Hsu (虚)	β	Aqr	306.89	−10.28	306.69	304.52	308.96	9.01	$10\frac{19}{3040}$	10
26.	Wei (危)	α	Aqr	315.90	− 5.69	316.67	313.40	317.97	16.04	$17\frac{3}{4}$	18
27.	Shih (室)	α	Peg	331.36	+ 9.00	336.82	329.21	334.01	18.09	$17\frac{1}{4}$	17
28.	Pi (壁)	γ	Peg	348.09	+ 8.53	352.49	347.04	352.10	9.11	$9\frac{3}{4}$	10

Table 2.

alongside with the equatorial coordinate system.[8] The next step will be to compare these ephemerides with the modern tables such as Tuckerman's.[9] However, at present I want to turn our attention only to the topics which are interesting in the context of the transmission of astronomy and astrology.

1. On the upper margin of the ephemerides, just above each numeral expressing the year within the period, one or two sexagesimal

year-cycle names are added almost without interruption. The names of Japanese eras are also sporadically indicated. These roughly cover the 11th to 13th centuries, a period when Buddhist astrology was most popular in Japan. Further we find that the second year of Genei (1119) is marked in all the ephemerides and that the first year of Enkyu (1069) is in all but those of Jupiter and Saturn. Thus we can at least say that there was a Japanese astrologer who used these ephemerides in order to obtain planetary positions for the years 1069 and 1119.

2. More interesting to me are the ephemerides of Rāhu and Ketu. The epoch for their tables is 806. Rāhu's constant and backward motion is given as $1^{\circ\circ}$ per 19 days, $1\frac{6}{10}^{\circ\circ}$ per month, $19\frac{1}{3}^{\circ\circ}$ per year, $30^{\circ\circ}$ per $1\frac{1}{2}$ years, and 1 rotation minus $11\frac{2}{3}^{\circ\circ}$ per 18 years. (I use the superscript of double circles for Chinese 'degrees'.)[10] The initial position of Rāhu is given as $10^{\circ\circ}$ of Chên (No. 14) which roughly corresponds to 177.6 modern degrees. I computed the position of the ascending node of the moon for the epoch (15. Feb., 806) by means of Brown's formula,[11] and the result was 175.74°. The identity of Rāhu with the lunar ascending node is thus beyond doubt.

The tabulation of Ketu would be superfluous if it were the moon's descending node. What is more, the motion of Ketu in our table is constant and forward. As Prof. Yabuuti (1969, p 184) first noted, the period ascribed to Ketu is that of the moon's perigee, that is, $1^{\circ\circ}$ per 9 days, $3\frac{4}{10}^{\circ\circ}$ per month, $30^{\circ\circ}$ per 9 months, $40\frac{7}{10}^{\circ\circ}$ per year, 1 rotation $6\frac{3}{10}^{\circ\circ}$ per 9 years. Ketu's initial position in the ephemeris is given as $5^{\circ\circ}$ of Niu (No. 23), which is about 291.7°. Computing by Brown's formula,[12] I got 104.67° as the position of the lunar perigee, which means that the apogee was located at 284.67°. Thus Ketu is not the perigee as Prof. Yabuuti speculated, but rather the apogee of the moon. In Indian astronomy as well as in Greek astronomy, lunar anomaly was always counted from the apogee, while in Chinese astronomy the perigee was the initial point. The tabulation of the motion of the lunar apogee (*candramandocca* in Sanskrit) shows that the *Ch'i-yao jang-tsai-chüeh* represents a tributary of Western tradition of astronomy, though with the confusing misnomer.

