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The *Tārīkh-i Qitā* in the *Zīj-i Īlkhānī*

—The Chinese calendar in Persian—

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I. Introduction

In this article, we provide a translation with commentary and an edition of a Chinese calendar described in a *zīj* (astronomical handbook with tables), the *Zīj-i Īlkhānī* compiled in 1272. Naṣīr al-Dīn Ṭūsī (1201–1274), a polymath in his age, incorporated a chapter on a Chinese calendar—entitled the Qitai calendar (*Tārīkh-i Qitā*)[1]—into his *zīj*, having obtained the information from "a sage of the Qitai."[2]As a result, as far as surviving sources are concerned, this *zīj* became the first astronomical handbook in which the Qitai calendar was described. Later, the Qitai calendar continued to appear in *zīj*es that were mainly written in Persian (although a few are in Arabic), as can be seen in the following table.[3] The parameters of the Qitai calendar, however, were little modified in the later *zīj*es, almost all of which fundamentally followed the Qitai calendar in the *Zīj-i Īlkhānī*, despite the presence of small differences among the *zij*es in the wording and epoch year (van Dalen *et al.* 1997, 112).

[1] Hereafter, the Chinese calendar in *zīj*es is cited as the "Qitai calendar." The word Qitai (*Qitā/Khaṭā* in Persian) originally referred to a nomadic people who, by the tenth century, dominated a vast area in northern China and established the Liao dynasty (916–1125). By the Mongol period, the Turko-Mongols and the people from the west of Turkistan used this word to refer to northern China and its inhabitants. Moreover, the Russian word for China, Китай, is derived from Qitai (as is the earlier English word "Cathay") (cf. Pelliot 1959-73, 1: 216-229).

[2] For the sage and situation about the compilation of the calendar, see Isahaya (2009)

[3] Benno van Dalen sent me this list, which I have slightly revised, in an e-mail dated October 1, 2009.

N.	Author	Title	Year
1.	Naṣīr al-Dīn Ṭūsī	*Zīj-i Īlkhānī*	1272
2.	Muḥyī al-Dīn Maghribī	*Adwār al-Anwār*	1276
3.	Jamāl al-Dīn b. Maḥfūẓ al-Baghdādī	Unknown	1286
4.	ʻAlā al-Munajjim al-Bukhārī	*ʻUmdat al-Īlkhānīya*	1287/88
5.	Sayf al-Munajjim al-Bāyzdiwī	*Zīj-i Ashrafī*	ca. 1303
6.	Nāṣir b. Haydar al-Shīrāzī	*Zīj-i Nāṣirī*	ca. 1310
7.	Shams al-Munajjim al-Wābiknawī	*Zīj al-Muḥaqqaq al-Sulṭānī*	ca. 1320
8.	Giyāth al-Dīn Jamshīd al-Kāshī	*Zīj-i Khāqānī*	1413
9.	Ulugh Beg	*Zīj-i Sulṭānī*	1440
10.	Rukn al-Dīn b. Sharaf al-Dīn al-Āmulī	*Zīj-i Jāmiʻ-i Saʻīdī*	1457
11.	ʻAbd al-Qādir b. Ḥasan al-Rūyānī	*Zīj-i Mulakhkhaṣ-i Mīrzāʼī*	1490
12.	Maḥumūd Shāh Kaljī	*Zīj-i Jāmiʻ*	16 c.
13.	Farīd Ibrāhīm Dihlawī	*Zīj-i Shāh-Jahānī*	ca. 1630

Given the above circumstances, we can appreciate the high value of the Qitai calendar in the *Zīj-i Īlkhānī*, especially from two standpoints: it is the first Chinese calendar described in *zīj*es, and it is a primary source produced as a result of cross-cultural contact during the period of the Mongol empire in Iran.[1] In the commentary, we analyze the contents of the Qitai calendar in comparison with Chinese astronomical tradition. To confirm the importance of this approach, we trace the course of studies on the Qitai calendar.

The Qitai calendar in *zīj*es has received attention from academics over the last few centuries. We could consider Ideler to be the forerunner of studies on the Qitai calendar in *zīj*es (Ideler 1832). In his study, Ideler dealt with Ulugh Beg's *Zīj-i Sulṭānī*—one of the most influential *zīj*es—that was keenly investigated by early modern scholars in Europe. Then, Sédillot edited, translated the Persian text of the calendar into French, and wrote a commentary on it on the basis of the *Zīj-i Sulṭānī* as part of his work to edit and translate that *zīj* (Sédillot 1847–1853). In the course of the nineteenth century, therefore, the Qitai calendar was studied along with an interest in the *Zīj-i Sulṭānī*, which was regarded as a

[1] Regarding astronomical interrelation between China and Iran in this period, while the situation of the eastern side was relatively well documented, the number of these kinds of sources is apparently small in the west (Allsen 2001, 161-175; van Dalen 2002).

zīj representative of "Islamic astronomy." Although these studies were useful enough to comprehend the general structure of the Qitai calendar, we should point out the inevitable problem of the text in the *Zīj-i Sulṭānī*, in which many Chinese technical terms transcribed in Persian are ignored. They would have found much of interest in these technical terms not only from a historical standpoint, but also from a linguistic one.

From the beginning of the twentieth century, when the history of science established itself as a discipline in the academic world, more detailed studies on this subject began to appear; first, we should refer to Kennedy's study (Kennedy 1964). Kennedy mathematically scrutinized the contents of the Qitai calendar, mainly by referring to Kāshī's *Zīj-i Khāqānī*, and provided later scholars with a reliable foundation to study this material. He explained the leading characteristics of the calendar consisting of the following three astronomical periods: (1) the solar year divided into twenty-four equal divisions, (2) the mean lunation, and (3) the anomalistic month. He also clarified some interesting facts in it; for example, he stated that a method in the lunar equation of the Qitai calendar was of Babylonian origin, as we shall discuss in the commentary.

Although we have pioneering works by Imai (1962) in which the Qitai calendar was contextualized in the Chinese astronomical tradition, the Qitai calendar attracted more attention in Japan after Kennedy's article. This interest is connected to the discovery of a fragment manuscript of the solar table of a Chinese astronomical system—the *Fu-tian li* 符天曆[1]—in Japan in 1963. As we shall see in the discussion of this astronomical system, it was never adopted as an official system by any Chinese dynasty, but it continued in use and even influenced several official astronomical systems. In China, there are few known sources that shed light on its contents. Nakayama, who carried out a close investigation into the fragment, noted that the specific method concerning the solar equation in the astronomical system can be identified as the same as that in the Qitai calendar (Nakayama 1966, 451-452).

Afterwards there appeared studies that dealt with the original source, the *Zīj-i Īlkhānī*. In an article focusing on the *Zīj-i Īlkhānī*, Mercier mentioned the Qitai calendar and tried to reconstruct several Chinese technical terms appearing in Persian transcriptions (Mercier 1984, 49-51). As a source for the Qitai calendar, he referred to the *Revised*

[1] For the notion of the Chinese term *li* 曆, which is better translated as an "astronomical system," see Martzloff (2009, 367-372) and Sivin (2009, 38-40).

Da-ming li 重修大明曆, which was officially adopted at the end of the Jin Dynasty (1182–1234) and initially used by the Mongols (Mercier 1984, 51-52).

From mathematical and astronomical viewpoints, this course of studies on the Qitai calendar resulted in a collaborative work by van Dalen, Kennedy, and Sayid (van Dalen *et al.* 1997). The study, which focused on the Qitai calendar, covers almost all the contents of the calendar. In addition, the authors reconstructed an extensive table for conversion between the Qitai and Hijri calendars. This table is attached at the end of the chapter on the Qitai calendar in the *Zīj-i Īlkhānī*. The study regards the *Revised Da-ming li* and *Fu-tian li* as main sources for the calendar. Therefore, it is clear that the Qitai calendar, in fact, does not completely accord with any known Chinese astronomical system but is an amalgam of various elements from several astronomical systems.

After elucidating its mathematical structure, studies followed attempting to embed the calendar into a historical context. Van Dalen assigned one section to the description of the calendar in his article concerning the astronomical interaction between Iran and China under Mongol domination (van Dalen 2002, 333-336). Although this calendar has been termed the "Chinese-Uighur" calendar, I have published an article in which I argued that the involvement of contemporary Uighurs in compiling the calendar is hard to validate (Isahaya 2009). This is why we call this calendar the "Qitai calendar" different from the conventional nomenclature.

In this way, the calendar has been investigated thoroughly from both mathematical and historical perspectives; however, we should acknowledge that some issues worth treating have been left unsolved. Among them, priority should be given to contextualizing the results achieved by previous studies concerning this calendar in the Chinese astronomical tradition. Although we have Imai's pioneering work, which is probably the only work undertaking this kind of approach, it is based on Sédillot's edition of Ulugh Beg's *Zīj-i Sulṭānī*. Now we need to scrutinize the contents of the Qitai calendar on the basis of the text of the *Zīj-i Īlkhānī*, critically edited on the basis of various manuscripts, to reassess all of the contents of the calendar in a comparison with the series of studies on Chinese astronomy accumulated over the last fifty years. Through continued analysis of this kind, we can gradually deepen our understanding of astronomical interrelation in Eurasia. For these purposes, a translation with commentary and an edition of the Qitai calendar shall be prepared.

II. Editorial Procedures

For textual criticism, we have Maas's comprehensive description of the stemmatic approach to philology (Maas 1958). Then, West's *Textual Criticism and Editorial Technique* (West 1973) can be regarded as a replacement for Maas's work. Whereas Maas's work treated contamination—which also has to be considered in this case—as a regrettable deviation, West reframed it into the "general" textual analysis. In addition, this work also deals with editorial method, which is not amply covered by Maas's work. Although West's focus is on Greek and Latin texts, the researchers of Arabic script-based text are also greatly benefited by his work. As a critical edition of a source written in Arabic script, Mano's edition of the *Bābur-nāma* can be considered to be a modeling work made by collating various manuscripts and reassessing the previous studies (Mano 1995). In addition, the draft of an edition and the English translation of the *Sheng-wu qin-zheng lu* 聖武親征錄 by Atwood has instructed me in the standard of a critical edition (Atwood forthcoming).

Among the many extant manuscripts of the *Zīj-i Īlkhānī*, the following nine, copied in relatively early periods, are collated to edit the text. As shall be explained after the short introduction of each manuscript, we can broadly classify these manuscripts into three versions: original, annotated, and embedded.

BoL (Oxford, Bodleian Library, 1513 [Hunt. 143]), was set as the base text for this edition, because this is the unique manuscript categorized into the embedded version which incorporates the marginal annotations—probably due to Ṭūsī himself—into the main text. This manuscript, in which author's revisions are reflected on the main text, can be considered the "final" version of this work. It was copied by Muḥammad b. Maḥmūd. b. 'Abd al-Raḥmān in 679 AH./1280–81. However, the first eleven leaves, including the description of the Qitai calendar (2v-10r), "are supplied later by other hands on white paper in a very bad and awkward hand writing" (Sachau & Ethé 1889, 926). So, the exact date when the part of the Qitai calendar was copied is unknown. In addition, BoL is a rare manuscript, in which the Qitai-Uighur calendar (*Tārīkh-i Khaṭā wa Uyghūr*) is explained in the sixth chapter (14v-19r), which is assigned to the explanation of the Jewish calendar in all other manuscripts we used.[1] Regarding the tables, unfortunately, almost all of these were illegible or not filled in. The leaf number appearing in the edited text is based on this manuscript.

BL (London, British Library, Or. 7464) was made at Maragha in 676 AH./1277–78, only three years after the death of Ṭūsī. This is a rare manuscript including the "longer" introduction (Boyle 1963). In this manuscript, supplemental annotations appear in the margin. Because of many differences of expression from other manuscripts, this manuscript seems to be categorized into a different group in terms of the wording.

KM (Tehran, Kitābkhāna, Mūza wa Markaz-i Asnād-i Majlis-i Shūrā-yi Islāmī, 181) was copied in the thirteenth century according to the introduction of the facsimile version recently published in Iran (Tusi 2012, 29). With regard to references to the Qitai calendar, unfortunately, the parts from the second section to the fifth section are missing. The main text is supplemented by marginal annotations as in BL.

SB (Berlin, Staatsbibliothek zu Berlin, Sprenger 1853)[2] was made in 689 AH./1290. The main text is similar to that of KM, but almost all the marginal notes appearing in BL and KM are little found in this manuscript.

DK (Cairo, Dār al-Kutub al-Miṣrīya, Dār al-Kutub Mīqāt Fārsī 1) was made at Maragha in 692 AH./1293 (King 1981, 203). The main text is close to that of SB, and this manuscript also lacks the marginal annotations appearing in some manuscripts like BL and KM.

BN (Paris, Bibliothéque nationale de France, Ms. Ancien fonds persan 163)[3] was copied by a son of the author, Aṣīl al-Dīn b. Naṣīr al-Dīn (d. 715 AH./1315), according to the first pages on the manuscript (Richard 1989, 179). He and his brother were in charge of the Maragha after the death of their father (Sayılı 1960, 217-218). With regard to the description on the Qitai calendar, the main text is well explained in contrast to the simple sentences appearing in SB and DK. But we do not find explanatory notes similar to the marginal annotations in BL and KM or those in the main text of BoL; therefore, this

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[1] The contents of the Qitai-Uighur calendar, consisting of ten sections in this manuscript, are by and large parallel with those of the Qitai calendar, but we find quite a few differences in the wording and values. In addition, many Persian transcriptions of the Chinese technical terms are cut off there.

[2] We can read the Berlin manuscript on the website of the Staatsbibliothek zu Berlin: (http://digital.staatsbibliothek-berlin.de/dms/werkansicht/?PPN=PPN635599538).

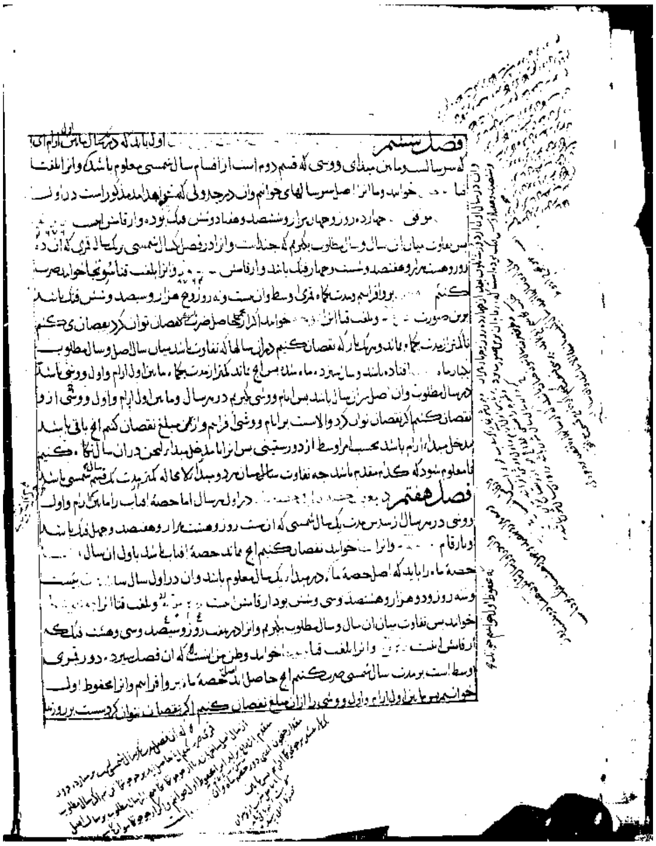
[3] This manuscript is available through Gallica, the digital library of the Bibliothèque nationale de France: (http://gallica.bnf.fr/ark:/12148/btv1b8410891x.r=Persan+163.langEN).

manuscript seems to be classified into an entirely independent group. The copyist was undoubtedly familiar with astronomical computation—we could conjecture that this is the aforementioned Aṣīl al-Dīn, though this is conjecture, because the end of the manuscript, from which we can usually take information about the copyist and date of copying, is missing. The copyist did not only revise the text but also the values in the tables.

NK: (Istanbul, Nuruosmaniye kütüphanesi, No. 2933) is a contaminated manuscript made by a cross-reference both to an embedded version, such as BoL, and the family of SB. In the manuscript, the marginal notes of the annotated versions like BL and KM appear in the main text as well as BoL. In addition, the specific values in the table of the seventh section only appear in this manuscript except for SB.

KDT (Tehran, Kitābkhāna-yi Dānishgāh-i Tihrān, Ḥikmat 165) is also noteworthy, because it is the only manuscript, besides the BL, which includes a longer introduction (Sawadi & Nik-Fahm 2012, 367). However, the wordings of the main text are a little bit different from that of BL; it is rather closer to the manuscripts of the other original and annotated versions. According to the catalogue, the manuscript was copied during the 14th and 15th centuries (Danish-Pazhuh, 1960-63, 1: 23). As far as the description of the Qitai calendar is concerned, the parts from the middle of the seventh section are omitted. This manuscript is also a contaminated one like NK, but the textual structure is closer to the original and annotated versions, unlike NK, which is closer to the embedded version.

BML (Florence, Biblioteca Medicea Laurenziana, Or. 24) has similar components with BL, KM and KDT, in which the contents of the main text are supplemented with marginal annotations. This manuscript is also made around 15th century as a result of contamination and the wording is close to the annotated versions. In regard to the values in the tables and Persian transcriptions of the Chinese technical terms, the copyist of the manuscript improved the values, probably through recomputation, and revised some foreign terms, perhaps through consultation with someone from China. Therefore, in terms of the tables and transcriptions, it is the most reliable manuscript among those which are used for this edition.



KDT (17v): we can see marginal annotations surrounding the main text.

As mentioned above, the aforementioned manuscripts can be classified into three versions: original, annotated, and embedded. The original versions include SB and DK. The main text of these manuscripts is sometimes too simple to explain the contents of the Qitai calendar. For this reason, further explanation would need to be added to the margins, as we shall discuss concerning the second versions. The second, annotated version consists of BL and KM, in which the main text of the original versions is supplemented by marginal annotations. There is little difference between the marginal annotations of the two manuscripts, so we can assume the close relationship of the manuscripts in this version. The annotations in the margins of the manuscripts appear in the main text of BoL which is classified into the third, embedded, version.

To consider the relationship among these three versions, we can refer to the case of the *Tadhkira fī ʿIlm al-Hayʾa* also compiled by Ṭūsī. Through an investigation into manuscripts of the work, Ragep identified two versions: the "original" Maragh and "final" Baghdad versions (Ragep 1993, 1: 70-75). The original version was revised at various times by Ṭūsī himself between 1261 and 1274, and the revision process can be seen in the margins of several manuscripts. "Ṭūsī would approve an original version and then have the copyist place the revisions he had made up to that point in the margins" (Ragep 1993, 1: 74). The final version refers to the one that incorporates all of the previous revisions into a new fair copy of the text, although it cannot be ascertained whether this version occurred before or after Ṭūsī's death (Ragep 1993, 1: 75).

The process of revision can be applied to the case of the *Zīj-i Īlkhānī*—at least in the part of the Qitai calendar—which was compiled around the same time as the *Tadhkira*. The original versions were probably revised by Ṭūsī himself. At first, revisions took the form of marginal annotations, and later, these annotations were incorporated into the main text. As Ragep did when editing the text of the *Tadhkira* (Ragep 1993, 1: 86), I have also designated the embedded version (BoL), which provides a consistent explanation of the contents, as the basic text for this edition.

Among the manuscripts to which we have referred, BN's position is relatively isolated. There is little marginal annotation in this manuscript. To clarify the meaning of the sentences, explanation was added in the main text of this manuscript; however, this explanation is original and it is not found in other manuscripts.

The other three manuscripts—NK, KDT, and BML—were made as a result of contamination; however, the characteristics of NK are quite different from the those of the other two. The text of NK was apparently based on an embedded version, like BoL, so that marginal notes appearing in the annotated versions are embedded into the main text; but, NK sometimes takes the description in the text and values in the tables from the other versions. Regarding the table of the seventh section, the values of a column are completely identical to those of SB and are not found in any other manuscript. On the other side, KDT and BML are essentially categorized into the annotated versions, like BL and KM; however, some passages are apparently also taken from embedded versions. We interpret this to mean that contamination occurred in these three manuscripts.

Since the first sentences about the lunar argument in the seventh section are quite a good example to show the abovementioned relationship among these nine manuscripts, we shall list the variations of this part in each version.

First, the text of SB, categorized into an original version, is taken:

> For the lunar argument, "the initial value of the lunar argument" at the beginning of a year must be known, which is called *jūnjūn kā* in the Qitai language.

و اما حصۀ ماه را باید که اصل حصۀ ماه در مبدأی یک سال معلوم باشد و به لغت قتا آن
را «جونجونکا» خوانند

As we can see, the specific value of the “the initial value of the lunar argument” is not mentioned in the original version. In the manuscripts of the annotated versions, the value is supplemented in the form of the marginal annotations as we can see the sentences in BL:

> For the lunar argument, “the initial value of the lunar argument” at the beginning of a year must be known.
>
> > (Marginal annotation) The value is 78 days and 3,948 *funk*s—78^d 1, 5, 48^f—in the year of the rat corresponding to the year 633 of the Yazdigird era, and then the value annually increases 7^d 0, 5, 38^f.
>
> The value is called *jūnjūn kā* in the Qitai language.

و اما حصۀ ماه را باید که اصل حصۀ ماه در مبدأی یک سال معلوم باشد

(حاشیه) و آن در سال موش که موافق خلج یزدجردی است، عح روز و اهمح فنک بوده است؛ و بعد از آن،
هر سال را این ز٠هلح مقدار می‌باید افزود

و به لغت قتا آن را «جونجونکا» خوانند

The marginal annotation is incorporated into the main text of the BoL, the embedded version:

> For the lunar argument, “the initial value of the lunar argument” at the beginning of a year must be known, which is 78 days and 3,948 *funk*s—78^d 1, 5, 48^f—in the first year of the Superior Epoch corresponding to the year 633 (of the Yazdigird era), and which is called *jūnjūn kā* in the Qitai language.

و اما حصهٔ ماه را باید که اصل حصهٔ ماه در مبدأی یک سال معلوم باشد؛ و آن در اول
سال شانک‌ون موافق خلج هفتاد و هشت روز و سه هزار ونهصد و چهل و هشت فنک بوده
است، ارقام آن عح اهمح و به لغت خطاییان را «جونجونکا» خوانند

The marginal passage “and then the value annually increases 7^d 0, 5, 38^f” in BL is not found in BoL. But the same explanation follows after the passage “the value is called *jūnjūn kā* in the Qitai language,” so that the sentence of BL is repetitive.

Then we see the sentences of BN as below:

> For the lunar argument, “the initial value of the lunar argument” at the beginning of a year must be known. The value is 23 days and 2,836 *funk*s—23^d 0, 47, 16^f—in the first year of the Superior Epoch. The value is called *jūnjūn kā* in the Qitai language.

و اما حصهٔ ماه را باید که اصل حصهٔ ماه در مبدأی یک سال معلوم باشد؛ و آن در اول
شانک‌ون بیست و سه روز و دو هزار و هشتصد و سی و شش فنک بوده و ارقامش کج
٠مزیو؛ و به لغت قتا آن را «جونجونکا» خوانند

The difference of the “initial value” between 78.3948 and 23.2836 days is caused by the fact that the latter subtracted the period of an anomalistic month as many times as possible from the value of the first. Although this difference does not affect the final result, the following marginal annotation related to this passage is worth noticing for consideration of the relationship of the manuscript with others:

> In the poor exemplar, the *junjūn*(s) (i.e., anomalistic months) have been added to the “initial value of the lunar argument.” It has been set as 78^d 1, 5, 48^f in the first year of the Superior Epoch.

در نسخهٔ اصل ضعیف، «جنجون» بر اصل حصهٔ ماه افزوده است و در اول شانک‌ون
نهاده و ارقامش این است عح ا٥مح

From this, we know that the copyist of the manuscript revised the original sentence of the "poor exemplar," probably an original version.

Now, we refer to the contaminated manuscripts, and, first of all, the sentences of NK are addressed:

For the lunar argument, "the initial value of the lunar argument" called the "first value to be kept" at the beginning of a year must be known.

(Marginal annotation 1) The value is 23 days and 2,836 *funk*s—23^d 0, 47, 16^f—in the first year of the Superior Epoch corresponding to the year 633 (of the Yazdigird era).

(Marginal annotation 2) The value is 78 days and 3,948 *funk*s—78^d 1, 5, 48^f—in the first year from the cycle of the Superior Epoch.

The value is called *jūnjūn kā* in the Qitai language.

و اما حصهٔ ماه را باید که اصل حصهٔ ماه را که محفوظ اول خوانیم در مبدأی یک سال معلوم
باشد

(حاشیهٔ اول) و آن در اول شانک‌ون موافق خلج کج روز بوده است ٠مزیو فنک
(حاشیهٔ دوم) و آن در سال اول از دور شانک‌ون هفتاد و هشت روز و سه هزاز و نهصد و چهل و هشت فنک
بوده است که ارقامش این است عح ا٥مح

و به لغت قتا آن را «جونجونکا» خوانند

There are two marginal annotations in NK; the first denotes the same value as that of BN, and the second is taken either from the text of an embedded version or from a marginal note of the annotated versions. The manuscript contains two values taken from different sources.

Next are the sentences of KDT in the same part:

For the lunar argument, “the initial value of the lunar argument”—(marginal annotation) we will call (it) the “first value to be kept”—at the beginning of a year must be known. The value is 23 days and 2,836 *funk*s—23^d 0, 47, 16^f—in the first year of the Superior Epoch.

(Marginal annotation) The value is 78 days and 3,948 *funk*s—78^d 1, 5, 48^f—in the first year of the cycle of the Superior Epoch.

The value is called *jūnjūn kā* in the Qitai language.

و اما حصهٔ ماه را باید که اصل حصهٔ ماه –(حاشیه) که محفوظ اول خواهیم خواند— در مبدأی یک سال معلوم باشد. و آن در اول سال شانک‌ون بیست و سه روز و دو هزار و هشتصد و سی و شش بود ارقامش این است کج ٠مزیو

(حاشیه) و آن در اول سال شانک‌ون هفتاد و هشت روز و سه هزار و نهصد و چهل و هشت فنک وده است و ارقامش این است عح امح

و به لغت قتا آن را «جونجونکا» خوانند

The main text of KDT is quite similar to that of BN, but the marginal annotation in NK are also taken.

Finally, we refer to the sentences of BML, which is also a contaminated manuscript:

For the lunar argument, “the initial value of the lunar argument”—(marginal annotation 1) we will call (it) the “first value to be kept”—at the beginning of a year must be known.

(Marginal annotation 2) The value is 78 days and 3,948 *funk*s—78^d 1, 5, 48^f—in the first year of the Superior Epoch.

The value is called *jūnjūn kā* in the Qitai language.

و اما حصهٔ ماه را باید که اصل حصهٔ ماه –(حاشیه) که آن را محفوظ اول خواهیم خواند— در مبدأی یک سال معلوم باشد

(حاشیه) و آن در اول سال شانک‌ون هفتاد و هشت روز و سه هزار و نهصد و چهل و هشت فنک وده است و ارقامش این است عح امح

و به لغت قتا آن را «جونجونکا» خوانند

The text is almost identical to that of the annotated versions, but the first marginal annotation is the same as that of NK.

We can hardly determine a single archetype, considering the constant revisions made to the text. This fact makes it clear that no stemma can be decisively constructed. Under these circumstances, we should be reconciled to see what groupings are apparent among these nine manuscripts (cf. West 1973, 42). Considering the variations between the manuscripts, therefore, we can make a table as below. While we have edited the text of the Qitai calendar on the basis of BoL, all variations between the manuscripts have been embedded in the footnotes of the edition.

Versions	Manuscripts (the Date of Coying)
Original Versions	SB (1290) and DK (1293)
Annotated Versions	BL (1277/78) and KM (13 c.)
Embedded Version	BoL (after 1280/81)
Revised Version	BN (by 1315)
Contaminated Versions	NK, KDT (14-15 c.) and BML (ca. 14 c.)

The values of all entries in the table have been recomputed through the computer program SCTR (Sexagesimal Calculator prepared by Benno van Dalen) on the basis of the constants taken from the text. These "exact" values have been filled in the tables of the edited text and translation. However, in some cases, every manuscript put a value different from the recomputed one in an entry. The variants different from the recomputed values are recorded in the footnote.

In editing this text, we adopted the modern Persian orthography according to a procedure followed by Nīk-Fahm and Shahīdī (Nik-Fahm & Shahidi 2009, 59-60). The edited text is punctuated to facilitate reading, though no markings appear in the original sentences. The letters "پ," "چ," and "گ" are represented as "ب," "ج," and "ک," in most manuscripts, and we basically revise the forms of the original text to suit modern orthography.

In addition, we have to mention our principle for transliterating Chinese characters into the Latin script. In the text, we encounter many Chinese words transcribed into

Persian, which undoubtedly have significant value from a linguistic standpoint. As is well known, Chinese pronunciation in the thirteenth century differed from that in the present; hence, we have to consider the then pronunciation—i.e. Yuan-era early Mandarin—in order to reconstruct the original Chinese characters from the phonetic transcriptions in the text. We refer to Li and Zhou's tabular work and Pulleyblank's lexicon concerning Yuan-era early Mandarin to deal with the Persian transcription forms in this text (Pulleyblank 1991; Li & Zhou 1993). On the other hand, in some cases, we find it more convenient to provide the present pronunciation; therefore, we parallelize two transliteration forms along with the Chinese characters. For example, let us take the case of *ke* 刻 (khiai). The italicized *ke* is the present pronunciation according to the *Pinyin* system, which is followed by the Chinese character 刻. Then, the historical pronunciation "khiai" using the International Phonetic Alphabet is shown within parentheses.

In any case, the Persian transcriptions seem somewhat inconsistent, when not obviously incorrect, as in the case of the "History of China" in *Jāmiʿ al-Tawārīkh* compiled in Iran under Mongol rule (cf. Wang 2006). In some cases, copyists transcribed the same Chinese character in different ways in a manuscript. For example, in the table of the twenty-four solar divisions (the third section), the term *xiao* 小 (siau) appears four times: the eighth, eleventh, twentieth, and twenty-third divisions. In the table, there are two distinctly different transcriptions as *siyū* and *siyāu*. We are interested in the obvious mistakes in the transcriptions. For example, *pī* for *yi* 乙 (i), the second of the cycle of the ten "heavenly stems." One would have to assume in the beginning *pī* was *yī*. But very early on, it seems they got corrupted, as can be seen in BoL, SB, and NK. But some manuscripts seem to have the correct form such as BL and BML. Since we can hardly find the direct relationship between BL and BML, it is possible that the BML copyist relied on some informant—probably Chinese—for the Persian transcriptions. I am not familiar with linguistics, but hopefully, this material will also have some value for specialists in that field.[1]

Before moving to the translation, we review the characteristics of the *Zīj-i Īlkhānī* itself, and then consider the significance of the Qitai calendar from the standpoint of its contents. Although the *Zīj-i Īlkhānī* is considered to be the major production by the

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[1] For the discussion of this paragraph, I am definitely indebted to comments upon the draft by Christopher Atwood.

scholars of the Maragha observatory, who achieved a series of astronomical innovations leading to the Copernican heliocentric celestial model, this *zīj* follows the Ptolemaic tradition, and the parameters underlying the solar, lunar, and planetary tables were taken from the previous *zīj*es, such as ones compiled by Ibn Aʻlam, Ibn Yūnus, and Bīrūnī. As King and Samsó point out, what is new in the *Zīj-i Īlkhānī* is the calendrical material; that is, the introduction of the Qitai calendar which covers more than the half of the first book (*maqāla*)—concerning chronology and calendar conversion—of the *zīj* (King & Samsó 2001, 46; 2002, 499). We list the table of contents of the chapter on the Qitai calendar in the *Zīj-i Īlkhānī* as follows (cf. Mercier 1984, 41-42).

Chapter 1
Description of the Qitai Calendar, on Knowing Its Years and Months.

Section 1
On the explanation of the divisions of a night-day among the people of the Qitai.

Section 2
On the consideration of the cycle of days.

Section 3
On knowing the years of the Qitai and their divisions in each year.

Section 4
On the consideration of the cycles of years among the Qitai and their era.

Section 5
On knowing the beginning of the divisions of the solar years which occur in each year.

Section 6
On knowing the beginning of the first month on mean motion.

Section 7
On knowing the arguments of the sun and the moon in the beginning of each year.

Section 8
On finding the equation of the sun.

Section 9
On finding the equation of the moon.

Section 10
On knowing the beginnings of each required year and determining an intercalary month in a year in which it occurs.

Section 11

On knowing the fourth cycle.

Section 12

On knowing the Qitai calendar from the Arabic calendar.

Symbols

( ): In the case of the Persian text, folio numbers from the BoL manuscript are given inside parentheses ( ) in the main text. In the case of the English translation, in addition to the former usage, parentheses ( ) are reserved for adding clarifying information to the original text or words.

[ ]: In the Persian text, passages or words which are missing from the base manuscript and were restored on the basis of evidence from other manuscripts are enclosed in square brackets [ ]. Square brackets are also used in cases in which the form found in the base manuscript was corrected on the basis of forms found in other manuscripts. In both cases, the source of evidence with other variants is given in footnotes.

« »: In the Persian edition, the Chinese technical terms transcribed into Persian are given inside double angular brackets « » in the main text. These terms are marked in *italics* in the English translation.

__: The *abjad* numerals are underlined in the Persian text.

III. Translation

(2v) **Chapter 1**

Exposition of the Qitai Calendar, on Knowing Its Years and Months Consisting of the Twelve Sections

Section 1

On the explanation of the divisions of a night-day among the people of the Qitai

Scholars in the Qitai and Turkistan establish a cycle of twelve for the divisions of a night-day, days and years, and apply a name to each twelve. The names of the twelve in two languages (i.e., Chinese and Turkish) are as follows.

Numbers	1	2	3	4	5	6
Names in Chinese	*zhih*	*chīu*	*yim*	*māu*	*chin*	*ṣiz*
Names in Turkish	*kuskū*	*ūṭ*	*bars*	*ṭāushqan*	*lū*	*yīlān*
Numbers	7	8	9	10	11	12
Names in Chinese	*wū*	*wī*	*shin*	*yū'u*	*sū*	*khā'ī*
Names in Turkish	*yūnd*	*qūy*	*bījīn*	*dāqūq*	*īt*	*ṭūnghūz*

They also divide each night-day, in the same manner as our arithmeticians divide it into twenty-four, into twelve *chāgh*s (i.e., double-hours).[1] (3r) They subdivide each double-hour into eight *kih*[2] and also divide the whole night-day into 10,000 *funk*s.[1] Thus,

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[1] This is a Turkish word *čāğ*, which means "time" (Dihkhuda *et al.* 1998, 5: 7998). According to Clauson, this word is not found in Turkish before the Mongol period, when it replaced *öd* (Clauson 1972, 404). For *öd*, see Bazin (1991, 43, 259-260). Here, the *čāğ* is equivalent to the Chinese *shi* 時, which is a double-hour; that is to say, a unit dividing a day into twelve equal intervals (Sivin 2009, 82-83). It is most likely that the word *čāğ* became synonymous with the Chinese *shi* through cultural contact during the Mongol period, and then, holding the meaning of a double-hour, was transmitted further west.

[2] Chinese *ke* 刻 (khiai). In Chinese astronomy, a *ke* was usually taken as a hundredth of a day, slightly less than the value of one ninety-sixth used in this calendar. The reason for adopting this value in this calendar might be ascribed to making one double-hour (*chāgh*) equal to an integral number of *ke*s. In fact, sometimes efforts were made to modify the traditional value of *ke* in China, in order to make the system commensurate with the double-hours; in one of these reforms, Emperor Wu of the Liang dynasty in 507 reduced the number

each double-hour is 833 *funk*s and one-third, and each *kih* is 104 *funk*s and one sixth. They regard the starting point of a night-day as midnight, that is the point when the first half of the double-hour of *zhih* or rat passes, and the second half remains.[2] After that, the double-hours continually pass one by one until the midday that falls on the middle of the double-hour of *wū* or horse. At the time when the length of a day and night are equal, the beginning of the day is the middle of the double-hour of *māu* or hare, and the beginning of the night is the middle of the double-hour of *yū'u* or cock. Because the length of day and night increases and decreases, the beginning of a day or night sometimes falls earlier and at other times later; however, the times of midnight and midday do not move at all. We have determined parts of double-hours and *kih*s with *funk*s, and put the results in a table in order to easily determine what time has passed in each double-hour and *kih*. According to the custom of our astronomers/astrologers, we have marked *funk*s in the sexagesimal form, and put (those on the table), and also marked fractional parts in the sexagesimal form. The whole *funk*s of a night-day are marked in the sexagesimal form, 2, 46, 40[f]. Then, whenever the number of *funk*s exceeds 10,000 *funk*s, it ought to be subtracted from that number. In place of the subtracted 10,000 *funk*s, a night-day is added. If a night-day is required to be represented in *funk*s, one is subtracted from the numbers of night-days and this number (i.e., 10,000 *funk*s) is put in place of it (i.e., a night-day) for the required calculation. The table is as follows.

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of *ke* in a day-night to ninety-six, the same as in this calendar. But this improvement, which made them exactly equivalent to the Chinese modern *ke* system, lasted only a very short time (Needham *et al.* 1960, 199).

[1] Chinese *fen* 分 (fuan). In Chinese astronomical systems *li* 曆, generally, the fractions of a day are denoted by means of specific denominators (called, for example *rifa* 日法; there are several nomenclatures for the fractions in Chinese astronomical systems, which might cause some confusion); with *rifa* 5230, for instance, the lengths of a year and month were represented as 365 1274/5230 and 29 2775/5230, respectively, in the *Revised Da-ming li* 重修大明曆, which was adopted as an official astronomical system at the end of the Jin dynasty (1182–1234) and was also initially used by the Mongols. Instead of a specific denominator, however, the Qitai calendar divided one day into 10,000 *funk*s, which is practically equivalent to adopting a decimal notation system up to the fourth decimal fraction; for example, as shall be mentioned later, the length of the solar year in this calendar is represented as 365 days and 2,436 *funk*s = 365.2436[d] (for fractions in the Chinese astronomy, see e.g., Sivin 2009, 63).

[2] The Chinese double-hours are called 12 *shi-chen* 時辰 and are represented by the twelve branches mentioned before. The first unit, the double-hour of *zi* 子, begins at 11:00 p.m. of the previous day and ends at 1:00 a.m, so that a day starts in the middle of the double-hour of *zi*.

Table on knowing the beginning of the double-hours and *kih* s in terms of the *funk* s of the night-day in sexagesimal form												
In Chiense	*zhih*	*chīu*	*yim*	*māu*	*chin*	*ṣiz*	*wū*	*wī*	*shin*	*yū'u*	*sū*	*khā'ī*
In Turkish	*kuskū*	*ūṭ*	*bārs*	*ṭāushqan*	*lū*	*yīlān*	*yūnd*	*qūy*	*bījīn*	*dāqūq*	*īt*	*ṭūnghūz*
Number of finks	2nd Power, 1st Power, *Funk* s, Fractions											
1	2,39,43,20	0, 6,56,40	0,20,50, 0	0,34,43,20	0,48,36,40	1, 2,30, 0	1,16,23,20	1,30,16,40	1,44,10, 0	1,58, 3,20	2,11,56,40	2,25,50, 0
2	2,41,27,30	0, 8,40,50	0,22,34,10	0,36,27,30	0,50,20,50	1, 4,14,10	1,18, 7,30	1,32, 0,50	1,45,54,10	1,59,47,30	2,13,40,50	2,27,34,10
3	2,43,11,40	0,10,25, 0	0,24,18,20	0,38,11,40	0,52, 5, 0	1, 5,58,20	1,19,51,40	1,33,45, 0	1,47,38,20	2, 1,31,40	2,15,25, 0	2,29,18,20
4	2,44,55,50	0,12, 9,10	0,26, 2,30	0,39,55,50	0,53,49,10	1, 7,42,30	1,21,35,50	1,35,29,10	1,49,22,30	2, 3,15,50	2,17, 9,10	2,31, 2,30
5	0, 0, 0, 0	0,13,53,20	0,27,46,40	0,41,40, 0	0,55,33,20	1, 9,26,40	1,23,20, 0	1,37,13,20	1,51, 6,40	2, 5, 0, 0	2,18,53,20	2,32,46,40
6	0, 1,44,10	0,15,37,30	0,29,30,50	0,43,24,10	0,57,17,30	1,11,10,50	1,25, 4,10	1,38,57,30	1,52,50,50	2, 6,44,10	2,20,37,30	2,34,30,50
7	0, 3,28,20	0,17,21,40	0,31,15, 0	0,45, 8,20	0,59, 1,40	1,12,55, 0	1,26,48,20	1,40,41,40	1,54,35, 0	2, 8,28,20	2,22,,21,40	2,36,15, 0
8	0, 5,12,30	0,19, 5,50	0,32,59,10	0,46,52,30	1, 0,45,50	1,14,39,10	1,28,32,30	1,42,25,50	1,56,19,10	2,10,12,30	2,24, 5,50	2,37,59,10

Section 2
On the consideration of the cycles of days

The Qitai have another cycle by which they take days and years into consideration. That is a cycle of ten, names of which are as follows: 1. *kā*, 2. *yī*, 3. *pīn*, 4. *tīn*, 5. *wū*, 6. *kī*, 7. *kin*, 8. *sin*, 9. *zhim*, 10. *kūy*. By combining this cycle with the cycle of twelve, a cycle of sixty is obtained. They count years and days with this cycle. This cycle is their substitute for our week. We call this cycle the "sixty-cycle." The compound of these two cycles is in the way that was put in the following table.

1. *kā-zhih*	2. *yī-chīu*	3. *pīn-yim*	4. *tīn-māu*	5. *wū-chin*	6. *kī-ṣiz*	7. *kin-wū*	8. *sin-wī*	9. *zhim-shin*	10. *kūy-yū'u*
11. *kā-sū*	12. *yī-khā'ī*	13. *pīn-zhih*	14. *tīn-chīu*	15. *wū-yim*	16. *kī-māu*	17. *kin-chin*	18. *sin-ṣiz*	19. *zhim-wū*	20. *kūy-wī*
21. *kā-shin*	22. *yī-yū'u*	23. *pīn-sū*	24. *tīn-khā'ī*	25. *wū-zhih*	26. *kī-chīu*	27. *kin-yim*	28. *sin-māu*	29. *zhim-chin*	30. *kūy-ṣiz*
31. *kā-wū*	32. *yī-wī*	33. *pīn-shin*	34. *tīn-yū'u*	35. *wū-sū*	36. *kī-khā'ī*	37. *kin-zhih*	38. *sin-chīu*	39. *zhim-yim*	40. *kūy-māu*
41. *kā-chin*	42. *yī-ṣiz*	43. *pīn-wū*	44. *tīn-wī*	45. *wū-shin*	46. *kī-yū'u*	47. *kin-sū*	48. *sin-khā'ī*	49. *zhim-zhih*	50. *kūy-chīu*
51. *kā-yim*	52. *yī-māu*	53. *pīn-chin*	54. *tīn-ṣiz*	55. *wū-wū*	56. *kī-wī*	57. *kin-shin*	58. *sin-yū'u*	59. *zhim-sū*	60. *kūy-khā'ī*

(3v) *Section 3*
On knowing the years of the Qitai and their divisions in each year

The years of the Qitai are solar, that is, they are measured from the time when the sun reaches a certain point on the celestial sphere until the time when the sun returns to the same place. According to them, this amounts to 365 days and 2,436 *funk*s which in the sexagesimal form is 365^{d} 0, 40, 36^{f} and which is called *suijū* in their language.[1] As our astronomers/astrologers divide a year into twelve, they divide the length of a year into twenty-four equal parts, each of which comprises 15 days and 2,184 5/6 *funk*s—which in the sexagesimal form is 15^{d} 0, 36, 24^{f} 50. Each part is called one *kīja* in their language.[2] Moreover, each season consists of six *kīja* and the beginnings of our seasons fall in the middles of their seasons. Thus, the beginning of spring among them approximately falls in the middle of the sign Aquarius. The four points of the solstices and equinoxes are in the middles of their seasons. The names of the divisions of a year in their language and the numbers of days and *funk*s in the sexagesimal form from the beginning of the year through to the end are presented in the following table.

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[1] The term *suijū* might well be the phonetic transcription of the Chinese *sui-zhou* 歲周 (sui-tʂiau), the length of a solar year, taken as 365.2436^{d} in this case. Although there are various values taken as the length of a solar year in the Chinese astronomical systems, the value in the *Zīj-i Īlkhānī* is almost equal to that of the *Revised Da-ming li* ($365.243594...^{d}$) adopted in the later Jin and early Yuan periods (1182–1234 and 1215–1280) (*Jin shi*, 21: Bu qi-shuo 1; Yabuuti 1990, 388-393). This is one reason why we can regard this astronomical system as one of sources of the Qitai calendar (other reasons shall be discussed below). This term has also been ascribed to *sui-shi* 歲實 (sui-ʂi) (van Dalen *et al.* 1997, 149), but this term denotes the Year Numerator (3,652,436 *funk*s in this case), not exactly the days of the solar year (Sivin 2009, 615). From the viewpoint of the Persian transcription, furthermore, it is somewhat difficult to read the term in such a way.

[2] The term *kīja* is probably the Chinese *qi-ce* 氣策 (khi-tʂhai), the length of the twenty-four equal divisions of a solar year, each 15.21848333... days long in this case (cf. Sivin 2009, 79-81). This term appears in the *Revised Da-ming li* and *Shou-shi li* 授時曆, the official astronomical systems of the Jin and Yuan dynasties respectively (*Jin shi*, 21: Bu qi-shuo 1; *Yuan shi*, 54: Bu qi-shuo 1; Sivin 2009, 79-81, 604). Although this term has been interpreted in other ways such as *jie-qi* 節氣 (tsiɛ-khi) or *zhong-qi* 中氣 (tʂiuŋ-khi), both of these are far from the Persian transcription form and the latter does not denote each of the twenty-four divisions of a solar year but only the even-numbered ones (Mercier 1984, 50; van Dalen *et al.* 1997, 149).

Table of the beginnings of each solar division, calculated in days and *funks* in sexagesimal form							
The Spring Season				The Summer Season			
Number of Divisions	Names of Divisions	Days	2nd Power, 1st Power, *Funks*, Fractions	Number of Divisions	Names of Divisions	Days	2nd Power, 1st Power, *Funks*, Fractions
1	*līјun*	0	0,0,0,0,	7	*līkha*	91	0,51,49,0
2	*wūshī*	15	0,36,24,50	8	*siyū-man*	106	1,28,13,50
3	*kin-jih*	30	1,12,49,40	9	*manjun*	121	2,4,38,40
4	*shūn-fūnd*	45	1,49,14,30	10	*shājir*	136	2,41,3,30
5	*shīnk-mīnk*	60	2,25,39,20	11	*siyāu-shū*	152	0,30,48,20
6	*kūwū*	76	0,15,24,10	12	*dāy-shū*	167	1,7,13,10
The Autumn Season				The Winter Season			
Number of Divisions	Names of Divisions	Days	2nd Power, 1st Power, *Funks*, Fractions	Number of Divisions	Names of Divisions	Days	2nd Power, 1st Power, *Funks*, Fractions
13	*līјū'u*	182	1,43,38,0	19	*lītūn*	273	2,35,27,0
14	*chīu-shū*	197	2,20,2,50	20	*siyāu-shih*	289	0,25,11,50
15	*baylū*	213	0,9,47,40	21	*dāy-shih*	304	1,1,36,40
16	*siyū-fan*	228	0,46,12,30	22	*dūnjin*	319	1,38,1,30
17	*khanlū*	243	1,22,37,20	23	*siyū-khan*	334	2,14,26,20
18	*shūn-kūn*	258	1,59,2,10	24	*dāy-khan*	350	0,4,11,10
					līјun	365	0,40,36,0

Section 4
On the consideration of the cycles of years among the Qitai and their era

The Qitai count years in the sixty-cycle (4r) and unite the cycles to the (following) three names; the first is called the cycle of the "Superior Epoch," the middle is the cycle of the

"Middle Epoch," and the final is the cycle of the "Inferior Epoch." The period of the three cycles is 180 years, and years are united to these cycles. If they want to consider a period exceeding this amount, they derive it from the creation of the world. According to their computation, 8,863 *wan*s had completely elapsed from the beginning up to the first year of Genghis Khan's reign. Each *wan* is 10,000 years. 9,679 years had passed in the current *wan*s, and the (9,6)80th year is that of the accession of Genghis Khan that corresponds to the 60th year of the sixty-cycle—the final year of the cycle of the Middle Epoch. According to the computation of the Persians, the year 633 of the Yazdigird era is the first year of the cycle of the Superior Epoch. But Turks only use a cycle of twelve and count it in their language. The regulation of their calendar is unknown to us.