3. It is particularly interesting that such a peculiar notion of Ketu was handed down to Japanese astrologers and survived in Japanese horoscopes. Of the several fragments of horoscopes cast by ancient

	Text			I approx. long.	II Tuckerman's table
Sun	Niu	(24)	5.19°°	302.64°	301.3°
Moon	Wei	(20)	4.93	245.08	240.3
Jupiter	Ching	(8)	21.30	103.79	107.0
Mars	I	(13)	0.93	153.96	167.4
Saturn	Shih	(27)	9.32	342.28	347.7
Venus	Nu	(24)	9.95	307.33	292.3
Mercury	Wei	(26)	4.10	321.38	319.5
					By Brown's formula
Răhu	K'uei	(1)	1.14	0.97	359.3 (Ω)
Ketu	Chên	(14)	9.44	181.16	173.5 (A)

Table 3a. Tenei Horoscope. Date: A.M. 1–3 Jan. 15 (Wed.), A.D. 1113 Julian Days 2127596

	Text			I approx. long.	II Tuckerman's table
Sun	Chang	(12)	3°°	139.5°	141.2°
Moon	Ching	(8)	6	91	98.5
Jupiter	Chang	(12)	10	146.5	150.0
Mars	Pi	(5)	13	71.8	84.2
Saturn	Ching	(8)	23	107.8	109.1
Venus	Chên	(14)	1	175.2	177.3
Mercury	Hsing	(11)	6	136.4	129.3
					By Brown's formula
Rāhu	Fang	(18)	1	232.3	230.7 (Ω)
Ketu	Lou	(2)	10	30.3	23.36 (A)

Table 3b. Bunei Horoscope. Date: P.M. 9–11 Aug. 6 (Mon.), A. D. 1268 Julian Days 2184413

Japanese astrologers only two have been preserved in their complete form, one for a native born at 1–3 A. M. of January 15 (Wednesday), A. D. 1113 (which I call the Tenei horoscope), and the other at 9–11 P. M. of August 6 (Monday), A. D. 1268 (which I call the Bunei horoscope).[13] In tables 3a and 3b I have given the positions of the planets and Rāhu and Ketu as I derived them from these horoscopes (column I),[14] and as computed from Tuckerman's tables and Brown's formulae (column II). In the case of the Tenei horoscope, Rāhu and Ketu are almost in opposition; therefore, no one has ever doubted Ketu's identity with the descending node, even though the motion of Ketu was described as 'forward'. But it was only a pure coincidence. Actually it is the position of the lunar apogee, although about 7.5 degrees off the true position. My interpretation is supported by the next case of the Bunei horoscope, where Ketu is clearly not in opposition to Rāhu, so we can confidently say that Ketu is the lunar apogee, again 7 degrees off the true position.

As was discovered by Prof. Momo,[15] the authors of both horoscopes employed the same epoch, namely, the *yu-shui* of A. D. 660. This epoch is exactly the same as that used by Ts'ao Shih-wei (曹士蔿) in his *Fu-t'ien li* (符天曆), a most mysterious calendar of probably Central Asian origin, to which Chinese historians frequently refer, but which has long been lost. In 1963 a fragment of the text was discovered in the Tenri Library, Japan.[16] It is now established that the *Fu-t'ien li* was widely used by the Sukuyodo school of Japanese astrologers of the 11th to 13th centuries. Prof. S. Nakayama proved that the fragment, which gave a table of the solar motion, was based on a parabolic function.[17] Prof. E. S. Kennedy, on the other hand, discovered a Uighur calendar in which the equation of center was expressed by a parabolic function.[18] Unfortunately what we have of the *Fu-t'ien li* is only a fragment and it does not permit any further study.

That the *Ch'i-yao jang-tsai-chüeh* is somewhat related to the *Fu-t'ien li* was already known from the fact that the latter refers to the epoch of the former and also from a Chinese historical record which states that Ts'ao Shih-wei tabulated the motions of Rāhu and Ketu using 806 as epoch.

Combining all the evidence, we can conclude that the tables of Rāhu and Ketu in the *Fu-t'ien lis* were not much different from those in the *Ch'i-yao jang-tsai-chüeh*.