Section 5
On knowing the beginnings of the divisions of the solar years which occur in each year

In order to know the beginning of one of the twenty-four solar divisions in a given year, we must know which day and double-hour within the sixty-cycle falls on the beginning of the *lījun* (i.e., first solar division) before or after the year. We call it the "initial value of the divisions of a year," and it is called *kījū* in the language of the Qitai.[1] The initial value is 11 days and 7,660 *funk*s—11^{d} 2, 7, 40^{f}—in the first year of the cycle of the Superior Epoch after the accession of Genghis Khan. In order to know the beginning of another year, we ascertain whether the year is before the "epoch year" or after; and how many years are between the two. We multiply the balance by the excess of a solar year over 360, i.e. 5 days and 2,436 *funk*s—5^{d} 0, 40, 36^{f}—, which is called *suiyū* in their language.[2] Regarding *funk*s that exceed 10,000—i.e., 2, 46, 40^{f}—, we consider each 10,000 to be one day and add (it) to the number of days, and then subtract 10,000 (from the *funk*s) in order to obtain the interval between the epoch year and the required year.

[1] *Qi-shou* 氣首 (khi-ʂiau) denotes the beginning of the first division of any solar year (van Dalen *et al.* 1997, 149).

[2] *Sui-yu* 歲餘 (sui-iu) indicates the excess of a solar year over 360, namely 5.2436 days (van Dalen *et al.* 1997, 149). This constant is called *tong-yu* 通餘 (thuŋ-iu) in the *Shou-shi li*; the former is used for denoting the surplus of the days of a solar year in this system, that is, 2,436 *funk*s in this case (*Yuan shi*, 54: Bu qi-shuo 1; Sivin 2009, 271-273, 390-391).

Then, if a required year is after the epoch year, we add that interval to the aforementioned initial value. (4v) If the *funk*s exceed 10,000—i.e., 2, 46, 40^{f}—, we subtract this amount (i.e., 10,000 *funk*s) and add one day to the days. If the number of days exceeds 60, we subtract 60 from it. If the required year is before the epoch year, we subtract the interval from the epoch. If the days cannot be subtracted, we add 60 to the epoch and subtract (the days from it). If the *funk*s cannot be subtracted, we subtract one day and add 10,000—i.e., 2, 46, 40^{f}—to the *funk*s.

What results after the addition or subtraction is the beginning of the *lījun* in the required year in the sixty-cycle. We consider the *funk*s to be one day, and each place that is reached marks the beginning of the required year, and the whole years are attached to the names (of the sixty-cycle).

For example, if we want to know the beginning of the 10th year of the cycle of the Superior Epoch that corresponds to the year 642 of the Yazdigird era and is the *kūy-yū'u* in the Qitai language—the year of the cock in Turkish—we multiply the interval between the epoch year and the required year—the value is 9—by the *sui-yū* (i.e., 5^{d} $2{,}436^{f}$); 45 days and 21,924 *funk*s—45^{d} 6, 5, 24^{f}—is obtained. For 20,000 *funk*s—i.e., 5, 33, 20^{f}—, we get two days; it becomes 47 days, and 1,924 *funk*s remain—47^{d} 0, 32, 4^{f}—. Then, we add this amount to the initial value, i.e., 11 days and 7,660 *funk*s—11^{d} 2, 7, 40^{f}—, because the required year is after the epoch year. The result is 58 days and 9,584 *funk*s—58^{d} 2, 39, 44^{f}—, which is the beginning of the required year. We consider the *funk*s to be one day and add it to the days, so that the total becomes 59 days. The 59th day of the sixty-cycle is *zhim-sū*, that is the day of the dog (*īt kūn*) in Turkish.[1] Since the beginning of the day, 9,584 *funk*s have elapsed—2, 39, 44^{f}—. If we seek that (value) in the table for the beginnings of double-hours and *kih*s, we find (it) between the first and second (double-hours). The excess over the beginning of the first double-hour—2, 39, 43^{f} 20—is two-thirds of a *funk*. Thus, we know that the beginning of the 10th year of the sixty-cycle corresponding to the year of the cock is (5r) in the first *kih* among the double-hour of *zhih* corresponding to the double-hour of rat in the 59th day of the sixty-cycle corresponding to the day of the dog; (the others can be known) also by analogy with this.

When the beginning of a year has been determined, we add the divisions of the year to the beginning, in order to know the beginning of each required division. For example, if

[1] Turkish *kün*, which means "a day."

we want to know the beginning of the seventh division in this year, in the table of the beginnings of the divisions of the years, we see that (it is) 91 days and 51, 49^{f} after (the beginning of the year). We add this to the days and *funk*s of the head of the year; it becomes 149 days and 3, 31, 33^{f}. Then, we subtract a day—i.e., 2, 46, 40^{f}— from the *funk*s, which results in 150^{d} 0, 44, 53^{f}. We subtract 60 from the days as many times as possible, and 30 remain. We know that, in the 31st day of the sixty-cycle—i.e., the day of *kā-wū* corresponding to the day of the horse in Turkish—the beginning of the seventh division is in the sixth *kih* from the double-hour of *māu*—hare in Turkish—and 89 *funk*s have elapsed since the beginning of the *kih*; (the others can be known) by analogy with this.

We have made a table consisting of the beginnings of years during 24 years from the cycle of the Superior Epoch, and another table on the beginnings of the divisions of the year of the cock as an example; these tables are as follows.

Table of the beginning of *lījun* in several years						
Yazdigird Years	Qitai Years	Turkish Years	Name of the Sixty –Cycle	*Funks* 1[st] Power 2[nd] Power	Name of the Beginning of *Lījun* in Qitai	Name of Beginning of *Lījun* in Turkish
633	*kā-zhih*	*kuskū*	11	2,7,40	*yī-khā'ī*	*ṭūnghūz*
634	*yī-chīu*	*ūṭ*	17	0,1,36	*sin-ṣiz*	*īlān*
635	*pīn-yim*	*bars*	22	0,42,12	*pīn-sū*	*īt*
636	*tīn-māu*	*ṭāushqan*	27	1,22,48	*sin-māu*	*ṭāushqan*
637	*wū-chin*	*lū*	32	2,3,24	*pīn-shin*	*bījīn*
638	*kī-ṣiz*	*yīlān*	37	2,44,0	*sin-chīu*	*ūṭ*
639	*kin-wū*	*yūnd*	43	0,37,56	*tīn-wī*	*qūy*
640	*sin-wī*	*qūy*	48	1,18,32	*zhim-zhih*	*kuskū*
641	*zhim-shin*	*bījīn*	53	1,59,8	*tīn-ṣiz*	*īlān*
642	*kūy-yū'u*	*dāqūq*	58	2,39,44	*zhim-sū*	*īt*
643	*kā-sū*	*īt*	4	0,33,40	*wū-chin*	*lū*
644	*yī-khā'ī*	*ṭūnghūz*	9	1,14,56	*kū'y-yū'u*	*dāqūq*
645	*pīn-zhih*	*kuskū*	14	1,54,52	*wū-yim*	*bars*
646	*tīn-chīu*	*ūṭ*	19	2,35,28	*kūy-wī*	*qūy*
647	*wū-yim*	*bars*	25	0,29,24	*kī-chīu*	*ūṭ*
648	*kī-māu*	*ṭāushqan*	30	1,10,0	*kā-wū*	*yūnd*
649	*kin-chin*	*lū*	35	1,50,36	*kī-khā'ī*	*ṭūnghūz*
650	*sin-ṣiḍ*	*yīlān*	40	2,31,12	*kā-chin*	*lū*
651	*zhim-wū*	*yūnd*	46	0,25,8	*kin-sū*	*īt*
652	*kūy-wī*	*qūy*	51	1,5,44	*yī-māu*	*ṭāushqan*
653	*kā-shin*	*bījīn*	56	1,46,20	*kin-shin*	*bījīn*
654	*yī-yū'u*	*dāqūq*	1	2,26,56	*yī-chīu*	*ūṭ*
655	*pīn-sū*	*īt*	7	0,20,52	*sin-wī*	*qūy*
656	*tīn-khā'ī*	*ṭūnghūz*	12	1,1,28	*pīn-zhih*	*kuskū*
657	*wū-zhih*	*kuskū*	17	1,42,4	*sin-ṣiz*	*yīlān*

Table of the beginnings of divisions of the year of the cock corresponding to the year 642 of the Yazdigird era				
Names of the Divisions	Days of the Sixty-Cycle	2nd Power 1st Power *Funks*	Names of the Beginnings of Divisions in Qitai	The Times of Divisions from the Position of the Sun
līјun	58	2,39,44	*zhim-sū* (*īt*)	Mid. Aquarius
wūshī	14	0,29,29	*wū-yim* (*bārs*)	Begin. Pisces
kin-jih	29	1,5,54	*kūy-ṣiz* (*īlān*)	Mid. Pisces
shūn-fūnd	44	1,42,19	*wū-shin* (*bījīn*)	Begin. Aries
shīnk-mīnk	59	2,18,43	*kūy-khā'ī* (*ṭūnghūz*)	Mid. Aries
kūwū	15	0,8,28	*kī-māu* (*ṭāushqan*)	Begin. Taurus
līkha	30	0,44,53	*kā-wū* (*yūnd*)	Mid. Taurus
siyū-man	45	1,21,18	*kī-yū'u* (*dāqūq*)	Begin. Gemini
manjun	0	1,57,43	*kā-zhih* (*kuskū*)	Mid. Gemini
shājir	15	2,34,8	*kī-māu* (*ṭāushqan*)	Begin. Cancer
siyāu-shū	31	0,23,52	*yī-wī* (*qūy*)	Mid. Cancer
dāy-shū	46	1,0,17	*kin-sū* (*īt*)	Begin. Leo
lījū'u	1	1,36,42	*yī-chīu* (*ūṭ*)	Mid. Leo
chīu-shū	16	2,13,7	*kin-chin* (*lū*)	Begin. Virgo
baylū	32	0,2,52	*pīn-shin* (*bījīn*)	Mid. Virgo
siyū-fan	47	0,39,17	*sin-khā'ī* (*ṭūnghūz*)	Begin. Libra
khanlū	2	1,15,42	*pīn-yim* (*bārs*)	Mid. Libra
shūn-kūn	17	1,52,6	*sin-ṣiz* (*īlān*)	Begin. Scorpio
lītūn	32	2,28,31	*pīn-shin* (*bījīn*)	Mid. Scorpio
siyāu-shih	48	0,18,16	*zhim-zhih* (*kuskū*)	Begin. Sagittarius
dāy-shih	3	0,54,41	*tīn-māu* (*ṭāushqan*)	Mid. Sagittarius
dūnjin	18	1,31,6	*zhim-wū* (*yūnd*)	Begin. Capricon
siyū-khan	33	2,7,30	*tīn-yū'u* (*dāqūq*)	Mid. Capricon
dāy-khan	48	2,43,55	*zhim-zhih* (*kuskū*)	Begin. Aquarius
līјun	4	0,33,40	*wū-chin* (*lū*)	Mid. Aquarius

(5v) *Section 6*

On knowing the beginning of the *ārām ay* (i.e., the first month) in mean motion

First, the interval in a year between the beginnings of the first month—the head of a year—and *wūshī*—the second division from the divisions of a solar year—must be known. In the first year of the cycle of the Superior Epoch corresponding to the year 633 of the Yazdigird era, the value is 14 days and 4,676 *funk*s—14^{d} 1, 17, 56^{f}—, as shall be mentioned on a table. It is called *shūnjan* in the Qitai language,[1] and we call it "the initial value of the head of years."

Then, we obtain the difference between that year and the required year. We multiply it by the excess of a solar year over a lunar year, i.e., 10 days and 8,764 *funk*s—10^{d} 2, 26, 4^{f}—, which is called *suijā* in the Qitai language.[2] We add the result to "the initial value of the head of years," if the required year is after that year (i.e., the year 633 of the Yazdigird era). The period of the mean lunar month is 29 days and 5,306 *funk*s—29^{d} 1, 28, 26^{f}—, which is called *shūja* in the Qitai language.[3] If (the period of the month) can be subtracted from the addition of the result of the multiplication to *shūnjan*, we subtract as many times as (the remainder) becomes smaller than the period of a month. Each time, when we subtract (the period of a month), an "intercalary month" (*māh-i shūn*)[4] falls in

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[1] This term is likely the Chinese *run-ying* 閏應 (ɽiuan-iaŋ). It represents the interval from the mean first month (*ārām ay*) to the second solar division (*wūshī*) for any particular year (van Dalen *et al.* 1997, 150). In the case of the *Shou-shi li*, this term is used for denoting the interval between the winter solstice of the epoch year and the last new moon (*Yuan shi*, 54: Shou-shi li jing 1; Sivin 2009, 392, 396).

[2] Probably, Chinese *sui-chai* 歲差 (sui-tʂha). This term denotes the difference between the solar year and twelve mean lunar months, 10.8764^{d}. This constant is called *tong-run* 通閏 (thuŋ-ɽiuan) in the *Shou-shi li* and resembles *sui-run* 歲閏 (sui-ɽiuan) mentioned in the Song dynastic history (*Song shi*, 77: Guan-tian li; *Yuan shi*, 54: Bu qi-shuo 1; van Dalen *et al.* 1997, 150; Sivin 2009, 390-391). *Sui-chai* 歲差 (sui-tʂha), on the other hand, means "annual precession" in the official Chinese astronomical systems in the later period.

[3] Chinese *shuo-ce* 朔策 (ʂau-tʂhai), a mean synodic month, 29.5306^{d}. This constant is slightly different from that of the *Revised Da-ming li*. It would be appropriate to consider that the value was rounded off from most Chinese values including that of the *Revised Da-ming li* ($29.53059...^{d}$), by means of the ten-thousand *funk*s method (*Jin shi*, 21: Bu qi-ce bu gua-hou bu ri-chan bu gui-lou; cf. van Dalen *et al.* 1997, 123). Although Mercier reconstructed the Persian phonetic form as *shou-shi* 朔實 (ʂau-ʂi) which van Dalen followed (Mercier 1984, 51; van Dalen *et al.* 1997, 150), *shou-ce* 朔策 (ʂau-tʂhai) is more appropriate than *shou-shi* 朔實 (ʂau-ʂi) from the standpoint of the meaning and the Persian form as in the case of *sui-zhou* 歲周 (sui-tʂiau) discussed before.

[4] This is a combination of the Persian term *māh* with Chinese *run* 閏 (ɽiuan), which means "intercalary."

the years between the epoch year and the required year, and the year (in which an intercalary month falls) includes thirteen months.

If the required year is before the epoch year, we subtract the result of the multiplication of the year interval by the excess of a solar year over a lunar year from “the initial value of the head of years.” If it cannot be subtracted, we add several times the length of a month (i.e., 29^{d} 1, 28, 26^{f}) to “the initial value of the head of years”; then, from that, we subtract the result of the multiplication (of the year interval by the excess of a solar year over a lunar year) as the remainder becomes smaller than the period of a month.

What remains smaller than the period of month is the interval between the beginning of the first month and the *wūshī* in the required year, and that is the initial value of the head of the year. Then, we find the days of the *wūshī* in that year, and subtract the interval between the beginning of the first month and the beginning of the *wūshī* from that. If it cannot be subtracted, we add 60 to the day of the *wūshī* (6r) and subtract from this amount. What remains is the sixty-cycle of the beginning of the first month in mean (lunar) motion. Then, we see the sixty-cycle of the beginning of the *līјun* (i.e., the first division of a solar year) in that year, in order to know which beginning (of the first month or the *līјun*) precedes the other and how much difference lies between them, an amount that is inevitably smaller than the period of a division of a solar year.

Section 7
On knowing the arguments of the sun and the moon at the beginning of each year

For the solar argument, we subtract the interval between the beginnings of the first month and the *wūshī* from one sixth of the period of a solar year, i.e., 60 days and 8,740 *funk*s—60^{d} 2, 25, 40^{f}—called *kījā* by them.[1] What remains is the solar argument at the beginning of the year.

For the lunar argument, “the initial value of the lunar argument” at the beginning of a year must be known, which is 78 days and 3,948 *funk*s—78^{d} 1, 5, 48^{f}—in the first year of

[1] The interval between the twenty-second solar division (the winter solstice) and the second solar division (*yu-sui* 雨水), namely one-sixth of a solar year, is 60.8740 days. The Persian transcription may be reconstructed as *qi-chai* 氣差 (khi-tʂha).

the cycle of the Superior Epoch corresponding to the year 633 (of the Yazdigird era), and which is called *jūnjūn kā* in the Qitai language.[1] Then, we obtain the difference between that year and the required year. We multiply the difference by 7 days and 338 *funk*s—7^{d} 0, 5, 38^{f}—, which is called *jūnjā* in the Qitai language.[2] In my opinion, that is the excess of a solar year over thirteen anomalistic cycles. If the required year follows the epoch year, we add the result to the initial value of the lunar argument; otherwise, we subtract (the result from the initial value of the lunar argument), in the manner described in the sixth section. We call the result the "first number to be kept." Thus, we subtract the interval between the beginnings of the first month and the *wūshī* from that amount. If it cannot be subtracted, we add 60 to the days, and then subtract. We call what remains the "second number to be kept." Thus, from the second number to be kept, we subtract the period of a cycle for the lunar argument—the value of which is 27 days and 5,556 *funk*s—27^{d} 1, 32, 36^{f}—, and called *junjūn* (i.e., an anomalistic month) by them—as many times as (the remainder) becomes smaller than the cycle.[3] What remains is a ninth of the initial value of the lunar argument. We multiply that by 9 to obtain the lunar argument of the beginning in the required year. If it exceeds 248 days, we subtract 248 days from those days. What remains is the lunar argument of the beginning in the required year.

(6v) We multiply an anomalistic month (i.e., 27.5556 days) by several numbers and put the resulting (values) in a table, so that the (required values) can easily be obtained from there. In addition, we put all (values) mentioned in the sixth and seventh sections in the case of two twelve-cycles from the beginning of the cycle of the Superior Epoch into a table as an example. The table is as follows.

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[1] Although the transcribed form *jūnjūn kā* is somewhat obscure, it could be read as the *zhuan-zhong ying* 轉終應 (tʂiuɛn-tʂiuŋ iaŋ) from the standpoint of the meaning. The first part *jūnjūn* undoubtedly denotes *zhuan-zhong* 轉終 (tʂiuɛn-tʂiuŋ), a (Lunar) Revolution Terminal Constant, that is to say, an anomalistic month (cf. van Dalen *et al.* 1997, 149; Sivin 2009, 606). The corresponding term in the *Shou-shi li* is denoted as *zhuan-ying* 轉應 (tʂiuɛn-iaŋ), that is, a Revolution Interval Constant between the epochal winter solstice and the preceding lunar perigee (*Yuan shi*, 54: Bu yue-li 4; Yabuuti & Nakayama 2006, 21; Sivin 2009, 455).

[2] This Persian transcribed form can probably be reconstructed as the Chinese *zhuan-chai* 轉差 (tʂiuɛn-tʂha) which, in this case, means the excess of a solar year over thirteen anomalistic months.

[3] The Chinese form of *junjūn* is *zhuan-zhong* 轉終 (tʂiuɛn-tʂiuŋ), i.e., an anomalistic month.

Table of the two aforementioned cycles from the beginning of the "Superior Epoch"																				
	Yazdigird Years	Qatai Years	Turkish Years	Interval between the Beginnings of th First Month and the *Wūshī*, i.e., the Initial Value of the Head of Years		Sixty-Cycle of the Beginning of the *Wūshī*		Sixty-Cycle of the Beginning of the First Month in Mean Motion		Years in Which the First Month Precede the *Lījun*	Solar Argument in the Head of the Years		First Number to Be Kept		Second Number to Be Kept		One-Ninth of the Initial Value of the Lunar Argument		Lunar Argument	
	633	*kā-zhih*	*kuskū*	14	1, 17, 56	26	2, 44, 5	12	1, 26, 9		46	1, 7, 44	78	1, 5, 48	63	2, 34, 32	8	2, 16, 0	79	0, 57, 20
shūn	634	*yī-chīu*	*ūṭ*	25	0, 57, 20	32	0, 38, 1	6	2, 27, 21	*muqaddam*	35	1, 28, 20	85	1, 11, 26	60	0, 14, 6	4	2, 42, 14	44	2, 6, 46
	635	*pīn-yim*	*bars*	6	1, 54, 58	37	1, 18, 37	30	2, 10, 19		54	0, 30, 42	92	1, 17, 4	85	2, 8, 46	3	0, 17, 38	27	2, 38, 42
	636	*tīn-māu*	*ṭāushqan*	17	1, 34, 22	42	1, 59, 13	25	0, 24, 51	*muqaddam*	43	0, 51, 18	99	1, 22, 42	81	2, 35, 0	26	2, 16, 28	241	1, 1, 32
shūn	637	*wū-chin*	*lū*	28	1, 13, 46	47	2, 39, 49	19	1, 26, 3	*muqaddam*	32	1, 11, 54	106	1, 28, 20	78	0, 14, 34	22	2, 42, 42	206	2, 10, 58
	638	*kī-ṣiz*	*yīlān*	9	2, 11, 24	53	0, 33, 45	43	1, 9, 1		51	0, 14, 16	113	1, 33, 58	83	2, 9, 14	1	0, 18, 6	9	2, 42, 54
shūn	639	*kin-wū*	*yūnd*	20	1, 50, 28	58	1, 14, 21	37	2, 10, 33	*muqaddam*	40	0, 35, 12	120	1, 39, 36	99	2, 35, 48	17	0, 44, 40	155	1, 8, 40
	640	*sin-wī*	*qūy*	2	0, 1, 46	3	1, 54, 57	1	1, 53, 11		58	2, 23, 54	127	1, 45, 14	125	1, 43, 28	15	1, 6, 24	138	1, 37, 36
	641	*zhim-shin*	*bījīn*	12	2, 27, 50	8	2, 35, 33	56	0, 7 43		47	2, 44, 30	134	1, 50, 52	121	2, 9, 42	11	1, 32, 38	104	0, 0, 22
shūn	642	*kūy-yū'u*	*dāqūq*	23	2, 7, 14	14	0, 29, 29	50	1, 8, 55	*muqaddam*	37	0, 18, 26	141	1, 56, 30	117	2, 35, 56	7	1, 58, 52	69	1, 9, 48
	643	*kā-sū*	*īt*	5	0, 18, 12	19	1, 10, 5	14	0, 51, 53		55	2, 7, 28	148	2, 2, 8	143	1, 43, 56	5	2, 20, 56	52	1, 41, 44
	644	*yī-khā'ī*	*ṭūnghūz*	15	2, 44, 16	24	1, 51, 21	8	1, 53, 45	*muqaddam*	44	2, 28, 4	155	2, 7, 46	139	2, 10, 10	2	0, 0, 30	18	0, 4, 30
shūn	645	*pīn-zhih*	*kuskū*	26	2, 23, 40	29	2, 31, 17	3	0, 7, 37	*muqaddam*	34	0, 2, 0	162	2, 13, 24	135	2, 36, 24	25	1, 59, 20	231	1, 14, 0
	646	*tīn-chīu*	*ūṭ*	8	0, 34, 38	35	0, 25, 13	26	2, 37, 15		52	1, 51, 2	169	2, 19, 2	161	1, 44, 24	23	2, 21, 24	214	1, 45, 56
shūn	647	*wū-yim*	*bars*	19	0, 14, 2	40	1, 5, 49	21	0, 51, 47	*muqaddam*	41	2, 11, 38	176	2, 24, 40	157	2, 10, 38	20	0, 0, 58	180	0, 8, 42
	648	*kī-māu*	*ṭāushqan*	0	1, 11, 40	45	1, 46, 25	45	0, 34, 45		60	1, 14, 0	183	2, 30, 18	183	1, 18, 38	18	0, 23, 2	163	0, 40, 38
	649	*kin-chin*	*lū*	11	0, 51, 4	50	2, 27, 1	39	1, 37, 57		49	1, 34, 36	190	2, 35, 56	189	1, 44, 52	24	0, 49, 16	218	1, 50, 4
shūn	650	*sin-ṣiz*	*yīlān*	22	0, 30, 28	56	0, 20, 57	33	2, 37, 9	*muqaddam*	38	1, 55, 12	197	2, 41, 34	175	2, 11, 6	10	1, 15, 30	94	0, 12, 50
	651	*zhim-wū*	*yūnd*	3	1, 28, 6	1	1, 1, 33	57	2, 20, 7		57	0, 57, 34	205	0, 0, 32	201	1, 19. 6	8	1, 37, 34	77	0, 44, 46
	652	*kūy-wī*	*qūy*	14	1, 7, 30	6	1, 42, 9	52	0, 34, 39		46	1, 18, 10	212	0, 6, 10	197	1, 45, 20	4	2, 3, 48	42	1, 54, 12
shūn	653	*kā-shin*	*bījīn*	25	0, 46, 54	11	2, 22, 45	46	1, 35, 51	*muqaddam*	35	1, 38, 46	219	0, 11, 48	193	2, 11, 34	0	2, 30, 2	8	0, 16, 58
	654	*yī-yū'u*	*dāqūq*	6	1, 44, 32	17	0, 16, 41	10	1, 18, 49		54	0, 41, 8	226	0, 17, 26	219	1, 19, 34	26	1, 38, 2	239	0, 48, 58
	655	*pīn-sū*	*īt*	17	1, 23, 56	22	0, 57, 17	4	2, 20, 1	*muqaddam*	43	1, 1, 44	233	0, 23, 4	215	1, 45, 48	22	2, 4, 16	204	1, 58, 24
shūn	656	*tīn-khā'ī*	*ṭūnghūz*	28	1, 3, 20	27	1, 37, 53	59	0, 34, 33		32	1, 22, 20	240	0, 28, 42	211	2, 12, 2	18	2, 30, 30	170	0, 21, 10
	657	*wū-zhih*	*kuskū*	9	2, 0, 58	32	2, 18, 29	23	0, 17, 31		51	0, 24, 42	247	0, 34, 20	237	1, 20, 2	17	0, 5, 54	153	0, 53, 6
	658	*kī-chīu*	*ūṭ*	20	1, 40, 22	37	2, 59, 5	17	1, 18, 43	*muqaddam*	40	0, 45, 18	214	0, 39, 58	193	1, 46, 16	0	2, 4, 44	6	2, 2, 36

Section 8

On finding the equation of the sun

We obtain the solar argument at the beginning of a year. To the argument, we add the length of a lunar month (i.e., synodic month), which is 29 days and 5,305 *funk*s—29^{d} 1, 28, 26^{f}—called *shūja* in the Qitai language; as a result, the arguments of (the beginnings of the successive) months become known in order. Every time the argument exceeds the length of a solar year, 365^{d} 0, 40, 36^{f}, we subtract the length from the value. If we want to know the (solar) argument at (the beginning of) a month in the middle of a year, we multiply the number of months between the first and the required months by the *shūja*. We add the result to the (solar) argument at the beginning of the year to obtain the (solar) argument at the head of that month. We multiply the result of the multiplication of the *shūja* by various numbers, and put (the resulting values) in a table to obtain (the required values) from there.

When the solar argument is known, if the number of days without *funk*s is smaller than the half-circle—that is, 182, called *bījūtin* by them[1]—we subtract the argument from 182 and also keep the original value. Then, we multiply the result of the subtraction by the original value.[2] We double the result, and obtain a ninth of the amount. The result is the solar equation, which is an additive value, they call the additive *nū*.[3]

If the days of the argument exceed 182, we calculate the excess over 182. We subtract the argument from the double of 182, which is the whole circle, and multiply the excess by the remainder of the subtraction. We double the result, and obtain a ninth of the amount. What is obtained is the solar equation, which is a subtractive value and they call the subtractive *tiyā'ū,* meaning "subtractive."[4] They call the solar equation *tāyānk zhikī*.[5]

We have made a table of the solar equation. We have put the *funk*s of the equation corresponding to the arguments in the sexagesimal form in that table, (7r) so that (values)

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[1] This term is the Chinese *ban zhou-tian* 半周天 (puɜan tʂiau-thiɛn), or the Celestial Half-Circle. The term appears in the fragment of the *Fu-tian li* on the solar equation (we shall address this fragment below) as well as in the *Shou-shi li* (Momo 1969, 401; Sivin 2009, 410, 614).

[2] For the obscure sentence "*pas ḥiṣṣa rā dar tamām-i ḥiṣṣa ḍarb kunīm*," there is a marginal note in the manuscript BN (9v) as follows: "*Maqṣūd az ḥiṣṣa-yi awwal ānche hama bāqī mānda az nīma-yi daur-i āftāb, wa maqṣūd az tamām-i ḥiṣṣa ḥiṣṣa-yi āftāb ast dar sar-i māh-i maṭlūb.*" (The meaning of the first "*ḥiṣṣa*" is what remains after subtracting from the half-cycle of the sun, and the meaning of the "*tamām-i ḥiṣṣa*" is the solar argument at the head of the required month.)

[3] The Chinese *nu* 朒 is used for the slow phase of the luminaries. Here, it means "additive," as applied to the solar and lunar equations (van Dalen *et al.* 1997, 149).

[4] The Chinese *tiao* 朓 is used for the fast phase of the luminaries. Here, it means "subtractive," as applied to the solar and lunar equations (van Dalen *et al.* 1997, 150).

[5] Regarding the term *tāyānk zhikī*, some obscurity remains. But at least we are able to affirm that the *zhikī*, the latter half of this technical term, is *ru-qi* 入氣 (ɽi-khi). It is a temporal parameter used for the computation of the solar equation (Martzloff 2009, 178, 181-189). With regard to the first half *tāyānk*, as van Dalen has mentioned, it would be appropriate to consider the word to be *tai-yang* 太陽 (thai-iaŋ), "the sun" (van Dalen *et al.* 1997, 150). So, we would like to suggest the compound *tai-yang ru-qi* 太陽入氣 (thai-iaŋ ɽi-khi) as a highly probable form from the standpoints of the Persian transliteration, meaning, and context. Mercier has argued that this term is comparable to the Turkish *tänkäš* (Mercier 1984, 50); however, it would be difficult to make this argument as far as the manuscripts we used are concerned. If it were permissible to read the *tāyānk* in this way, we would not interpret well the latter half words *zhikī.*

As I have discussed in a previous article, the contemporary Uighurs were scarcely involved in compiling the Qitai calendar, but this calendar was directly brought from China into Iran by a Qitai sage—a Taoist master—accompanying his Mongol ruler (Isahaya 2009). In consideration of the fact that almost all technical terms are Chinese, there is little justification for regarding the term as Turkish one.

corresponding to the (solar) arguments at the heads of months are obtained from that table.

(7v) *Section 9*
On finding the equation of the moon

We establish the lunar argument at the beginning of a year, which is called *jūnjūn kā* in the Qitai language. For the other months, we add 17 days and 7,754 *funk*s—17^d 2, 9, 14^f—, which is called *junjūn shā* by them,[1] to the argument at the beginning of the year—when the argument exceeds 248, 248 is subtracted from it and the remainder is kept—so that the argument at the head of each month is obtained. We set a table consisting of the values of multiplying the *junjūn shā* by several numbers, so that we add what corresponds with each different number to the argument of the beginning of a year; as a result, the argument at the head of the required month is obtained.

If the days of the argument are smaller than 124, which is called *banjūshā*,[2] we subtract the number of days from 124 and keep the original value. We multiply the days by the original value. What is obtained is the lunar equation; it is called *nū*, meaning "additive." If (the days) exceed 124, we multiply the excess by the original value after subtracting (the original) from 248. What is obtained is the lunar equation. It is called *tiyā'ū*, meaning "subtractive." They call the lunar equation *tāyānk zhichūn*.[3]

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[1] As Mercier has assumed, we should read this term as *zhuan-zhong chai* 轉終差 (tʂiuɛn-tʂiuŋ tʂha), which means "nine times the excess of a lunar month over an anomalistic month" (27.5556 days, in this case), i.e., 17.7754 days (Mercier 1984, 51). As mentioned before, the excess of a lunar month over an anomalistic month is represented as *zhuan-chai* 轉差 (tʂiuɛn-tʂha) in the *Shou-shi li*.

[2] This term should be read as *ban zhou-xian* 半周限 (puɜan tʂiau-hian), the parts of the half-cycle, or 124. The cycle of an anomalistic month is divided into 248 parts in this calendar, so that the half-cycle consists of 124 parts. The parts of the cycle *zhou-xian* 周限 (tʂiau-hian) are used in the *Shou-shi li*; in this case, the cycle is approximately divided into 336 parts (Sivin 2009, 453).

[3] In this case, also, we could not offer the definite reconstruction form; however, the latter part, *zhichūn*, could probably be interpreted as *ru-zhuan* 入轉 (ʐi-tʂiuɛn) which is a temporal parameter to use for the computation for the lunar equation as well as *ru-li* 入曆 (ʐi-li) (Martzloff 2009, 189-196). Although we could consider the first half to be the same form as *tai-yang ru-qi* 太陽入氣 (thai-iaŋ ʐi-khi), we would like to suggest that the first half is, rather, *tai-yin* 太陰 (thai-iam), "the moon." Therefore, the compound form could be reconstructed as *tai-yin ru-zhuan* 太陰入轉 (thai-iam ʐi-tʂiuɛn).

We have made a table illustrating the lunar equation, so that (the values) corresponding with the arguments of the heads of months are obtained from that table.The tables are as follows.

Table of the solar equation that is called "*Tāyānk Zhikī*"

Positive		Solar Equation	Negative		Positive		Solar Equation	Negative		Positive		Solar Equation	Negative	
Solar Argument			Solar Argument		Solar Argument			Solar Argument		Solar Argument			Solar Argument	
0	182	0, 0, 0	182	364	30	152	0, 16, 53	212	334	60	122	0, 27, 7	242	304
1	181	0, 0, 40	183	363	31	151	0, 17, 20	213	333	61	121	0, 27, 20	243	303
2	180	0, 1, 20	184	362	32	150	0, 17, 47	214	332	62	120	0, 27, 33	244	302
3	179	0, 1, 59	185	361	33	149	0, 18, 13	215	331	63	119	0, 27, 46	245	301
4	178	0, 2, 38	186	360	34	148	0, 18, 38	216	330	64	118	0, 27, 58	246	300
5	177	0, 3, 17	187	359	35	147	0, 19, 3	217	329	65	117	0, 28, 10	247	299
6	176	0, 3, 55	188	358	36	146	0, 19, 28	218	328	66	116	0, 28, 21	248	298
7	175	0, 4, 32	189	357	37	145	0, 19, 52	219	327	67	115	0, 28, 32	249	297
8	174	0, 5, 9	190	356	38	144	0, 20, 16	220	326	68	114	0, 28, 43	250	296
9	173	0, 5, 46	191	355	39	143	0, 20, 39	221	325	69	113	0, 28, 53	251	295
10	172	0, 6, 22	192	354	40	142	0, 21, 2	222	324	70	112	0, 29, 2	252	294
11	171	0, 6, 58	193	353	41	141	0, 21, 25	223	323	71	111	0, 29, 11	253	293
12	170	0, 7, 33	194	352	42	140	0, 21, 47	224	322	72	110	0, 29, 20	254	292
13	169	0, 8, 8	195	351	43	139	0, 22, 8	225	321	73	109	0, 29, 28	255	291
14	168	0, 8, 43	196	350	44	138	0, 22, 29	226	320	74	108	0, 29, 36	256	290
15	167	0, 9, 17	197	349	45	137	0, 22, 50	227	319	75	107	0, 29, 43	257	289
16	166	0, 9, 50	198	348	46	136	0, 23, 10	228	318	76	106	0, 29, 50	258	288
17	165	0, 10, 23	199	347	47	135	0, 23, 30	229	317	77	105	0, 29, 57	259	287
18	164	0, 10, 56	200	346	48	134	0, 23, 49	230	316	78	104	0, 30, 3	260	286
19	163	0, 11, 28	201	345	49	133	0, 24, 8	231	315	79	103	0, 30, 8	261	285
20	162	0, 12, 0	202	344	50	132	0, 24, 27	232	314	80	102	0, 30, 13	262	284
21	161	0, 12, 31	203	343	51	131	0, 24, 45	233	313	81	101	0, 30, 18	263	283
22	160	0, 13, 2	204	342	52	130	0, 25, 2	234	312	82	100	0, 30, 22	264	282
23	159	0, 13, 33	205	341	53	129	0, 25, 19	235	311	83	99	0, 30, 26	265	281
24	158	0, 14, 3	206	340	54	128	0, 25. 36	236	310	84	98	0, 30, 29	266	280
25	157	0, 14, 32	207	339	55	127	0, 25, 52	237	309	85	97	0, 30, 32	267	279
26	156	0, 15, 1	208	338	56	126	0, 26, 8	238	308	86	96	0, 30, 35	268	278
27	155	0, 15, 30	209	337	57	125	0, 26, 23	239	307	87	95	0, 30, 37	269	277
28	154	0, 15, 58	210	336	58	124	0, 26, 38	240	306	88	94	0, 30, 38	270	276
29	153	0, 16, 26	211	335	59	123	0, 26, 53	241	305	89	93	0, 30, 39	271	275
										90	92	0, 30, 40	272	274
										91	91	0, 30, 40	273	273

Table of the lunar equation that is called *"Tāyānk Zhichūn"*

Positive: Lunar Argument		Lunar Equation	Negative: Lunar Argument		Positive: Lunar Argument		Lunar Equation	Negative: Lunar Equation	
0	124	0, 0, 0	124	248	32	92	0, 49, 4	156	216
1	123	0, 2, 3	125	247	33	91	0, 50, 3	157	215
2	122	0, 4, 4	126	246	34	90	0, 51, 0	158	214
3	121	0, 6, 3	127	245	35	89	0, 51, 55	159	213
4	120	0, 8, 0	128	244	36	88	0, 52, 48	160	212
5	119	0, 9, 55	129	243	37	87	0, 53, 39	161	211
6	118	0, 11, 48	130	242	38	86	0, 54, 28	162	210
7	117	0, 13, 39	131	241	39	85	0, 55, 15	163	209
8	116	0, 15, 28	132	240	40	84	0, 56, 0	164	208
9	115	0, 17, 15	133	239	41	83	0, 56, 43	165	207
10	114	0, 19, 0	134	238	42	82	0, 57, 24	166	206
11	113	0, 20, 43	135	237	43	81	0, 58, 3	167	205
12	112	0, 22, 24	136	236	44	80	0, 58, 40	168	204
13	111	0, 24, 3	137	235	45	79	0, 59, 15	169	203
14	110	0, 25, 40	138	234	46	78	0, 59, 48	170	202
15	109	0, 27, 15	139	233	47	77	1, 0, 19	171	201
16	108	0, 28, 48	140	232	48	76	1, 0, 48	172	200
17	107	0, 30, 19	141	231	49	75	1, 1, 15	173	199
18	106	0, 31, 48	142	230	50	74	1, 1, 40	174	198
19	105	0, 33, 15	143	229	51	73	1, 2, 3	175	197
20	104	0, 34, 40	144	228	52	72	1, 2, 24	176	196
21	103	0, 36, 3	145	227	53	71	1, 2, 43	177	195
22	102	0, 37, 24	146	226	54	70	1, 3, 0	178	194
23	101	0, 38, 43	147	225	55	69	1, 3, 15	179	193
24	100	0, 40, 0	148	224	56	68	1, 3, 28	180	192
25	99	0, 41, 15	149	223	57	67	1, 3, 39	181	191
26	98	0, 42, 28	150	222	58	66	1, 3, 48	182	190
27	97	0, 43, 39	151	221	59	65	1, 3, 55	183	189
28	96	0, 44, 48	152	220	60	64	1, 4, 0	184	188
29	95	0, 45, 55	153	219	61	63	1, 4, 3	185	187
30	94	0, 47, 0	154	218	62	62	1, 4, 4	186	186
31	93	0, 48, 3	155	217					

Multiples of "*Shūja*," i.e., The Period of the Lunar Month

Nos.	Days	*Funk*s: 2nd Power	1st Power	*Funks*
1	29	1	28	26
2	59	0	10	12
3	88	1	38	38
4	118	0	20	24
5	147	1	48	50
6	177	0	30	36
7	206	1	59	2
8	236	0	40	48
9	265	2	9	14
10	295	0	51	0
11	324	2	19	26
12	354	1	1	12

Multiples of "*Jūnjūn Shā*," i.e., Arg. of Begin. of the Month

Nos.	Days	2nd Power	1st Power	*Funks*
1	17	2	9	14
2	35	1	31	48
3	53	0	54	22
4	71	0	16	56
5	88	2	26	10
6	106	1	48	44
7	124	1	11	18
8	142	0	33	52
9	159	2	43	6
10	177	2	5	40
11	195	1	28	14
12	213	0	50	48
13	231	0	13	22
14	248	2	22	36

Multiples of "*Junjūn*," i.e., the Anomalistic Month

Nos.	Days	*Funk*s: 2nd Power	1st Power	*Funks*
1	27	1	32	36
2	55	0	18	32
3	82	1	51	8
4	110	0	37	4
5	137	2	9	40
6	165	0	55	36
7	192	2	28	12
8	220	1	14	8
9	248	0	0	4

The Value of the Sum of Half-Night and a Day in Each Month Approx.

Months		*Funk*s
11	12	1, 56, 40
10	1	2, 0, 0
9	2	2, 3, 20
8	3	2, 6, 40
7	4	2, 10, 0
6	5	2, 13, 20

Nos.	Multiples of *Funk*s of a Night-Day		
1	2	46	40
2	5	33	20
3	8	20	0
4	11	6	40
5	13	53	20
6	16	40	0
7	19	26	40
8	22	13	20
9	25	0	0

Section 10
On knowing the beginnings of each required year, and determining an intercalary month in a year in which it occurs

From the solar argument at the beginning of a month, we know the (solar) equation, and know whether (the equation) is additive or subtractive. From the lunar argument at the beginning of a month, we also know the (lunar) equation, and know whether (the equation) is additive or subtractive. If both of the two equations are additive or subtractive, we add them together; otherwise, we obtain the excess of one over the other, and we call that the "compound equation." Then, if both of the equations or the excess are additive, the compound equation is additive. If both of the equations or the excess are subtractive, the compound equation is subtractive. Then, we obtain the sixty-cycle of the first day of the first month on the mean motion. We add the value of a month, which is 29 days and 5,306 *funk*s—29^d 1, 28, 26^f—, i.e., *shūja,* to the first day. Whenever the days exceed 60, we reduce 60; so that, the sixty-cycle of the first day of each month on mean motion is obtained. Then, if the compound equation is additive on the first day of each month, we add (it) to the first day of that month. If (the equation) is subtractive, we reduce (it); so that the sixty-cycle of the first day of each month becomes precisely known. If the *funk*s are smaller than the value of a half-night and one day, we count it as one day, and add it to the days. If (the *funk*s) exceed the value of a half-night and one day, we count it as two days, and add them to the days. Then, we insert the result into the table of the sixty-cycle, so that the cycle of the first day of each month in the cycle becomes known. From the sixty-cycles of the first days of a month and the month that follows it, it becomes known whether the former month has 30 days or 29 days. There must not be more than two consecutive 29-day months, nor more than three consecutive 30-day months. Then, they take into consideration the sixty-cycles of the first days of the divisions of a solar year, which fall in each month. If (the year is) an intercalary one in which there are 13 months, a month in which only the sixty-cycle of the first day of a division of a solar year falls is the intercalary month and each month in which the sixty-cycles of the first days of two divisions fall is not an intercalary month.

As an example, we have computed (the values of) months in the 10th year from the cycle of the Superior Epoch, which is the year of *kūy-yū*—the year of the cock in Turkish—and the year of 642 of the Yazdigird era according to the calculation of the Persians. We have detailed the operations in a table, so that (the others can be known) also by analogy with this. That table is as follows.

Table of the calendar for the 10th year that is "*kūy-yū'u*" and the year of the cock corresponding to the 642nd year of the Yazdigird era, constructed as an example

Months	Solar Argument		Solar Equ.	Lunar Argument		Lunar Equ.	Compound Equ.	Beginnings of the Months in Mean Motion		Beginnings of the True Months		Days of the Months	Names of the Beginnings	Tthe Values of the Solar Year That Occur in Each Months			
Ārām	37	0, 18, 26	(+) 0, 19, 52	69	1, 9, 48	(+) 1, 3, 15	(+) 1, 23, 7	50	1, 8, 55	50	2, 32, 2	29	*yī-māu*	8	*zhim-sū*	23	*tīn-chīu*
Īkindi	66	1, 46, 52	(+) 0, 28, 21	87	0, 32, 22	(+) 0, 53, 59	(+) 1, 22, 20	19	2, 37, 21	20	1, 13, 1	30	*kā-shin*	10	*kūy-ṣiz*	25	*wū-shin*
Ujunj	96	0, 28, 38	(+) 0, 30, 35	104	2, 41, 36	(+) 0, 34, 40	(+) 1, 5, 15	49	1, 19, 7	49	2, 24, 22	29	*kā-yim*	10	*kūy-khā'y*	26	*kī-māu*
Tūrtūnj	125	1, 57, 4	(+) 0, 26, 23	122	2, 4, 10	(+) 0, 4, 4	(+) 0, 30, 27	19	0, 0, 53	19	0, 31, 20	29	*kūy-wī*	12	*kā-wū*	27	*kī-yū'u*
Bīshīnj	155	0, 38, 50	(+) 0, 15, 30	140	1, 26, 44	(-) 0, 28, 48	(-) 0, 13, 18	48	1, 29, 19	48	1, 16, 1	30	*zhim-zhih*	13	*kā-zhih*	28	*kī-māu*
Altīnj	184	2, 7, 16	(-) 0, 1, 20	158	0, 49, 18	(-) 0, 51, 0	(-) 0, 52, 20	18	0, 11, 5	17	2, 5, 25	29	*zhim-wū*	14	*yī-wī*	29	*kin-sū*
Shūn	214	0, 49, 2	(-) 0, 17, 47	176	0, 11, 52	(-) 1, 2, 24	(-) 1, 20, 11	47	1, 39, 31	47	0, 19, 20	29	*sin-khā'ī*	15	*yī-chīu*		
Yitīnj	243	2, 17, 28	(-) 0, 27, 20	193	2, 21, 6	(-) 1, 3, 15	(-) 1, 30, 35	17	0, 21, 17	16	1, 37, 22	30	*kin-chin*	1	*kin-chin*	17	*pīn-shin*
Sikisīnj	273	0, 59, 14	(-) 0, 30, 40	211	1, 43, 40	(-) 0, 53, 39	(-) 1, 24, 19	46	1, 49, 43	46	0, 25, 24	30	*kin-sū*	2	*sin-khāy*	17	*pīn-yim*
Ṭūqsūnj	302	2, 27, 40	(-) 0, 27, 33	229	1, 6, 14	(-) 0, 33, 15	(-) 1, 0, 48	16	0, 31, 29	15	2, 17, 21	29	*kin-chin*	2	*sin-ṣiz*	17	*pīn-shin*
Unūnj	332	1, 9, 26	(-) 0, 17, 47	247	0, 28, 48	(-) 0, 2, 3	(-) 0, 19, 50	45	1, 59, 55	45	1, 40, 5	30	*kī-yū'u*	4	*zhim-zhih*	19	*tīn-māu*
Biryikizminj	361	2, 37, 52	(-) 0, 1, 59	16	2, 38, 2	(+) 0, 28, 48	(+) 0, 26, 49	15	0, 41, 41	15	1, 8, 30	30	*kī-māu*	4	*zhim-wū*	19	*tīn-yū'u*
Jaqshābāṭ	26	0, 39, 2	(+) 0, 15, 1	34	2, 0, 36	(+) 0, 51, 0	(+) 1, 6, 1	44	2, 10, 7	45	0, 29, 28	30	*kī-yū'u*	4	*zhim-zhih*	20	*wū-chin*
Ārām	55	2, 7, 28	(+) 0, 25, 52	52	1, 23, 10	(+) 1, 2, 24	(+) 1, 28, 16	14	0, 51, 53	14	2, 20, 9		*kī-māu*				

(8r) *Section 11*
On knowing the fourth cycle

The people of Qitai have another cycle on which they rely for the "choice of days." This is also a cycle of twelve, and the names of those twelve are as follows: 1. *kin* 2. *chū* 3. *man* 4. *pin* 5. *tin* 6. *chih* 7. *pū* 8. *wī* 9. *chin* 10. *shīu* 11. *khā'ī* 12. *pī*. Among these, four numbers are *khī*, meaning "black"[1] and incline toward corruption; those are *kin*, *man*, *pin*, and *shīu*. Four are *khūnk*, meaning "yellow,"[2] and incline toward beneficence; those are *chū*, *tin*, *chih*, and *wī*. Two are *pah*, meaning "white,"[3] and are extremely beneficent; those are *chin* and *khā'ī*. Two are *hūn*[4] representing extremely corrupt; those are *pū* and *pī*. They count the days of the solar divisions in the same order (of this cycle) as mentioned at the beginning (of this section). When the turn comes to odd-numbered divisions such as the first, third, and fifth divisions, they count the first day of that division and the preceding day as one; that is to say, what comes about in the preceding day is repeated at the first day of the division. The remaining days are in order.