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NOTES

1. The list of books brought from China by Shuei is contained in the Taisho Tripitaka (Tokyo) No. 2175a (Vol. 54, pp. 1108–1111). In the same list is found the title *Tu-li-yü-ssu-ching* (都利聿斯經) of which the first four characters seem to represent a corrupt phonetic translation of the name Ptolemaios.
2. Taisho Tripitaka No. 1308 (Vol. 21, pp. 426–452).
3. H. Momo, 'Nichien no Futenreki Seirai', *Ritsuryokokka to Kizokushakai* (Dr. Takeuchi Commemoration Volume), Tokyo 1969, pp. 393–420, esp. note 26 on p. 417.
4. I use the Sanskrit names Rāhu and Ketu. In our Chinese text they are transcribed as 羅睺 (Lo-hou) and 計都 (Chi-tu). For these very controversial two imaginary 'planets', readers are referred to W. Hartner, 'The Pseudoplanetary Nodes of the Moon's Orbit in Hindu and Islamic Iconographies', *Oriens-Occidens* I, 1968, pp. 349–404.
5. For this terminology, see O. Neugebauer, *A History of Ancient Mathematical Astronomy,* Berlin-Heidelberg-New York 1975, p. 386.
6. K. Yabuuti, *Chugoku no Tenmon-rekiho,* Tokyo 1969, pp. 181–186, esp. Table 15 on p. 182.
7. K. Yabuuti, *op. cit.*, p. 279. I used P. V. Neugebauer's *Sterntafeln* (Leipzig 1912) for right ascension (α) and declination (δ) of A. D. 800 and converted the right ascension into ecliptic longitude (λ) and polar longitude(λ^*). The latter was again converted into Chinese degrees ($\lambda^{*\circ\circ}$), the differences of which ($\triangle\lambda^{*\circ\circ}$) were compared with the numbers found in the *Ta-yen li* (T) which was compiled by I Hsing in A. D. 727 and those of the *Ch'i-yao jang-tsai-chüeh* (Ch).
8. Yabuuti, *op. cit.*, pp. 54–64.
9. B. Tuckerman, *Planetary, Lunar, and Solar Positions A. D. 2 to A. D. 1649,* Philadelphia 1964.
10. In Chinese astronomy, the number of degrees of a circumference of celestial circles was equated with that of days in a solar year. In the case of *Wu-chi li,* for example, where the year length is 365 328/1340, one Chinese degree = 0.98564°.
11. $\Omega = 259.183275^\circ - 0.0529539222^\circ\, d + 0.002078^\circ T^2 + 0.000002^\circ T^3$ (Simplified for computational purpose by Prof. T. Watanabe, former Professor of Kyoto Sangyo University), where d is the number of days and T is the number of centuries between the given date and the epoch which falls on Jan. $0^d\, 0^h$, 1900 A. D.
12. $\Pi = 334.329556^\circ + 0.1114040803^\circ\, d - 0.010325^\circ T^2 - 0.000012^\circ T^3$. For the notations etc., see above note 11.
13. The diagrams of both horoscopes were reproduced in S. Nakayama, *A History of Japanese Astronomy,* Harvard University Press 1969, pp. 60 and 61 (with wrong dating). Further details are given in H. Momo, 'Sukyodo to Sukuyo-kanmon', *Rissho-shigaku* Vol. 39 (1975), pp. 1–20.

14. I converted the numbers in the text into the ecliptic longitude for the two dates by the reversed process of note 7 above.
15. Momo (1975), p. 9.
16. H. Momo, 'Futenreki ni tsuite', *Kagakushi Kenkyu* 71 (1964), pp. 118–119.
17. S. Nakayama, 'The Significance of the *Fuit'ien li,* on the History of Astronomy', *Kagakushikenkyu,* 71 (1964), pp. 120–123.
18. E. S. Kennedy, 'The Chinese-Uighur Calendar as Described in the Islamic Sources', *Isis* Vol. 55, No. 182 (1964), pp. 435–443, reprinted in his *Studies in the Islamic Exact Sciences,* American University of Beirut 1983, pp. 652–660.