We noted what turn comes about at the beginnings of years in the two (twelve-)cycles from the first year of the cycle of the Superior Epoch, so that the order is counted from there. We put what turn comes about on the first day of the *lījun* in each year. Each year after that, the turn comes to the sixth (from the order of the cycle on the *lījun* of the preceding year). If that year is an intercalary year, the turn comes to the seventh. We have placed a "k" next to the intercalary years. (The others) can (be known) by analogy with this.

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1 The term *khī*, as mentioned here, means "black" *hei* 黒 (hei).

2 The term *khūnk* means "yellow" *huang* 黄 (huaŋ).

3 The term *pah* means "white" *bai* 白 (pai).

4 For this color, no manuscript has a translation into Persian except for DK, in which this color is expressed as the *aghbar,* meaning "dusty (color)" (12 v). In the *Zīj-i Khāqānī* compiled later, this color is expressed as the *khāk-i ālūd* "polluted soil" (van Dalen *et al.* 1997, 123)

Yazdigird Years	Turkish Years	First Turn of the Cycle of "*Lījun*"	Intercalary Years	Yazdigird Years	Turkish Years	First Turn of the Cycle of "*Lījun*"	Intercalary Years
633	*kuskū*	*shīu*	k	646	*ūṭ*	*chih*	k
634	*ūṭ*	*pin*		647	*bars*	*pī*	
635	*bars*	*chin*		648	*ṭāushqan*	*tin*	
636	*ṭāushqan*	*chū*		649	*lū*	*shīu*	
637	*lū*	*pū*		650	*yīlān*	*man*	k
638	*yīlān*	*pī*	k	651	*yūnd*	*chin*	
639	*yūnd*	*chih*		652	*qūy*	*chū*	
640	*qūy*	*khā'ī*		653	*bījīn*	*pū*	
641	*bījīn*	*pin*		654	*dāqūq*	*pī*	k
642	*dāqūq*	*chin*	k	655	*īt*	*chih*	
643	*īt*	*man*		656	*ṭūnghūz*	*khā'ī*	
644	*ṭūnghūz*	*wī*		657	*kuskū*	*pin*	
645	*kuskū*	*kin*					

Section 12
On knowing the Qitai calendar from the Arabic calendar

Since the Hijri calendar is more familiar to our astronomers/astrologers, we have put the Hijri years and months for a hundred years from the first year of Genghis Khan's reign in a table. The (Hijri) years are in the right side, the (Hijri) months are at the head of the table, and the months of the Mongols are in the middle of the table with numerals. The name of the Turkish year and an intercalary month are inserted. The table includes the weekday of the first day of the Arabic month on the upper part (of an entry), and also the sixty-cycle of the first day of the Qitai month, and the number of the days of the (Qitai) month. The table is on the next page.

IV. Commentary

Section 1

In the first section, the units of time in the Qitai calendar are explained. Among them, the first is the cycle of the twelve "terrestrial branches" (*tu-zhi* 地支), which functioned as basic unit of time in the Chinese chronology.

These were originally abstract notions; however, from early on in China, each branch was attached to an animal name and this twelve-animal cycle was quite popular in the civil sphere. The Turks in the northern and western steppes also adapted the Chinese calendar, replacing this abstract and official cycle of twelve branches with its popular equivalent, namely, the twelve-animal cycle, which was not used for date-reckoning in the Chinese official chronology (Bazin 1991). The Turko-Mongols in the Ilkhanid period also used this twelve-animal cycle to denote their years: for example, the "year of the rat" (Melville 1994). The order of the cycle both in Chinese and Turkish is as below:

	1	2	3	4	5	6
Chinese	*zi* 子 (tsï)	*chou* 丑 (tʂhiau)	*yin* 寅 (ian)	*mao* 卯 (mau)	*chen* 辰 (tʂhian)	*si* 巳 (sï)
Turkish Animals	*kuskū* rat	*ūt* ox	*bars* tiger	*ṭāushqan* hare	*lū* dragon	*yīlān* snake

	7	8	9	10	11	12
Chinese	*wu* 午 (u)	*wei* 未 (vui)	*shen* 申 (ʂian)	*you* 酉 (iau)	*xu* 戌 (ʂiu)	*hai* 亥 (hai)
Turkish Animals	*yūnd* horse	*qūy* sheep	*bījīn* monkey	*daqūq* cock	*īt* dog	*ṭūnghūz* pig

Then, three units for a night-day are explained: the *chāgh*, *kih*, and *funk*. The *chāgh* (double-hour) is denoted with the twelve branches shown above, such as the double hour of *zi*, or rat (*chāgh-i zi* or *kuskū*). The ratio of each unit is shown in the following table:

1 day	12 *chāgh*s
1 *chāgh*	8 *kih*s
1 day	10,000 *funk*s
1 *chāgh*	833 and 1/3 *funk*s
1 *kih*	104 and 1/6 *funk*s

The *funk*s are also marked with the sexagesimal form in accordance with the usage of astronomers/astrologers in Iran.

The method dividing a day into 10,000 *funk*s called the "ten-thousand *funk*s method" (*wan-fen fa* 万分法) was rarely adopted by official Chinese astronomical systems. Yabuuti has argued that this method was first introduced into China through the *Fu-tian li* 符天曆 compiled by Cao Shi-wei 曹士蔿 during the late Tang period, the Jian-zhong 建中 era (780–783). In regard to the *Fu-tian li*, the *Xin wu-dai shi* 新五代史 offers the following passage:

> During the Jian-zhong era, an astrologer, Cao Shi-wei, first changed the old method. He set the fifth year of the Xian-qing era (i.e., 661 AD) as the start of the epoch and *yu-shui* as the starting point of the year. He entitled (the astronomical system) the *Fu-tian li*. It was used only among the people as an unofficial astronomical system.
> 唐建中時，術者曹士蔿始變古法，以顯慶五年為上元，雨水為歲首，號符天曆。然世謂之小曆，祇行於民間。
>
> (*Xin wu-dai shi*, 58: Si-tian kao; Yabuuti 1982, 2)

In addition, regarding Cao Shi-wei 曹士蔿, we can find another source, Ma Duan-lin 馬端臨's *Wen-xian tong-kao* 文獻通考 compiled in the Yuan period (1271–1368), in which the author mentions the *Ge-yuan wan-fun li* 合元万分曆 compiled by this Cao Shi-wei:

> Chao said: Cao Shi-wei compiled (it) in the Tang period. His name is unknown. The epoch was derived from the fifth year of the Xian-qing era, and it was an unofficial astronomical system that was current in the civil sphere. The method was based on Indian astronomical system. I heard it from Li Xian-chen.
> 晁氏曰。唐曹氏撰，未知其名。曆元起唐高宗顯慶五年庚申，蓋民間所行小曆也。本天竺曆為法，李獻臣云。
>
> (*Wen-xian tong-kao*, 219: Jing-ji kao 46; Yabuuti 1982, 3)

Judging from the accordance of the epochs and the same designation as an "unofficial" astronomical system, without doubt, the *Ge-yuan wan-fun li* is another name of the *Fu-tian li*. Although the contents of this calendar are only partially known, it is most likely that this system adopted the ten-thousand *funk*s method judging from the name *wan-fun li* [Ten-Thousand *Funk*s Astronomical System]. Yabuuti has conjectured that this was one of new methods of Cao Shi-wei who "changed the old method" (Yabuuti 1982, 5). In fact, this method was unknown in the Chinese astronomical systems before the *Fu-tian li*. It was also adopted by the *Shou-shi li* 授時暦: 1281–1384, the official astronomical system of the Yuan dynasty, distributed from 1281 sometime after the compilation of the *Zīj-i Īlkhānī*. The system has gained fame as the masterpiece of traditional Chinese astronomical systems.

Section 2

This section explains what is called the cycle of the ten "heavenly stems" (*tian-gan* 天干). The order is as below:

1	2	3	4	5	6	7	8	9	10
jia 甲 (kia)	*yi* 乙 (i)	*bing* 丙 (piaŋ)	*ding* 丁 (tiaŋ)	*wu* 戊 (vu)	*ji* 己 (ki)	*geng* 庚 (kiaŋ)	*xin* 辛 (sian)	*ren* 壬 (ɽiam)	*gui* 癸 (kui)

In China, traditionally, the sexagenary cycle called *gan-zhi* 干支 was used for reckoning days and years. It is constituted by combining the ten-stem cycle with the twelve-branch cycle mentioned in the previous section. The combination of each element is as below (Sivin 2009, 69):

1. *jia-zi* 甲子	2. *yi-chou* 乙丑	3. *bing-yin* 丙寅	4. *ding-mao* 丁卯	5. *wu-chen* 戊辰
6. *ji-si* 己巳	7. *geng-wu* 庚午	8. *xin-wei* 辛未	9. *ren-shen* 壬申	10. *gui-you* 癸酉
11. *jia-xu* 甲戌	12. *yi-hai* 乙亥	13. *bing-zi* 丙子	14. *ding-chou* 丁丑	15. *wu-yin* 戊寅
16. *ji-mao* 己卯	17. *geng-chen* 庚辰	18. *xin-si* 辛巳	19. *ren-wu* 壬午	20. *gui-wei* 癸未
21. *jia-shen* 甲申	22. *yi-you* 乙酉	23. *bing-xu* 丙戌	24. *ding-hai* 丁亥	25. *wu-zi* 戊子
26. *ji-chou* 己丑	27. *geng-yin* 庚寅	28. *xin-mao* 辛卯	29. *ren-chen* 壬辰	30. *gui-si* 癸巳
31. *jia-wu* 甲午	32. *yi-wei* 乙未	33. *bing-shen* 丙申	34. *ding-you* 丁酉	35. *wu-xu* 戊戌
36. *ji-hai* 己亥	37. *geng-zi* 庚子	38. *xin-chou* 辛丑	39. *ren-yin* 壬寅	40. *gui-mao* 癸卯
41. *jia-chen* 甲辰	42. *yi-si* 乙巳	43. *bing-wu* 丙午	44. *ding-wei* 丁未	45. *wu-shen* 戊申
46. *ji-you* 己酉	47. *geng-xu* 庚戌	48. *xin-hai* 辛亥	49. *ren-zi* 壬子	50. *gui-chou* 癸丑
51. *jia-yin* 甲寅	52. *yi-mao* 乙卯	53. *bing-chen* 丙辰	54. *ding-si* 丁巳	55. *wu-wu* 戊午
56. *ji-wei* 己未	57. *geng-shen* 庚申	58. *xin-you* 辛酉	59. *ren-xu* 壬戌	60. *gui-hai* 癸亥

Section 3

The third section is assigned for the explanation of the year of the Qitai and the twenty-four divisions of a year. For the Qitai, the length of a year is the period when the sun returns to the same position on the celestial sphere, which was counted as 365.2436^{d} and called *suijū* in their language. They also divide the length of a year into twenty-four equal parts called *kīja*; that is 15.21848333...^{d}. The name of each division is as follows:

1. *li-chun* 立春 (li-tʂhiuan)	2. *yu-sui* 雨水 (iu-ʂui)	3. *jing-zhe* 驚蟄 (kiŋ-tʂi)	4. *chun-fun* 春分 (tʂhiuan-fuan)
5. *qing-ming* 清明 (tshiaŋ-miaŋ)	6. *gu-yu* 穀雨 (ku-iu)	7. *li-xia* 立夏 (li-hia)	8. *xiao-man* 小滿 (siau-muan)
9. *mang-zhong* 芒種 (muaŋ-tʂiuŋ)	10. *xia-zhi* 夏至 (hia-tʂɿ)	11. *xiao-shu* 小暑 (siau-ʂiu)	12. *da-shu* 大暑 (tai-ʂiu)
13. *li-qiu* 立秋 (li-tshiau)	14. *chu-shu* 處暑 (tʂhiu-ʂiu)	15. *bai-lu* 白露 (pai-lu)	16. *qiu-fun* 秋分 (tshiau-fuan)
17. *han-lu* 寒露 (han-lu)	18. *shuang-jiang* 霜降 (ʂaŋ-kiaŋ)	19. *li-dong* 立冬 (li-tuŋ)	20. *xiao-xue* 小雪 (siau-siuɛ)
21. *da-xue* 大雪 (tai-siuɛ)	22. *dong-zhi* 冬至 (tuŋ-tʂɿ)	23. *xiao-han* 小寒 (siau-han)	24. *da-han* 大寒 (tai-han)

The end of the section addresses the difference between China's and Iran's notions of seasons. Turkic people, composing the main body of the "Mongol" troop, had a seasonal notion more similar to that of Iran than that of China, at least concerning spring. Since ancient times, the Turko-Mongols had appreciated solar motion not directly by astronomical observations or calculations, but indirectly, through its effect on vegetation, in a way suitable to their pastoral economy (Bazin 1991, 119). In the official Chinese history of the sixth-century dynasty, it is stated that "(Turks) do not know the succession of years, and only count it based on the grass turning green" (*Zhou shu*, 50: Yi-yu chuan 2; Bazin 1991, 118). In steppes across northern and western China, this timing falls around the spring equinox, which is considered the starting point of spring in Iran. On the other hand, the starting point of the Chinese notional spring usually falls during the severity of winter in the steppes. In the course of unifying Mongolia, the Turko-Mongols seem to have adopted the Chinese calendar through contacts with the Jin dynasty (1115–1234) around 1201 (Bazin 1991, 402). As a rule, the adoption of the Chinese calendar by the neighboring steppe people was a measure of Chinese success in imposing its authority and the benefits of its civilization upon the so-called “barbarians.” Despite the disharmony between the astronomically determined beginning of the Chinese year and the Turkic nomadic tradition, according to which the year starts at the beginning of spring, the Turko-Mongols accepted the Chinese calendar. At about the same time, from the beginning of their conquest of northern China in 1215, the Mongols acquired an official Chinese calendar, in conformity with their status as a Chinese imperial power (Melville 1994, 84).

Outside China proper, where the root of living was based on its own time, the Turko-Mongols used the Chinese calendar as well as in China proper. Xu Ting 徐霆, who was the Sung ambassador to the Mongol court in 1237, reported that he encountered the Chinese calendar on the way to Mongolia. Upon his inquiry, the calendar was identified as the one made by Yelü Chucai 耶律楚材, a sinicized Qitan 契丹 who accompanied Genghis Khan on several campaigns, and was famous as the chief “Chinese” adviser of the early Mongol rulers (Allsen 2001, 165-166).

We might be tempted to conjecture that the Qitai calendar is exactly the one compiled by Yelü Chucai and used in the Mongol court in a period close to that of the compilation of the *Zīj-i Īlkhānī.* But, according to the *Yuan shi* 元史, the *Xi zheng geng-wu yuan li* 西征庚午元曆 he compiled is identical to the *Revised Da-ming li* with the exception of a small correction due to the difference in geographical longitude (*Yuan shi*, 56-57: Geng-wu yuan li 1-2; Yabuuti 1997, 11-12). As shall be discussed in detail, we cannot identify the Qitai calendar as the *Revised Da-ming li*, despite the fact that the latter can undoubtedly be regarded as one of main sources of the former. Therefore, Yelü Chucai’s astronomical system also differs from the Qitai calendar.

Section 4

The way of reckoning years is explained in this section. The sixty-cycle is attached to the three epochs by the following order: first, the cycle of the Superior Epoch (*shānk wan*), then the cycle of the Middle Epoch (*jūnk wan*), and the final is the cycle of the Inferior Epoch (*khā wan*):

Persian	English Translation	*Piyin*	Characters	Yuan-Era Early Mandarin	Length
shānk wan	Superior Epoch	*shang-yuan*	上元	ʐĭaŋ-iuɛn	60 years
jūnk wan	Middle Epoch	*zhong-yuan*	中元	tʂiuŋ-iuɛn	60 years
khā wan	Inferior Epoch	*xia-yuan*	下元	hia-iuɛn	60 years

These epochs, called *san-yuan jia-zi* 三元甲子, appear from the Tang period onwards. Furthermore, we can find them in annotated calendars among Uighurs and Tibetans from the Tang period, in collaboration with nine-color palaces (*jiu-fang se* 九方色). Bazin has found Indian influence in this collaboration, in connection with nine luminaries (*jiu-yao* 九曜), including Mars, Mercury, Jupiter, Venus, and Saturn, the Sun, the Moon, as well as positions in the sky: Rāhu (ascending lunar node) and Ketu (descending lunar node). Interestingly, this epoch starts from 784. Bazin ascribed this to the 1260 years grand cycle consisting of the three epochs: sexagenary cycle, nine-color palaces, and 28 "*nakshatra*" (Bazin 1991, 265-273). However, Arrault, who investigated several series of documents and fragments excavated at Dunhuang, has connected the era with the beginning of the cycle of *tai-yi* 太一 in the Sui period in 604 (784–180) (Arrault & Marzloff 2003, 109 n. 100).

To count years over this 180-year epoch, the accumulated years from the creation are taken into consideration. According to the computation of the Qitai calendar, 8,863 *wan*s—Chinese *wan* 万 (van) means 10,000 years—and 9,679 years had elapsed from the creation to the year of the accession of Genghis Khan. As described in the longer introduction in the *Zīj-i Īlkhānī*, the "year of the accession" is the year of the legendary "Baljuna covenant" in 1203 (Boyle 1963, 250-251).

The Chinese astronomical systems set up a starting point for a great cosmic cycle, from which all celestial phenomena start. Each system has a different origin, mainly in the distant past (Sivin 2009, 73). The era of the Qitai calendar completely corresponds with that of the *Revised Da-ming li*, which regards 88,639,656 years as the elapsed years from the starting point to A.D. 1180 (*Jin shi*, 21: Bu qi-ce bu gua-hou bu ri-chan bu gui-lou). This accordance is strong evidence that the astronomical system is one of the sources of the Qitai calendar.

The beginning year of the Superior Epoch after the accession of Genghis Khan is in accordance with the year 633 of the Yazdigird era (A.D. 1264)—which is named after the last Sassanid king—commencing with A.D. 632. The era fixing the annual length as 365 days without a fractional remainder survived after the collapse of the dynasty and is often referred to in Islamic and Byzantine astronomical treatises because of its convenience in calculation (Neugebauer 1957, 81; van Dalen 2000, 267).

The final sentences of this section are also of interest: “Turks only use a cycle of twelve and count it in their language. The regulation of their calendar is unknown to us.” As mentioned in the first section, the Turks in the northern and western steppes employed only the twelve branches in the form of the twelve-animal cycle, not the ten stems. Even after the Mongol court adopted the “proper” Chinese calendar, probably a large number of the Turko-Mongols continued to recognize time passing from their pastoral circumstances and not from observation or astronomical computation; this obscurity might well be reflected in the above-quoted passage.

Section 5

This section is assigned for explaining the way to compute the beginning of the first division of a solar year, the *lījun* (*li-chun* 立春). All official astronomical systems in the Chinese dynasties adopted the beginning of the twenty-second division *dong-zhi* 冬至—the winter solstice—as the standard of astronomical computation. But, as one of the gestures to signal a change of heavenly mandate, early dynasties shifted the first month of the civil year. The final shift in 103 B.C. situated the civil new year at the beginning of the second lunar month after the winter solstice. Therefore, the new year falls around at the beginning of the *lījun*. Although the official Chinese astronomical systems used their own “astronomical year,” which differed from the civil year in that its Astronomical First Month (*tian-zheng* 天正) contained the winter solstice, the civil new year is taken into consideration in the Qitai calendar (Sivin 2009, 75-76); therefore, the beginning of the *lījun* is computed as “the initial value of the divisions of a year” in this calendar.

As found in the passage, the initial value is set as 11.7660 in the epoch era of the Qitai calendar (A.D. 1264). 360 is multiples of 60. By a year, therefore, the initial value slides by 5.2436 days, which is equal to the excess of a solar year over 360, also called *suiyū*. Then, if the required year falls after the epoch year, the initial value (11.7660) is added to the product of the *suiyū* and the interval between the epoch and required years. Finally, the result is diminished by 60 as many times as possible. As a result, we can obtain a formula to compute “the initial value of the divisions of a year” as follows:

$11.7660 + 5.2436\,T - [60]_r$ (I)

T = the interval between the epoch and required years.

$[x]_r$ = subtracting x as many times as possible (i.e., taking the remainder of the division by x) (cf. Imai 1962, 32).

We shall compare the above formula with the formula in the *Revised Da-ming li*. We quote the following passage which computes the beginning of the twenty-second division *dong-zhi* 冬至—the winter solstice—in the epoch year (A.D. 1180):

> To compute the Winter Solstice in the Astronomical First Month
>
> Set up the Accumulated Years from the First Year of the Superior Epoch, and multiply it by the Year Numerator to yield the Accumulated *Funk*s. Cast out the full Sexagenary-Days Cycles from that. Simplify (i.e., divide) the remainder by the Day Divisor to yield the days. The remainder is expressed as the fractions. Do not count the First Year. The result is the desired days and fractions on the Winter Solstice (from the beginning of the month).
>
> 求天正冬至
>
> 置上元甲子以來積年，歲實乘之，為通積分。滿旬周去之，不盡以日法約之為日，不盈為餘。命甲子算外，即所求天正冬至日大小餘。
>
> （*Jin shi*, 21: Bu qi-shuo 1）

That is to say, as mentioned in the commentary of the fourth section, 88,639,656 years are accumulated years from the first days of the Superior Epoch to A.D. 1180 in accordance with the computation of the *Revised Da-ming li*. It is multiplied by the Years Numerator that is the *funk*s of a year (1,910,224 *funk*s), and the result is 169,321,598,242,944 *funk*s. From the value, we subtract the Sexagenary-Days Cycle, which is the value obtained by the multiplication of the Day Divisor (the *funk*s of a day: 5,230 *funk*s) by 60, as many times as possible. As a result, we obtain 5.6489... days as falling on the winter solstice from the beginning of the eleventh month in the epoch year (A.D. 1180). On the basis of this initial value in the epoch year, we devise the following formula to compute the winter solstice in another year (Imai 32):

$5.6489 + 5.2435946\,T - [60]_r$

If we convert it into a formula for A.D. 1264, the era of the Qitai calendar, by adding 84 (1264–1180) times 5.2435946 and canceling multiples of 60, the following is obtained:

$26.1108 + 5.2435946\,T - [60]_r$

Furthermore, by adding the time between the winter solstice and the beginning of the *līјun* (the interval of the three solar divisions or one eighth of a solar year, 45.65545 days), we convert it again into a formula on the basis of the *līјun*, as in the *Zīj-i Īlkhānī*:

$11.7662 + 5.2435946\,T - [60]_r$ (II)

As we can see, the initial values in formulas (I): 11.7660 and (II): 11.7662 are almost identical. The small difference in the fourth decimal position may be ascribed to the fact that the former calendar adopts the ten-thousand *funk*s method explained in the commentary of the first section, in which the fifth and further decimal places are disregarded. From this fact, we can point out the great possibility that the Qitai calendar borrowed constants from the *Revised Da-ming li* to compute the beginning of the *līјun*.

In the latter half of this section, the beginning of the *līјun* in the 10th year of the Superior Epoch is computed as an example. To obtain the value, we substitute 9—the interval from the epoch year—into the formula (I). So, first 9 is multiplied by 5 days and 2,436 *funk*s and we obtain 45 days and 21,924 *funk*s. As explained in the first section, 20,000 *funk*s equal 2 days; therefore, the result is converted into 47 days and 1,924 *funk*s. Then, 11 days and 7,660 *funk*s—"the initial value"—is added to the former result, and we obtain 58 days and 9,584 *funk*s. Since the remaining *funk*s are counted as a day, we obtain 59, making the 59th day beginning of the *līјun* in the 10th year of the Superior Epoch. The 59th day is the *zhim sū* in the sixty-cycle. More precisely, the beginning of the *līјun* in this year is considered the point at which 9,584 *funk*s have elapsed since the beginning of the day. From the last table of the first section, we know that 9,584 *funk*s—2, 39, 44— fall in the first double-hour; specifically, it is the time at which the two-thirds of a *funk* elapsed since the first double hour began.

Once we have determined the beginning of the *līјun*, we can obtain the beginning of other solar divisions in the year. As an example, the beginning of the seventh division is computed. From the table in the third section, we know that the seventh division starts 91 days and 3,109 *funk*s—0, 51, 49—later than the beginning of the *līјun*. We add the value to the beginning of the *līјun* (58 days and 9,584 *funk*s). We obtain 149 days and 12,693 *funk*s—3, 31, 33—, convert 10,000 *funk*s into one day, and yield a total of 150 days and 2,693 *funk*s—0, 44, 53. To obtain the beginning of the seventh division, we need to subtract 60 from the days as many times as possible; as a result, 30 days and 2,693 *funk*s remain. Therefore, we know that the 31st day—the day of *kā-wū*—is the beginning day of the seventh division in the year. Regarding the remaining 2,693 *funk*s—0, 44, 53—, we know that the beginning falls in the fourth double-hour; more precisely, it is the time at which 89 *funk*s have elapsed since the beginning of the sixth *kih* of the fourth double-hour.

Section 6

This section demonstrates the computation of the beginning of the first month, the *ārām ay*. Since we discussed how to compute the beginning of the *lījun* in the previous section, we can also find the beginning of the *wūshī* (the second solar division). This section explains how to compute the interval between the beginnings of the first month and *wūshī*.

The names of the months in the Chinese calendar as found in Persian sources of the Mongol period are Turkish ordinal numbers followed by the Turkish term *ay* that means "month," except for the first and twelfth months. The first month appears in the form of *ārām.* According to Bazin, we can find the influence of Buddhism in the use of this term. The term quite likely comes from the Persian *rām*, meaning "joyous." The name of the twelfth month, *čaqšapat*, was borrowed from the Soghdian language, whose original is the Sanskrit *śikṣāpada*, which means "prescriptions" (Bazin 1991, 294; van Dalen *et al.* 1997, 124). The Soghdian language belongs to the Iranian language group. In the Mongol period, these names were used by Turko-Mongols in Iran and Central Asia, and the aforementioned names of the two months were probably borrowed from Soghdians who were quite flourishing in these regions from the period before the Mongols. The names of the months are as follows (van Dalen *et al.* 1997, 124):

1. *aram ay*	2. *ikindi ay*	3. *üčünč ay*
4. *törtünč ay*	5. *bešinč ay*	6. *altïnč ay*
7. *yetinč ay*	8. *sekizinč ay*	9. *toquzïnč ay*
10. *onunč ay*	11. *biryegirminč ay*	12. *čaqšapat ay*

In Chinese astronomical systems in the later period, each lunar month must include the beginning of an even-numbered division of a solar year—called *zhong-qi* 中氣 (tʂiuŋ-khi)—corresponding to odd-numbered divisions called *jie-qi* 節氣 (tsiɛ-khi). The correspondence relation between even-numbered solar divisions and lunar months is as follows:

Month Number	1	2	3	4	5	6
Solar Division	*yu-sui* 雨水	*chun-fun* 春分	*gu-yu* 穀雨	*xiao-man* 小滿	*xia-zhi* 夏至	*da-shu* 大暑
Month Number	7	8	9	10	11	12
Solar Division	*chu-shu* 處暑	*qiu-fun* 秋分	*shuang-jiang* 霜降	*xiao-xue* 小雪	*dong-zhi* 冬至	*da-han* 大寒

The interval between two even-numbered divisions (30.4375^d) is a little bit longer than the period of a lunar month (in this case, 29.5306^d). In several years, therefore, a month that does not contain the beginning of an even-numbered division will occur. This month is regarded as an intercalary month, which is named according to the ordinal number of the preceding month prefixed by the word *run* 閏 (ʐiuan), meaning "intercalary," for example "the intercalary twelfth month 閏十二月" (Yabuuti 1990, 275-276). In Chinese astronomical systems, the position of an intercalary month is not fixed, and can fall in any month.

The winter solstice (the beginning of the twenty-second solar division), whose position was determined through a series of observations, was the standard of computation in Chinese official astronomical systems. As explained in the commentary of the previous section, however, the civil year gets under way from the second new moon after the winter solstice, in which the beginning of the second division *wūshī* must be included. Therefore, the interval between the beginnings of the first month (*ārām ay*) and the *wūshī* is taken into consideration in this section.

According to the passage in this section, the interval between the beginnings of the first month and the *wūshī* is 14.4676 days in the epoch year. Since the month moves in accordance with lunation and the *wūshī* is based on the solar motion, the interval of both annually increases 10.8764 days—which is the difference between the solar year and twelve mean lunar months called *suijā*. If the year is after the epoch year, we compute the interval between the beginnings of the first month and the *wūshī* in a year as follows: after computing the interval between the epoch and the required years, the result is multiplied by the *suijā* and added to 14.4676 days which is the initial value of the epoch year. However, the beginning of *wūshī* should fall in the first month, so that the interval should be shorter than the length of a mean lunar month (29.5306 days). That is the reason why the value of the length must be subtracted as many times as possible from the result. The formula is set up as below:

$14.4676 + 10.8764\ T - [29.5306]_r$ (III)

Here, as in the previous section, we shall compare the formula with that of the *Revised Da-ming li* for A.D. 1180 on the basis of the winter solstice (*dong-zhi* 冬至). The passage on how to compute it is as follows:

> To compute the beginning of the Astronomical First Month
>
> Cast out the full Lunation Numerators from the Accumulated *Funk*s (from the First Year of the Superior Epoch) to yield the Intercalary Surplus. Subtract it from the Accumulated *Funk*s to yield the Accumulated *Funk*s until the Beginning (of the Astronomical First Month). Cast out the full Sexagenary-Days Cycles from that. Simplify the remainder by the Day Divisor to yield the days. The remainder is expressed as the fractions. The result is the desired days and fractions on the beginning of the Astronomical First Month.
>
> 求天正經朔
>
> 以朔實去通積分，不盡為閏餘，以減通積分為朔積分。滿旬周去之，不盡如日法而 一為日，不盈為餘，即所求天正經朔大小餘也。
>
> (*Jin shi*, 21: Bu qi-shuo 1)

That is to say, the Lunation Numerator (the *funk*s of a mean lunar month, totaling 154,445 *funk*s) is subtracted as many times as possible from the Accumulated *Funk*s from the first year of the Superior Epoch—that is, 169,321,598,242,944 *funk*s, as computed in the previous section. By this computation, we obtain the Intercalary Surplus 75,749 *funk*s, which represents the interval between the winter solstice and the beginning of the month prior to the winter solstice. By division of the value by the Day Divisor (5,230 *funk*s), we obtain 14.48355... days as the interval between the winter solstice and the beginning of the month prior to the winter solstice in the epoch year (A.D. 1180). Therefore, the formula to compute the interval between the winter solstice and the beginning of the month prior to the winter solstice can be devised as follows:

$14.4836 + 10.8764818\ T - [29.5305927]_r$

By adding 84 times 10.8764818 and canceling multiples of 29.5305927, we can convert the above formula into one for A.D. 1264, the epoch of the Qitai calendar, and the following formula is obtained:

$12.6597 + 10.8764818\ T - [29.5305927]_r$

Furthermore, we convert it again into the formula on the *wūshī* as in the *Zīj-i Īlkhānī*, by adding the time between the winter solstice (the twenty-second solar division) and the beginning of the *wūshī*, one-sixth of a solar year, i.e., 60.8739 days, being 1.8127 days more than two whole lunar months:

$14.4724 + 10.8764818\,T - [29.5305927]_r$ (IV)

As with the formula to compute the beginning of the *līјun*, we find a close similarity in the constants of the both formulas (III): 14.4676 and (IV): 14.4724 between the Qitai calendar and the *Revised Da-ming li*; the slight difference is caused by the adoption of the ten-thousand *funk*s method in the former calendar. Therefore, it is clear that this computation is also based on that of the *Revised Da-ming li* (cf. Imai 1962, 32-33).

Section 7

The explanation for the solar and lunar equations commences in this section. This section explains the way to determine the arguments of the sun and moon at the beginning of a year.

In a Babylonian tradition that has survived into modern astronomy, a celestial circle is divided into 360 degrees. Chinese instead defined their basic unit *du* 度 (or Chinese "degree") to record celestial positions as one day's mean solar travel among the stars (Sivin 2009, 89); so that, in the case of the Qitai calendar in which a solar year is defined as 365.2436 days, the cycle of the annual solar motion is rendered 365.2436 Chinese degrees.

Due to variation in the distance between the sun and the earth as the latter moves on its elliptical orbit, the observed velocity of the sun undergoes a change. In the Chinese astronomical system, it was established that the inequality of the sun was zero at the solstices and symmetrical about them. Chinese astronomers considered the winter solstice to be the standard of computation for the solar equation. The equation of center is positive during the period when the sun moves from the winter to the summer solstices; during the other half-year, on the other hand, the equation of center is negative (Sivin 2009, 408-412).

To obtain the solar argument at the beginning of a year, therefore, it is necessary to know the time elapsed since the winter solstice (Imai 1962, 33). To compute the interval from the winter solstice to the beginning of the first month, the interval between the beginnings of the first month and the *wūshī* in a year is subtracted from one-sixth of a solar year (60.8740 days), corresponding with the interval between the twenty-second solar division (the winter solstice) and the *wūshī*.

To compute the inequality of the lunar motion, in turn, the anomalistic month is taken into consideration. That is the period of the moon's travel from perigee back to perigee. Since there was no explicit concept of perigee or apogee in their astronomical vocabulary, Chinese saw the anomalistic month as the revolution for which the Revolution Terminal Constant (*zhuan-zhong* 轉終) is named and transcribed it as *junjūn* in Persian. In the Chinese astronomical system, the standard point is the perigee in the moon's orbit when it is closest to the earth, and its apparent speed is fastest (Sivin 2009, 101-102). In this section, therefore, "the initial value of the lunar argument" that means the interval between the beginnings of *wūshī* and the anomalistic month preceding the former in the epoch year is obtained as 23.2836 days called *junjūnkā* (van Dalen *et al.* 1997, 149). The value of the interval annually slides by 7.0338 days called *jūnjā*, which means the excess of a solar year over thirteen anomalistic months.

In consideration of this computation, we obtain the value of an anomalistic month by the following formula:

$(365.2436 – 7.0338)/13 = 27.5546$ days

This value is almost the same as the values used in various Chinese astronomical systems, including the *Revised Da-ming li* (van Dalen *et al.* 1997, 126).

To compute the value of the interval between the beginnings of the *wūshī* and the anomalistic month preceding the former in another year, therefore, the initial value is added to the value of the multiplication of the interval between the epoch and required years by the *jūnjā* when the required year falls after the epoch year. The value of the interval between the beginnings of the *wūshī* and the anomalistic month preceding the former is called the "first number to be kept." Then, the interval between the beginnings of the first month and *wūshī* computed in the previous section is subtracted from the first number to yield the interval between the beginnings of the first month and the anomalistic month preceding the former, which is called the "second number to be kept." If the subtraction is not possible, the value of the sixty-cycle is added prior to the subtraction. From the second number, the length of an anomalistic month whose value is 27.5556 days, is subtracted as many times as possible. That is because the interval between the beginnings of the first month and the anomalistic month preceding the former must be shorter than the length of an anomalistic month.

However, it is somewhat odd to denote the value as 27.5556 days here, given its difference from the value of 27.5546 days computed in terms of *jūnjā*, the excess of a solar year over thirteen anomalistic months as shown below. In comparison with this value, which is common in Chinese astronomical systems, the value 27.5556 is quite inaccurate, and we never find this value in any Chinese historical record since description on the *Qian-xiang li* (乾象曆: 206–237), in which an anomalistic month was first used (Imai 1962, 33). But adopting this value here is not unreasonable, because it is only used to calculate the age of an anomalistic month within a year, and nine of these anomalistic months are equal to an integer value 248 (248/9 = 27.5555..., rounded to 27.5556), which is convenient for the calculation of the lunar equation (Imai 1962, 33-34). By means of this period relation, the "second number to be kept" is multiplied by 9 to yield the lunar argument at the beginning of a year. If the value exceeds 248 days, 248 is subtracted from the value.

Between the Qitai calendar and *Revised Da-ming li*, we can compare the computation to obtain the interval between the beginnings of the certain solar division and the anomalistic month preceding the former. In the case of the Qitai calendar, the following formula is devised to compute the interval between the beginnings of the *wūshī* and anomalistic month preceding the former in a required year:

$23.2836 + 7.0338\ T - [27.5556]_r$ (V)

We compare this formula with that of the *Revised Da-ming li*; in this case, the formula computes the interval of the beginnings of the winter solstice (the twenty-second solar division) and the anomalistic month preceding the winter solstice. In this astronomical system, an anomalistic month is defined as 144,110.6066 *funk*s (*Jin shi*, 22: Bu yue-li 5). From the Accumulated *Funk*s from the first year of the Superior Epoch, the value of an anomalistic month is subtracted as many times as possible. The result is divided by the Day Divisor to yield the days of the interval between the beginnings of the winter solstice and the preceding anomalistic month in the epoch year (A.D. 1180); the value is 19.0981 days. Since the value of the excess of a solar year over thirteen anomalistic months is 7.03367384… days and an anomalistic month is 27.55460929… days, we devise the formula to compute the interval as follows:

$19.0981 + 7.0336738\ T - [27.5546093]_r$

The converted formula for A.D. 1264, the epoch year of the Qitai calendar, is as follows:

$3.7253 + 7.0336738\ T - [27.5546093]_r$

From this, we may derive a formula for the interval between the beginnings of the *wūshī* and the preceding anomalistic month, by adding the time between the winter solstice and the *wūshī*, one-sixth of a solar year, i.e., 60.8739 days. After canceling two anomalistic months, 5.7647 days are left, and the value is added to 3.7253 to yield the initial value:

$9.4900 + 7.0336738\ T - [27.5546093]_r$ (VI)

As we can see, there is a significant difference between the constants of the two formulas (V): 23.2836 and (VI): 9.4900. However, recomputing the lunar mean anomaly for the time of the beginning of the *wūshī* from the planetary tables in the *Zīj-i Īlkhānī*, we find it to be 301; 22° at noon on the first day of the *wūshī* (February 13, 1264), corresponding to 83.7% of its cycle, i.e., 23.1 days. That is very close to the epoch value of 23.2836; therefore, there is little problem as far as the computation in the *Zīj-i Īlkhānī* is concerned, although we have had no way thus far to judge whether or not this value was intentionally adjusted according to parameters in planetary tables in the *Zīj-i Īlkhānī*.[1]

Section 8

The computation of the solar equation is the subject of this section. Since the solar argument at the beginning of a year was obtained in the previous section, we can compute the arguments at the beginnings of months in the year in such a way that the argument at the beginning of the year is added to the result of the multiplication of a synodic month (29.5305 days) by the interval between the first and required months.

If the argument is smaller than 182 (called *bīnjūtin*), the value is subtracted from 182 and the result is multiplied by the original value. Then, the result is doubled and a ninth of the amount is obtained; what is obtained is the solar equation. The value, called *nū*, is positive. If the argument is larger than 182, the excess over 182 is obtained. Then, the argument is subtracted from 364 (182 doubled). The excess is multiplied by the result of the subtraction; finally, the result is doubled and a ninth of the amount is obtained; what is obtained is the solar equation. The value, called *tiyā'ū*, is negative.

In this calendar, the celestial cycle (*zhou-tian* 周天), which accords with the length of a solar year in Chinese official astronomical systems as explained in the commentary of

[1] Regarding the computation of this paragraph, I received great assistance from Benno van Dalen.

the previous section, was shortened to 364 degrees, which is a crude approximation to the solar year, but is the best approximation for making a quarter of the cycle an integer (Kennedy 1964, 440); therefore, the half-cycle *bīnjūtin* becomes 182 degrees. The sun's path has been halved symmetrically at the two solstices. As also explained in the previous section, the equation of center is positive during the period when the sun moves from the winter to the summer solstices; so that, the equation of center from 0 degree (the winter solstice) to 182 degrees (the summer solstice) becomes positive. During the other half-year, on the other hand, the equation of center is negative.

In consideration of the passage of this section, a quadratic interpolation scheme is used for the computation of the solar equation. The formula can be devised as follows:

$\mathrm{int}\,[(2/9)\cdot n(182-n)]\ for\ 0 \le n < 182$

$-\mathrm{int}\,[(2/9)\cdot (n-182)(364-n)]\ for\ 182 \le n \le 364$ (VII)

n = the integral part of the solar argument (van Dalen *et al.* 1997, 129)

As Imai pointed out, the maximum of the solar equation in this formula is ±1,840 *funk*s, different from ±1,797 *funk*s in the case of the *Revised Da-ming li*; after all, the latter's equation is not computed by any quadric function (*Jin shi*, 21: Er-shi si qi zhong-ji ji tiao-nu; Imai 1962, 34). Therefore, we do not find the similarity between the Qitai calendar and the *Revised Da-ming li* that we have observed in previous cases.

From these formulas, however, we can detect a certain relation of the calendar with the *Fu-tian li*, which we have regarded as one of the sources of the Qitai calendar due to several similarities between them. The contents of the *Fu-tian li* had been unknown for a long time until a small fragment entitled "Futenreki nitten sa rissei" 符天曆日躔差立成 [the table of the solar equation in the *Fu-tian li*] was found at Tenri Library, Japan, in March 1963. From this, it has been proven that this astronomical system uses the following formula for the solar equation (Nakayama 1966, 451; van Dalen *et al.* 1997, 129):

$1/3300\cdot n(182-n)$ (XIII)

The difference between the formulas (VII) and (XIII) is derived mainly from the fact that the former regards the equation in the *funk*s of lunar elongation instead of solar motion (van Dalen *et al.* 1997, 129). The maximum is 2.47 degrees in the *Fu-tian li* and 2.24 degrees in the Qitai calendar from the modern point of view, so we can find the differences in terms of the values.

However, we identify these formulas in terms of the algebraic method. This kind of method was not popular among the Chinese astronomical systems and was not used before the *Fu-tian li*, since traditionally Chinese astronomical systems relied on a different, empirical method on the basis of the observations of the midday gnomon-shadow lengths over a period of ten days (Nakayama 1992, 877). Afterward, the algebraic method was succeeded by several official astronomical systems in the Song dynasty such as *Yi-tian li* 儀天曆 (1001–1023), *Ming-tian li* 明天曆 (1065–1076), and *Guan-tian li* 觀天曆 (1094–1102). Finally, this tradition developed into the method of the *Shou-shi li*, in which two third-order formulas are used (Chen 1986; Sivin 2009, 415).

In addition to the adoption of the ten-thousand *funk*s method, therefore, we also find a similarity between the Qitai calendar and the *Fu-tian li* in the method for the computation of the solar equation. Especially, the way of dividing the celestial cycle into 364 parts is different from any other astronomical system except for these two. From this fact, we can trace a certain line between the two systems. We know that, although the *Fu-tian li* was considered "unofficial" and was never adopted as an official astronomical system, it was quite influential in the Tang and Five Dynasties' periods in the civil sphere and even officials in the Bureau of Astronomy used it for astrological purposes. Then, the *Fu-tian li* is known to have kept its status as one of the important texts on astrology in the Song period (Yabuuti 1982, 6-7). In addition, the *Fu-tian li* was adopted as a text for the examinations of the Bureau of Astronomy in the Jin and Yuan dynasties (Yamada 1980, 119-125). Until the period when the *Zīj-i Īlkhānī* was compiled, therefore, the *Fu-tian li* continued to be used in China, and its use was not confined to civil sphere, but bureaucrats also made use of this text for matters of astrology.

Section 9

This section is for the computation of the lunar equation. As in the case of the solar equation, the lunar argument at the beginning of a year has been obtained in the seventh section; therefore, we can compute the arguments at the beginnings of months by the following way where the argument at the beginning of the year is added to the result of multiplication of the interval between the first and required months by the *junjūn shā* (17.7754 days). This term means nine times the excess of a synodic month over an anomalistic month. Month by month, the starting-point of an anomalistic month shifts by the excess of a synodic month over an anomalistic month. We should also consider the period relation equalizing 9 anomalistic months with 248 days to compute the lunar argument at the beginning of a month.

If the argument is smaller than 124 (called *banjūshā*), the value is subtracted from 124 and the result is multiplied by the original value to yield the lunar equation. The value, called *nū*, is positive. If the argument is larger than 124, the excess over 124 is obtained on the one hand; on the other hand, the argument is subtracted from 248 (124 doubled). Then, the excess is multiplied by the result of the subtraction to yield the lunar equation. The value, called *tiyā'ū*, is negative. The 248 divisions of an anomalistic month are yielded in consideration of the period relation equalizing nine anomalistic months with 248 days.

In consideration of the passage of this section, a quadratic interpolation scheme is also used for the computation of the lunar equation. The formula can be devised as follows:

$\mathrm{int}\,[n\,(124-n)]\ for\ 0 \leq n < 124$

$-\mathrm{int}\,[(n-124)(248-n)]\ for\ 124 \leq n < 248$ (IX)

The maximum of these formulas is ±3,844 *funk*s, which is different from that of the *Revised Da-ming li*, whose maximum is ±4,144 *funk*s (*Jin shi*, 22: Zhuan ding fen ji ji-du tiao-nu shuai; Imai 1962, 34). As with the case of the solar equation, we find hardly any similarity between the Qitai calendar and the *Revised Da-ming li* in terms of the lunar equation.

There are several interesting points with regard to the period relation equalizing nine anomalistic months with 248 days. This kind of period relation is of ancient Babylonian origin and subsequently appears in Sanskrit treatises on mathematical astronomy, such as the sixth century *Pañcasiddhāntikā* of Varāhamihira, probably through the mediation of the Greek tradition (Kennedy 1964, 441; Jones 1983/84, 11-). Some elements of those Sanskrit texts are known to have appeared in a Chinese astronomical system based on Indian methods, the *Jiu-zhi li* 九執暦 compiled in 718, although this 248-day scheme is not found in the system itself (Jones 1983/84, 34). In China, we know that this scheme was at least used in the *Qin-tian li* 欽天暦 (956–963) of the late Zhou Dynasty (*Xin wu-dai shi*, 58: Si-tian kao; Yabuuti 1963, 95; van Dalen *et al.* 1997, 128). The *Qin-tian li* is derived from the eighth-century *Fu-tian li* (Yabuuti 1990, 105), whose "method was based on Indian astronomical system," as we have mentioned in the commentary of the first section. Therefore, we can conjecture a connection between the *Fu-tian li* and Qitai calendar here as well (Isahaya 2009, 33). In addition, we know that there is a tradition of using "two" anomalistic months depending on the purpose in Babylonia; one of which is the value extracted by the aforementioned period relation 248/9 ≈ 27.5556 days (Neugebauer 1957, 161-162).

Section 10

This section is assigned to the explanation for determining the *madkhal* of a month on the true motions of the two luminaries. In the *zīj*es, the *madkhal*—which literally means "entrance"—is used as a term to denote the weekday of the first day of a year or month or of a particular date (van Dalen 2000, 270). As in the following passage from the second section, the sixty-cycle is considered a substitute for a weekly cycle in the Qitai calendar:

> By combining this cycle with the cycle of twelve, a cycle of sixty is obtained. They count years and days with this cycle. This cycle is their substitute for our week. We call this cycle the "sixty-cycle."

Therefore, we can regard the *madkhal* as the sixty-cycle of the first day of a year or month in this calendar.

Until the previous section, we can obtain the values of the solar and lunar equations at the beginning of a month in a year. In addition, we can compute the beginning of the first month in a year on mean motion. By adding the value to a synodic month as many times as required, we can obtain the beginning of a required month on mean motion. If the value of the equations is additive, it is added to the beginning; and if the value is subtractive, it is subtracted from the beginning.

In terms of the *funk*s, if the value is shorter than that of a day and the half of a night (namely, shorter than 7,500 *funk*s), it is considered to be a day; larger than that value, the *funk*s are considered to be two days. This method is called *jin-shou* 進朔 in the Chinese astronomical system. If the total days exceed 60, 60 is subtracted from the total to yield the first day of a month.

By computing the first days of the successive two months, we can know the length of the former month. In the Chinese astronomical system, there are two months: the long month containing 30 days and short month containing 29 days. In regard to the pattern of month lengths, there were various ways in each Chinese astronomical system, as discussed by Martzloff (2009, 72-75). In the Qitai calendar, it is stipulated that more than two consecutive 29-day months is not permissible, and more than three consecutive months is not permissible in the case of the 30-day months.

According to the text, the intercalary month is that which contains only the beginning of one solar division; however, as explained in the commentary of the sixth section, the following expression is more precise; that is to say, a month which does not contain the beginning of an even-numbered division is regarded as an intercalary month.

Section 11

In this section, the “fourth cycle,” which functioned as the standard for the “choice of days” (*ikhtiyār-i rūz-hā*) is explained. In the Islamicate world, the term *ikhtiyārāt* (the plural form of *ikhtiyār*) means the literature or method concerning astrological choices, the discernment of auspicious and inauspicious days. Of course, the literature on *ikhtiyārāt* were well established in the world long before the introduction of the Chinese system (Fahd 1995, 107-108); especially in Iran, this kind of astrology flourished in connection with the worship of Imams (Ja‘fariyan 2011).

This cycle, called *jian-chu* 建除 or *shi-er zhi* 十二直—twelve-presage cycle—, is written down on annotated calendars to determine auspicious and inauspicious days for each specific action (e.g., war, moving, marriage, etc.). These names are as follows.

N.	Chinese	Text	In the Uighur text	Meaning
1	*jian* 建 (kiɛn)	*kin*	*kin*	instauration
2	*chu* 除 (tʂhiu)	*chū*	(*chuu*)	eviction
3	*man* 滿 (muɜn)	*man*	*man*	plenitude
4	*ping* 平 (phiaŋ)	*pin*	*pii*	equilibrium
5	*ding* 定 (tiaŋ)	*tin*	(*ti*)	fixity
6	*zhi* 執 (tʂi)	*chih*	*chip*	maintenance
7	*po* 破 (phuɜ)	*pū*	*pa*	destruction
8	*wei* 危 (ui)	*wī*	*küü*	danger
9	*cheng* 成 (tʂiaŋ)	*chin*	(*chi*)	maturity
10	*shou* 收 (ʂiau)	*shīu*	*shiu*	reception
11	*kai* 開 (khai)	*khā’ī*	*kay*	opening
12	*bi* 閉 (pi)	*pī*	(*pi*)	closing

(Bazin 1991, 287; Arrault & Marzloff 2003, 103–104)

This twelve-presage cycle frequently appears in Sino-Uighur calendars, but the phonetic transcription forms in the *Zīj-i Īlkhānī* are somewhat different from the transcription into Uighur script of the same cycle in a document from 1202, which we have also incorporated into the above table (Bazin 1991, 286-288). Also, the dates of a Uighur text written in Brahmi script from 1277 agree with those of the official Chinese system (Bazin 1991, 306-308). In consideration of these facts, we conclude that the Qitai calendar cannot be identified as the contemporary calendar used by Uighurs (Isahaya 2009, 34-35).

The cycle pertains to the twenty-four solar divisions. If the cycle is about to recommence at the beginning of an odd numbered division, the element of the cycle for the preceding day is repeated, whereupon the cycle begins one day later (van Dalen *et al.* 1997, 123).

Section 12

The final section explains the conversion table between the Qitai and Hijri calendars. Since the extensive table for converting from Hijri dates to Chinese dates has been so intensively investigated by van Dalen *et al.* (1997, 135-148), we have little to add to their study here. The basic structure of the table is as follows:

Hijri month				(Example 1)	safar				(Example 2)	Sha'ban			
(*the name of the Turkish year*)		the initial week day of the Hijri month (1–7)	Hijri year				6	602		*Horse*		5	606
the number of days inthe Qitai month (29 or 30 days)	the number of the Qitai month in the current Qitai year (1–12, or *shūn*)	The initial days of the Qitai month (1–7)			29	*shūn*	5			30	1	4	

The location of intercalary months on this table is one of the interesting points that their study made clear. According to their investigation, all positions of intercalary months except two agree with the contemporary, official astronomical systems of the Jin and Yuan dynasties. As they have stated, it seems possibly that intercalary months in the calendar were adjusted to the computation of the official astronomical systems in China; rather than by the method of calculation in the *Zīj-i Īlkhānī* (van Dalen *et al.* 1997, 138). From this fact, we can assume that the Qitai calendar or the original Chinese source of this calendar was, from the very beginning, not expected to provide exact computation.

For example, determining the positions of intercalary months requires a more complicated mathematical procedure; rather, this calendar might well have its role in "following" the results of the contemporary official astronomical system concerning, for example, determination of either the beginning of a year or a solar division during some period, in order to make use of it for the purposes of astrological choices as we have seen in the preceding section.

V. References

Zhou shu 周書 [The Standard History of the [Northern] Zhou Dynasty]. Ling Hu 令狐 & De Fen 德棻. eds., 3 vols. Beijing: Zhong-hua shu-ju, 1971 (in Chinese).

Xin wu-dai shi 新五代史 [The New Standard History of the Five Dynasties]. Ou-Yang Xiu 欧陽修 ed., 2 vols. Taipei: Taiwan zhong-hua shu-ju, 1974 (in Chinese).

Song shi 宋史 [The Standard History of the Song Dynasty]. Tuo Tuo 脱脱 *et al.* eds. 40 vols. Beijing: Zhong-hua shu-ju, 1985 (in Chinese).

Jin shi 金史 [The Standard History of the Jin Dynasty]. Tuo Tuo 脱脱 *et al.* eds., 8 vols. Beijing: Zhong-hua shu-ju, 1975 (in Chinese).

Wen-xian tong-kao 文獻通考 [Comprehensive Examination of Literature]. Ma Duan-Lin 馬端臨 ed., 2 vols. Beijing: Zhong-hua shu-ju, 1986 (in Chinese).

Yuan shi 元史 [The Standard History of the Yuan Dynasty]. Song Lian 宋濂 *et al.* ed., 15 vols. Beijing: Zhong-hua shu-ju, 1976 (im Chinese).

Allsen, T.T. 2001. *Culture and Conquest in Mongol Eurasia*. New York: Cambridge University Press.

Arrault, A. and Martzloff J.C. 2003. "Calendriers." In *Divination et société dans la Chine médiévale*, *étude des manuscrits de Dunhuang de la Bibliothèque nationale de France et de la British Library*, ed. Marc Kalinowski, pp, 85-211. Paris: Bibliothèque nationale de France.

Atwood, Ch. Forthcoming. *Record of the Campaigns of Chinggis Khan.* Leiden: Brill.

Bazin, L. 1991. *Les systèmes chronologiques dans le monde turc ancien*. Budapest: Akadémiai Kiadó.

Boyle, J.A. 1963. "The Longer Introduction to the 'Zij-i Ilkhani' of Nasir-ad-Din Tusi." *Journal of Semitic Studies* (8): pp. 244-254.

Chen M. 陈美东 1986. “Wo-guo gu-dai-de zhong-xin-cha suan-shi ji qi jing-du” 我国古代的中心差算式及其精度 [Ancient China’s Solution for the Equation of the Centre and Its Precision]. *Zi-ran ke-xue shi yan-jiu* 自然科学史研究 [Studies in the History of Natural Science]. 5 (4): pp. 289-297 (in Chinese).

Clauson, G. 1972. *An Etymological Dictionary of Pre-Thirteenth-Century Turkish*. Oxford: Clarendon Press.

Danish-Pazhuh, M.T. 1960-63. *Fihrist-i Nushkha-hā-yi Khaṭṭī-yi Kitāb-khāna-yi Dānish-kada-yi Adabiyāt* [The Catalogue of Manuscripts at the Library of the Faculty of Literature]. 2 vols. Tehran: Dānishgāh-i Tihrān (in Persian).

Dihkhuda, A.A. *et al*. (M. Muʿin M. & J. Shahidi) eds. 1998. *Lughat-nāma* [Lexicon]. Vol. 5. Tehran: Dānishgāh-i Tihrān (in Persian).

Fahd, T. 1995. “NUDJŪM (AḤKĀM al-).” In *Encyclopaedia of Islam*, New Edition, vol. VIII, pp. 105-108. Leiden: Brill.

Ideler, L. 1832. “Über die Zeitrechnung von Chata und Igur.” *Abhandlungen der königlichen Akademie der Wissenschaften zu Berlin, historisch-philologische Klasse*. 271-299.

Imai, I. 今井湊 1962. “Ulugh Beg hyō no Uighur reki” Ulugh Beg 表の畏吾児暦 [Īghūr’s Chronogram in the Ulugh Beg’s Astronomical Tables]. *Seinan ajiashi kenkyū* 西南アジア史研究 [Bulletin of the Society for Western and Southern Asiatic Studies] (8): pp. 29-37 (in Japanese).

Isahaya Y. 諫早庸一 2009. “History and Provenance of the ‘Chinese’ Calendar in the *Zīj-i Īlkhānī*.” *Tarikh-e Elm: Iranian Journal for the History of Science* (8): pp. 19–44.

Jaʿfariyan, R. 2011. “Dīdgāh-i ʿilmī-yi ʿaṣr-i ṣafawī darbāra-yi aḥkām-i nujūmī wa saʿd wa naḥs-i ayyām” [Scientific Perspective on Astrology for Auspicious and Inauspicious Days in the Safavid Period]. *Payām-i Bahāristān* (10): pp. 333-349 (in Persian).

Jones, A. 1983/84. “The Development and Transmission of 248-Day Schemes for Lunar Motion in Ancient Astronomy.” *Archive for History of Exact Sciences* (29): pp. 1-36.

Kennedy, E.S. 1964. “The Chinese-Uighur Calendar as Described in the Islamic Sources.” *Isis: an International Review Devoted to the History of Science and Its Cultural Influences*. 55 (4): pp. 435-443.

King, D. 1981. *Catalogue of the Scientific Manuscripts in the Egyptian National Library*. Part 1. Cairo: General Egyptian Book Organization.

King, D. & Samsó, J. 2001. “Astronomical Handbooks and Tables from the Islamic World (750-1900): An Interim Report.” *Suhayl* (2): pp. 9-105.

——. 2002. “ZĪDJ.” In *The Encyclopaedia of Islam*. New Edition, vol. XI, pp. 496-508. Leiden: Brill.

Li Zh. 李珍華 & Zhou Ch. 周長楫 1993. *Han-zi gu-jin yin-biao* 漢字古今音表 [Chart of Ancient and Modern Pronunciations]. Beijing: Zhong-hua shu-ju (in Chinese).

Maas, P. 1958. Barbara Flower (trans.) *Textual Criticism*. Oxford: Clarendon Press (original in German: *Textkritik*. 1927).

Mano, E. ed. 1995. *Bābur-Nāma (Vaqāyi‘): Critical Edition Based on Four Chaghatay Texts with Introduction and Notes*. Kyoto: Syokado.

Martzloff, J.C. 2009. *Le calendrier chinois: structure et calcus (104 av. J.-C.-1644). Indétermination céleste et réforme permanente. La construction chinoise officielle du temps quotidien discret à partir d’un temps mathématique caché, linéaire et continu.* Paris: Honore Champion.

Melville, Ch. 1994. “The Chinese-Uighur Animal Calendar in Persian Historiography of the Mongol Period.” *Iran: Journal of the British Institute of Persian Studies* (XXXII): pp. 83-98.

Mercier. R. 1984. “The Greek ‘Persian Syntaxis’ and the Zīj-i Īlkhānī.” *Archives internationales d’histoire des sciences* (34): pp. 35-60.

Momo H. 桃裕行 1969. “Nichien no Futenreki seirai 日延の符天暦齎来” [Bringing the *Fu-tian li* by Nichien]. In *Ritsuryō kokka to kizoku syakai* 律令国家と貴族社会 [State under the *Ritsuryō* Codes and the Aristocracy], pp. 395-420. Tokyo: Yoshikawa kōbunkan (in Japanese).

Nakayama Sh. 中山茂 1966. “Characteristics of Chinese Astrology.” *Isis: an International Review Devoted to the History of Science and Its Cultural Influences* 57 (4): pp. 442-454.

——. 1992. “The Emergence of the Third Paradigm for Expressing Astronomical Parameters: Algebraic Function.” *Erdem: Atatürk Kültür Merkezi dergisi* 6 (18): pp. 877-879.

Needham, J. *et al.* (W. Ling & D.J. de Solla Price) 1960. *Heavenly Clockwork: the Great Astronomical Clocks of Medieval China.* Cambridge: Cambridge University Press.

Neugebauer, O. 1957. *The Exact Sciences in Antiquity*. Second edition. Providence: Brown University Press.

Nik-Fahm. S & Shahidi. P. 2009. “Risāla-yi fārsī usṭurlāb-i mansūb-i ‘Abd al-Rahmān Ṣūfī” [A Persian Treatise on Astrolabe Ascribed to ‘Abd al-Rahmān al-Ṣūfī]. *Tarikh-e Elm: Iranian Journal for the History of Science* (8): pp. 55-102 (in Persian).

Pelliot, P. 1959-73. *Notes on Marco Polo*. 3 vols. Paris: Imprimerie nationale.

Pulleyblank, E. 1991. *Lexicon of Reconstructed Pronunciation in Early Middle Chinese, Late Middle Chinese and Early Mandarin*. Vancouver: UBC Press.

Ragep, F.J. 1993. *Naṣīr al-Dīn al-Ṭūsī's Memoir on Astronomy: al-Tadhkira fī ʿIlm al-Hayʾa*. 2 vols. New York: Springer-Verlag.

Richard, F. 1989. *Catalogue des manuscrits persans*. Vol. I *Ancien fonds.* Paris: Bibliothèque Nationale.

Sachau, E. & Ethé, H. 1889, continued, completed and edited. *Catalogue of the Persian, Turkish, Hindûstânî, and Pushtû Manuscripts in the Bodleian Library*. Part 1 *the Persian Manuscripts*. Oxford: Clarendon Press.

Sawadi, F. & Nik-Fahm, S. 2012. “Ḥarakat-i wasaṭ-i kawākib dar *Zīj-i Īlkhānī* wa naqd-hā-yi wārid bar ān” [The Mean Motion of the Planets in *Zīj-i Īlkhānī* and the Criticisms regarding It]. In *Ustād-i bashar: pazhūhish-hā dar zindigī, rūzgār, falsafa wa ‘ilm-i Khwāja Naṣīr al-Dīn Ṭūsī* [Teacher of Humankinds, Studies on Naṣīr al-Dīn al-Ṭūsī’s Life, Time and Knowledge], edited by H. Ma‘ṣūmī-Hamadānī, pp, 365-472. Tehran: Mīrāth-i maktūb (in Persian).

Sayılı, A. 1960. *The Observatory in Islam and Its Place in the General History of the Observatory.* Ankara: Türk Tarih Kurumu Basımevi.

Sédillot, L.P.E. 1847-1853. *Prolégomènes des tables astronomiques d'Oloug-Beg: publiés avec notes et variantes et précédés d'une introduction.* Paris: Typographie de Firmin Didot frères.

Sivin N. 2009. *Granting the Seasons: the Chinese Astronomical Reform of 1280, with a Study of Its Many Dimensions and an Annotated Translation of Its Record.* New York: Springer.

Tusi, Naṣīr al-Dīn. 2012. Y. B. Bābāpūr & M. Ghulāmīya ed. *Zīj-i Īlkhānī*. Qum: Majma‘-i dhakhā’ir-i islāmī (in Persian).

Van Dalen, B. 2000. “TA’RĪKH,” I. 2. Era Chronology in Astronomical Handbooks. In *Encyclopaedia of Islam.* New Edition, vol. X, pp. 264-271. Leiden: Brill.

——. 2002. “Islamic and Chinese Astronomy under the Mongols: a Little-Known Case of Transmission.” In *From China to Paris: 2000 Years Transmission of Mathematical Ideas*, edited by Y. Dold-Samplonius, J. W. Dauben, M. Folkerts, and B. van Dalen, pp. 327-356. Stuttgart: Franz Steiner Verlag.

Van Dalen, B. *et al.* 1997 (E.S. Kennedy & M.K. Saiyid). "The Chinese-Uighur Calendar in Ṭūsī's Zīj-i Īlkhānī." *Zeitschrift für Geschichte der arabisch-islamischen Wissenschaften* (11): pp. 111-152.

Wang Y. 王一丹 2006. *Bo-si La-shi-te "Shi-ji. Zhong-guo shi"yan-jiu yu wen-ben fan-yi* 波斯拉施特《史集.中國史》研究與文本翻譯 [The Persian Rashīd's History of China in the *Compendium of Chronicles*: Its Study and Translation]. Beijing: Kun-lun chu-ban she (in Chinese).

West, L.M. 1973. *Textual Criticism and Editorial Technique: Applicable to Greek and Latin Texts.* Stuttgart: Teubner.

Yabuuti K. 薮内清 1963. "Astronomical Tables in China, from the Wutai to the Ch'ing Dynasties." *Japanese Studies in the History of Science* (2): pp. 94-100.

——. 1982. "Tou Soushiei no Futenreki ni tsuite" 唐曹士蔿の符天暦について [The *Fu-tian li* of the Tang Scholar Cao Shi-wei]. *Biburia* ビブリア [Biblia] (78): pp. 2-18 (in Japanese).

——. 1990. *Chūgoku-no tenmon rekihō* 中国の天文暦法 [Chinese Astronomical and Calendrical Sciences]. Tokyo: Heibonsha (in Japanese).

——. 1997. B. van Dalen, trans. & partially revised. "Islamic Astronomy in China during the Yuan and Ming Dynasties." *Historia Scientiarium* (7): pp. 11-43.

Yabuuti K. & Nakayama Sh. 2006. *Jyuji reki: yakucyū to kenkyū* 授時暦: 訳注と研究 [The *Shou-shi li*: Translation with Notes and Studies]. Kawasaki: Ai Cooperation (in Japanese).

Yamada K. 山田慶児 1980. *Jujireki no michi: Chūgoku chūsei no kagaku to kokka* 授時暦の道: 中国中世の科学と国家 [The Road to the *Shou-shi li*: Science and the State in Medieval China]. Tokyo: Misuzu Shobō (in Japanese).

VI. Edition

باب اول (2 با)

در شرح تاریخ [قتا][1] و معرفت سال‌ها و ماه‌های آن، و آن مشتمل بود بر دوازده فصل[2]

فصل اول

در شرح اقسام شبانروز نزدیک اهل [قتا][3]

حکمای [قتا][4] و ترکستان[5] اقسام شبانروز و روزها و سال‌ها را دوری نهاده اند که بر دوازده می‌گردد. و هر یکی را از آن دوازده نامی نهاده اند.[6] و [نام‌های دوازده‌گانه به هر دو لغت این است].[7]

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[1] BL, KM, SB, DK, BN, NK, KDT and BML: قتا; BoL: خطاییان.

[2] BoL, SB, DK and NK: مشتمل بود بر دوازده فصل; BL, BN, KDT and BML: مشتمل بر دوازده فصل است; KM: مشتمل بر دوازده فصل.

[3] SB, DK, BN, NK, KDT and BML: قتا; BL and KM: خطا; BoL: ختا.

[4] SB, BN, NK, KDT and BML: قتا; BoL, BL and KM: خطا.

[5] BoL, BL, KM, SB, DK, BN, NK, KDT and BML: ترکستان; SB: ترکستانی.

[6] BoL, SB, NK, KDT and BML: نهاده اند; BL, KM, DK and BN: نهاده.

[7] BL, KM, DK, SB, NK and BML: نام‌های دوازده‌گانه به هر دو لغت این است; BoL: نام‌های دوازده هر دو گفته این است; BN: نام‌های دوازده‌گانه به هر دو لغت این است که در این جدول است.

اعداد	ا	ب	ج	د	ه	و	ز	ح	ط	ی	یا	یب
نام‌ها به قتایی	ژِه[1]	چیوُ[2]	یِم[3]	ماوُ[4]	چِن[5]	صِز[6]	وُو[7]	وِی[8]	شِن[9]	یُوو[10]	سُو[11]	خایی
نام‌ها به ترکی	کُسکو	اُوط	بارس	طاوشقن	لو	ییلان	یُوند	قُوی[12]	بیجین	داقوق	اِیت	طونغوز[13]

و هر شبانروزی همچنانکه محاسبان ما به بیست و چهار ساعت قسمت کرده اند، ایشان به دوازده «چاغ»[14] قسمت کرده اند. و هر یک (3 الف) چاغ به هشت «کِه» و تمامتی شبانروز را نیز[15] به ده هزار «فنک» قسمت کرده اند.[16] پس هر یک چاغ هشتصد و سی و سه فنک باشد و ثُلثی. و هر یک کِه صد و چهار فنک باشد و سُدسی. و آغاز شبانروز از نیمهٔ شب کنند. و آن وقت از چاغ ژه و کُسکُو یک نیمه گذشته باشد و یک نیمه مانده. و بعد از آن [یک یک چاغ می‌گُذرد][17] پیوسته[18] تا نیمهٔ روز نیمهٔ چاغ وُو و یوند باشد. و اول روز در[19] وقت تساوی شب و روز در نیمهٔ

[1] SB, NK, KDT and BML: ژِه; BoL, DK and BN: ژه; KM: زه; BL: زِه.

[2] KDT: چِیوُ; BL: جیوُ; BoL: چیو; KM: چیوُ; SB: جیُو; DK: جیو; BN: چَیُو; NK: جِیُو; BML: جِیُو.

[3] BL, SB, NK and BML: یِم; BoL and KM: یم; BN; یَم; DK: نم; KDT: یِمُ.

[4] BL and KM: ماوُ; BoL and DK: ماو; SB, NK and KDT: مَاو; BN and BMT: مَاوُو.

[5] BN, NK, KDT and BML: چِن; BL: جِن; KM: جن; BoL and SB: چن; DK: خن.

[6] BL, SB, NK, KDT and BML: صِز; BoL: رص; KM: صز; DK: صر; BN: ضَر.

[7] BL, KM, NK, KDT and BML: وُو; BoL and DK: وو; SB وُوَ; BN: وَو.

[8] BL, KM, SB, NK, KDT and BML: وِی; BoL: روی; DK: وی; BNوُی.

[9] BL, BN, NK, KDT and BML: شِن; BoL, KM and DK: شن; SB: سِن.

[10] BL, SB and NK: یُوو; BoL, KM and DK: یوو; BN: پُووُ; KDT and BML: یُووُ.

[11] BL, DK, NK, KDT and BML: سُو; BoL: شیو; KM: سو; DK: سـو; BN: سپُو.

[12] BoL, BL, KM, SB, DK, NK and KDT: قوی; BN and BML: قوین.

[13] BoL, BL, KM, DK, BN, NK, KDT and BML: طونغوز; SB: طونقوز.

[14] BoL, NK and BML: چاغ; BL, KM, SB, DK, BN and KDT: جاغ.

[15] Not in SB.

[16] قسمت کرده اند; Not in NK.

[17] BL, KM, SB, DK, BN, NK, KDT and BML: یک یک چاغ می‌گُذرد; BoL: یک چاغ چاغ می‌گذرد.

[18] BL: پیوسته به نوبت.

[19] NK: تا.

چاغ ماوُ و طاوشقن باشد. و اول شب در نیمهٔ چاغ یُوُ و داقوق. و به سبب درازی و کوتاهی شب و روز،[1] اول روز و اول شب پیش از آن یا پس از آن می‌افتد. اما نیمهٔ شب و نیمهٔ روز از آن هرگز بنگردد. ما حصهٔ چاغ‌ها و که‌های شبانروز از [فنک‌ها][2] معین کردیم. و در جدولی نهادیم تا به آسانی معلوم کنند که از هر چاغی و هر کهی چند گذشته باشد. و فنک‌ها بر عادت منجمان ما از شصت شصت مرفوع کرده، بنهادیم. و کسور فنک‌ها هم[3] از کسور شصت. و جملهٔ فنک‌های یک شبانروز مرفوع کرده، بر این شکل باشد: بـموم. پس عدد فنک‌ها هرچه از این زیادت شود، این قدر از آن[4] نقصان باید کرد و به جای آن نشان یک شبانروز نهاد.[5] و چون خواهند که[6] شبانروزی با[7] فنک‌ها کنند، یکی از عدد شبانروزها نقصان باید کرد و این عدد به جای [آن][8] نهاد، چنانکه مقتضای[9] حساب باشد. و جدول این است.[10]

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[1] BoL, KM, SB, DK, BN, NK, KDT and BML: شب و روز; BL: روز و شب.

[2] BL, KM, SB, DK, BN, NK, KDT and BML: از فنک‌ها; BoL: از چاغ‌ها.

[3] Not in SB.

[4] BoL, KM, SB, DK, BN, NK, KDT and BML: آن; BL: او.

[5] BoL, KM, SB, DK, BN, KDT and BML: به جای آن نشان یک شبانروز نهاد; BL: به جای ایشان یک شبانروز نهاد; not in NK.

[6] Not in SB.

[7] Not in DK.

[8] BL, KM, SB, DK, BN, NK, KDT and BML: آن; BoL: او.

[9] Not in BL.

[10] و جدول این است ; not in BN.

جدول معرفت مبادی جاغها و کهها از فنک‌های شبانروز مرفوع به شصت شصت												
به قتایی	ژه	چیو	یم	ماو	چن	صز	وو	وی	شن	یوو	سو	خاپی
به ترکی	کسکو	اوط	بارس	طاوشقن	لو	ییلان	یوند	قوی	بیجین	داقوق	ایت	طونغوز
عدد کهها	مرفوع دوبار مرفوع یک بار فنکها کسور											
ا	بلطمجک	٠ونوم	٠کن٠	٠لدمجک	٠مجلوم	ابل٠	ایوکجک	الیوم	امدی٠	انحجک	بیاهوم	بکجن٠
ب	بماکزل	٠حمن	٠کبلدی	٠لوکزل	٠نکن	ادیدی	ایجزل	الب٠ن	امهندی	انطمزل	بیجمن	بکزلدی
ج	بمجیام	٠یکه٠	٠کدیجک	٠لحیام	٠نبه٠	اهنحک	ایطنام	الجنه٠	امزلحک	بالام	بیهکه٠	بکطیجک
د	بمدنهن	٠یبطی	٠کوبل	٠لطنهن	٠نجمطی	ازمبل	اکالهن	الهکطی	امطکبل	بجیهن	بیزطی	بلابل
ه	٠٠٠٠	٠یجنجک	٠کزموم	٠مام٠	٠نهلحک	اطکوم	اکجک٠	الزیجک	اناوم	به٠٠	بیجنجک	بلبموم
و	٠امدب	٠یهلزل	٠کطلن	٠مجکدی	٠نزیزل	ایاین	اکهدی	الحنزل	انبنن	بومدی	بکلزل	بلدلن
ز	٠جکجک	٠یزکام	٠لایه٠	٠مهحک	٠نطام	ایبنه٠	اکومجک	اممام	اندله٠	بحکجک	بکبکام	بلویه٠
ح	٠هیبل	٠یطهن	٠لبنطی	٠مونبل	٠١٠مهن	ایدلطی	اکحلبل	امبکهن	انویطی	بییبل	بکدهن	بلزنطی

(4 با) فصل دوم

در اعتبار دور در روزها

[قتاییان][1] را دوری دیگر است که در روزها و سال‌ها اعتبار می‌کنند. و آن[2] دور بر ده می گردد و نام‌های آن[3] ده این است. اِ کا،[4] بِ [پی]،[5] جِ پین، دِ تین، هِ وِو، وِ کی، زِ کن،[6] حِ سن[7]، طِ ژم یِ

[1] DK: قتاییان; BoL, BL, SB, BN, NK, KDT and BML: خطاییان.

[2] BoL, SB, DK, BN, NK, KDT and BML: آن; BL: این.

[3] BoL, SB, DK, BN, NK, KDT and BML: آن; BL: این.

[4] BoL, SB, DK, BN, NK, KDT and BML: کا; BL: نکا.

[5] BL and BML: پی; BoL, SB and NK: پیی; DK and BN: بی; KDT: بی.

[6] BoL, SB, DK, BN, NK, KDT and BML: کن; BL: کی.

[7] BoL, BL, KDT and BML: سن; SB, DK, BN and NK: شن.

کوی. و چون [این][1] دور با دور دوازده‌گانه ترکیب کنند، دوری حاصل آید که بر شصت گردد. و سال‌ها و روزها به آن دور می‌شمارند. و آن دور ایشان را در روزها به جای ایام هفته است ما را. و ما این دور را «دور ستینی» می‌خوانیم. و ترکیب این دو دور بر این گونه باشد [که در این جدول نهاده شد].[2]

ا کا ژه	ب يي چيو	ج پين يم	د تين ماو	ه وو چن	و کی صز	ز کن وو	ح سن وی	ط ژم شن	ی کوی یوو
یا کا سو	یب يي خايي	یج پين ژه	ید تين چيو	یه وو يم	یو کی ماو	یز کن چن	یح سن صز	یط ژم وو	ک کوی وی
کا کا شن	کب يي يوو	کج پين سو	کد تين خايي	که وو ژه	کو کی چيو	کز کن يم	کح سن ماو	کط ژم چن	ل کوی صز
لا کا وو	لب يي وی	لج پين شن	لد تين يوو	له وو سو	لو کی خايي	لز کن ژه	لح سن چيو	لط ژم يم	م کوی ماو
ما کا چن	مب يي صز	مج پين وو	مد تين وی	مه وو شن	مو کی يوو	مز کن سو	مح سن خايي	مط ژم ژه	ن کوی چيو
نا کا يم	نب يي ماو	نج پين چن	ند تين صز	نه وو وو	نو کی وی	نز کن شن	نح سن يوو	نط ژم سو	س کوی خايي

(3 با) فصل [سوم][3]

در معرفت سال‌های [قتاییان][4] و اقسام هر سال

سال‌های [قتاییان][5] شمسی باشد. و آن از وقت رسیدن آفتاب باشد به موضعی از فلک‌البروج[6] تا وقت باز رسیدن او با همانجائی. و آن نزدیک ایشان در سیصد و شصت و پنج روز و دو هزار و

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[1] BL, SB, DK, BN, NK, KDT and BML: این; BoL: آن.

[2] BL, DK and BN: که در این جدول نهاده شد; SB: که در جدول نهاده شد; NK: که در جدول نهاده شد، و جدول این است; KDT and BML: که در این جدول نهاده است; not in BoL.

[3] BL, BN, KDT and BML: سوم; BoL, SB, DK and NK: سیم.

[4] BL, SB, BN, NK, KDT and BML: قتاییان; BoL and DK: خطاییان.

[5] BL, SB, DK, BN, NK, KDT and BML: قتاییان; BoL: ختاییان.

[6] Not in SB and NK.

چهار صد و سی و شش فنک باشد که ارقام آن بعد از رفع فنک‌ها بر این گونه باشد شسه ۰ملو. و [به][1] زبان ایشان آن را «سیجو»[2] خوانند. و چنانکه منجمان ما سال به دوازده قسم[3] می‌کنند، ایشان مدت یک سال به بیست و چهار قسم متساوی می‌کنند.[4] هر قسمی پانزده روز[5] و دو هزار و صد و هشتاد و چهار فنک باشد و پنج سُدس از یک فنک، و ارقام مرفوع آن چنین باشد: یه۰ لوکدن. و هر قسمی[6] را به زبان ایشان یک «کیجه»[7] خوانند. پس هر فصلی[8] از سال شش کیجه باشد. و اوایل فصل‌های سال ما اواسط فصل‌های سال[9] ایشان باشد. پس اول فصل بهار نزدیک ایشان در حدود نیمهٔ دلو باشد. و نقطهٔ انقلاب اربعه [در][10] اواسط فصول سال ایشان باشد.[11] و اسامی اقسام [سال][12] به لغت ایشان و عدد ایام و فنک‌های مرفوع از اول سال تا آخر در این جدول نهاده شد.

1 BL, SB, DK, BN, NK, KDT and BML: به; BoL: بر.

2 KDT: سیجو; BoL: سجو; BL: سینجور; SB and BML: سپچو; DK, BN and NK: سپچو.

3 BoL, SB, DK, BN, NK, KDT and BML: قسم; BL: قسمت.

4 BoL, SB, DK, BN, NK, KDT and BML: قسم متساوی می‌کنند; BL: قسمت می‌کنند مُتساوی.

5 Not in BL.

6 BoL, BL and KDT: قسمی; DK, SB, BN, NK and BML: قسم.

7 SB: کیجه; BoL and DK: کحه; BL, KDT and BML: کجه; BN: کنجه; NK: کیچه.

8 BoL, SB, DK, BN, NK, BML and KDT: فصلی; BL: فصل.

9 Not in BL.

10 Not in BoL.

11 BoL, BL, SB, DK, BN and BML: و نقطهٔ انقلاب اربعه در اواسط فصول سال ایشان باشد; not in NK and KDT.

12 Not in BoL.

جدول مبادی هر قسمتی از اقسام سال به حسب روزها و فنکهای مرفوع شصت شصت															
فصل بهار				فصل تابستان				فصل پاییز				فصل زمستان			
اعداد اقسام	نامهای قسمها	روزها		اعداد اقسام	نامهای قسمها	روزها		اعداد اقسام	نامهای قسمها	روزها		اعداد اقسام	نامهای قسمها	روزها	
ا	لِیجُن[1]	٠	٠٠٠٠	ز	لیخَه[2]	صا	٠نامط٠	یج	لیجوو[3]	قفب	امجلح٠	یط	لیتون	رع	بلهکز٠
ب	وُوشی[4]	به	٠لوکدن	ح	سیُومَن[5]	قو	اکحیجن	ید	چیوشو[6]	قصز	بکبن	ک	سیاوشه[7]	رفط	٠کهیان
ج	کِنجه[8]	ل	ایبمطم	ط	منجُن[9]	قکا	بدلحم	یه	بَیلو[10]	ریج	٠طمزم	کا	دایشه[11]	شد	االوم
د	شونفوند[12]	مه	امطیدل	ی	شاجر[13]	قلو	بماجل	یو	سیوفَن[14]	رکح	٠یویبل	کب	دونجن[15]	شیط	الحال
هـ	شینکمینک[16]	س	بکهلطک	یا	سیاوشو[17]	قنب	٠لمحک	یز	خَنلو[18]	رمج	اکبلزک	کج	سیوخن[19]	شلد	بیدکوک
و	کووو	عو	٠یهکدی	یب	دایشو[20]	قسز	ازیجی	یح	شونکون[21]	رنخ	انطبی	کد	دایخن[22]	شن	٠دیای
													لیجن	شسه	٠ملو٠

[1] BML: لِیجُن; BoL, SB: لحن; BL and KDT: لیجن; DK and BN: لجن; NK: لِیحُن.

[2] KDT: لیخَه; BoL: لحه; BL, SB, DK and BN: لخه; NK: لیخه; BML: لیخُه.

[3] BL and BN: لیجوو; BoL: لجوو; SB and DK: لحوو; NK: لیحوو; KDT: لپجوو; BML: لیَجُوُو.

[4] KDT and BML: وُوشی; BoL, BL and DK: ووشی; SB and BN: ووسی; NK: ووشِی.

[5] KDT and BML: سیُومَن; BoL: سومن; BL and NK: سیوفن; SB: سوفن; DK: سیومن; BN: سپومن.

[6] KDT and BML: چیوشو; BoL: جیوشو; BL: جیوسینو; SB: حیوشه; DK: حیوشیو; BN: حیوشو; NK: جیوشه.

[7] BoL, BL, KDT and BML: سیاوشه; SB: ساوسه; DK, BN and NK: سیاوسه;.

[8] BML: کِنجه; BoL, BL, DK, BN and KDT: کنجه; SB: کنحه; NK: کِیخه.

[9] BML: منجُن; BoL, DK and NK: منجن; BL: متجن; SB: منحن; BN: منجون; KDT: مُنچُن.

[10] NK: بَیلو; BoL and SB: بلو; BL and BML: بِیلو; DK: بلو; BN and KDT: بیلو.

[11] KDT and BML: دایشه; BoL, SB and NK: داشه; BL, DK and BN: دایسه.

[12] BoL, BL, DK and BML: شونفوند; SB and NK: شونفند; BN: شونفنل; KDT: شوفوند.

[13] BoL, DK and BN: شاجر; BL: شاجن; SB: شاحو; NK: شاجُر; KDT and BML: شاجُن.

[14] NK and KDT: سیوفَن; BoL and SB: سوفن; BL, DK and BN: سیوفن; BML: سیوفُن.

[15] DK, NK and KDT: دونجن; BoL and SB: دونحن; BL: دهنجن; BN: دوچن; BML: دونُجن.

[16] BL and BML: شینکمینک; BoL and KDT: شینکمنک; SB: سینکمنک; DK and BN: سینکمک; NK: سینکمینک.

[17] BoL, BN and NK: سیاوشو; BL and SB: ساوشو; DK: سیاشو; KDT: شیاوشو; BML: سیاوُشُو.

[18] NK, KDT and BML: خَنلو; BoL, SB, BN: ختلو; BL: خلو; DK: خلو.

[19] BL and KDT: سیوخن; BoL and DK: سیوحن; BL, SB and NK: سوخن; BML: سیوخُن.

[20] BL, BN, KDT and BML: دایشو; SB and NK: داشو; DK: دایسو.

[21] BL, SB, NK, KDT and BML: شونکون; DK: شوکون; BN: شونکن.

[22] BML: دایخن; BL and SB: داحن; DK: داخن; BN and KDT: دابجن; NK: دایجن.

فصل چهارم

در اعتبار دورها در سال‌های [قتاییان][1] و تاریخ[2] ایشان

[قتاییان][3] سال‌ها[4] به دور ستینی می‌شمرند. (4 الف) و دورها مقید کنند به سه نام: اول را دور «شانک وَن»[5] خوانند و میانه را دور «جونک ون» خوانند[6] و آخرین را دور «خا ون». و مدت هر سه دور صد و هشتاد سال باشد. [پس][7] سال‌ها مقید [می‌کنند][8] به این دورها. و اگر خواهند که تقیید به زیادت از این مبلغ کنند، از ابتدای آفرینش عالم بگیرند. و به حساب ایشان از آن مبدأ تا سال اول که چنکز[9] خان به پادشاهی نشست، هشت هزار و هشتصد و شصت و سه «وَن»[10] تمام گذشته بود[11] —و هر یک وَن ده هزار سال باشد[12]— و از وَن ناقصه، نه هزار و ششصد و هفتاد و نه سال تمام گذشته بود[13] و سال هشتادم جلوس چنکز خان بود و آن سال کوی‌خایی بود —یعنی سال آخر از دور جونک ون. و به حساب پارسیان[14] سال ششصد و سی و سوم[15] یزدجردی،

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[1] BL, SB, DK, BN, NK, KDT and BML: قتاییان; BoL: خطاییان.

[2] BoL, SB, DK, BN, NK, KDT and BML: تاریخ; BL: تواریخ.

[3] BL, SB, DK, BN, NK, KDT and BML: قتاییان; BoL: خطاییان.

[4] BoL, BL, SB, BN, NK, KDT and BML: سال‌ها; DK: سال‌ها را.

[5] BML: شانک‌وَن; BL, NK and KDT: شانک‌وِن; BoL, DK and BN: شانک‌ون.

[6] BL and BoL: «جونک ون» خوانند; SB, DK, BN, NK, KDT and BML: خوانند.

[7] Not in BoL.

[8] Not in BoL.

[9] BoL: چنکز; BL, SB and BN: جنکز; DK: حنکیز; NK: چکز; KDT and BML: جنکز.

[10] BN, NK, KDT and BML: وَن; BL: وِن; BoL, SB and DK: ون.

[11] BoL, BL, SB, DK, BN, KDT and BML: تمام گذشته بود; NK: تمام شده بود.

[12] Not in SB, DK and NK.

[13] Not in SB, KR and KDT.

[14] BoL, BN and NK: پارسیان; BL, DK and BML: بارسیان; SB and KDT: ـارسیان.

[15] BoL, BN, KDT and BML: سوم; BL: سه‌ام; SB, DK and NK: سیم.

ابتدای دور شانک ون [باشد].[1] و اما ترکان بر دوازده‌گانه اقتصار کنند. و آن را به نام‌هائی که به لغت ایشان است، می‌شمارند. و قید تاریخ ایشان ما را معلوم نیست.

فصل پنجم

در معرفت مبادی اقسام سال‌های شمسی که واقع باشد در هر [سال][2]

هر گاه[3] که خواهیم که مبدأی هر[4] قسمی از اقسام بیست و چهارگانه در سالی معین بدانیم، باید که در یک سال پیش از آن سال یا بعد از آن سال[5] دانسته باشیم که مبدأی [لیجن][6] در کدام روز و چاغ بوده است از دور ستینی. و ما آن را اصل اقسام سال[7] می‌خوانیم. و آن را به لغت [قتاییان][8] «کیجو» خوانند. و آن در سال اول از دور شانک ون که بعد از جلوس چنکز خان بود، بعد از[9] یازده روز و هفت هزار و ششصد و شصت فنک بوده است که ارقام آن[10] بر این صورت باشد <u>یا بـزم</u>.[11] [پس][1] چون خواهیم که مبدأی سال[2] دیگر معلوم کنیم، بنگریم تا آن سال پیش از سال اصل

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[1] BL, SB, DK, BN, NK, KDT and BML: باشد; BoL: بود.

[2] BL, SB, DK, BN, NK, KDT and BML: سال; BoL: سالی.

[3] BL, SB, DK, BN, NK, KDT and BML: هرگاه; BoL: در هرگاه.

[4] Not in BL.

[5] Not in BL.

[6] BL and BML: لیجن; BoL: لیچن; SB and NK: لـچن; DK, BN and KDT: لـجن.

[7] BL, SB, DK, BN, NK, KDT and BML: اصل اقسام سال; BoL: اصل اقسام دور ستینی.

[8] BL, SB, DK, BN, NK, KDT and BML: قتاییان; BoL: خطاییان.

[9] BL, SB, DK, BN, NK, KDT and BML: بعد از; BoL: و بعد از.

[10] BL, SB, DK, BN, NK, KDT and BML: آن; BoL: آن را.

[11] Not in BL and DK.

است یا بعد از آن و میان هر دو چند سال بوده است؛ پس عدد تفاضل را در مقدار فضل یک سال شمسی بر سیصد و شصت روز [که][3] آن پنج روز و دو هزار و چهارصد و سی و شش فنک باشد و رقم آن این است هـ ٠ملو و به لغت ایشان آن[4] را «سُیُو»[5] خوانند، ضرب کنیم؛ و فنک‌ها که از ده هزار —یعنی بـموم— زیادت باشد،[6] [هر ده هزار را یکی بر عدد روزها افزاییم؛ و آن ده هزار بیفکنیم تا تفاوت میان سال اصل و سال مطلوب حاصل آید.

پس اگر سال مطلوب بعد از سال اصل باشد، آن تفاوت را بر اصل مذکور افزاییم؛ (4 با) و اگر فنک‌ها از ده هزار —یعنی از بـموم— زیادت شود]،[7] این مقدار بیفکنیم؛ و یک روز بر روزها افزاییم؛ و آن ایام اگر بر شصت زیادت باشد، شصت می‌کاهیم.[8] و اگر سال مطلوب پیش از سال اصل باشد، تفاوت را از اصل بکاهیم؛ اگر روزها نقصان نتوان کرد، شصت بر روزهای اصل افزاییم و نقصان کنیم؛ و اگر فنک‌ها نقصان نتوان کرد، یک روز بکاهیم؛ و به جای آن، ده هزار —یعنی بـموم— بر فنک‌ها افزاییم و فنک‌ها از مجموع بکاهیم؛[9]

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[1] Not in BoL.

[2] BoL, BL, BN, KDT and BML; سال; SB, DK and NK: سالی.

[3] Not in BoL.

[4] BoL, BN, SB, DK, NK, KDT and BML: آن; BN: این.

[5] BL: سُیُو; BoL, SB, NK and KDT: سی‌و; DK: سیو; BN and BML: سی‌یو.

[6] BoL, DK, BN, NK, and BML: باشد; BL, SB and KDT: شود.

[7] BL, DK, BN, KDT and BML: هر ده هزار را یکی بر عدد روزها افزاییم؛ و آن ده هزار بیفکنیم تا تفاوت میان سال اصل و سال مطلوب حاصل آید. پس اگر سال مطلوب بعد از سال اصل باشد، آن تفاوت را بر اصل مذکور افزاییم؛ و اگر فنک‌ها از ده هزار —یعنی از بـموم— زیادت شود; BoL: و ده هزار یکی بر عدد روزها افزاییم؛ و آن ده هزار بیفکنیم تا تفاوت میان سال مطلوب و سال اصل مطلوب حاصل آید. پس اگر سال مطلوب بعد از سال اصل باشد، آن تفاوت را بر اصل مذکور افزاییم؛ و اگر فنک‌ها از ده هزار —یعنی از بـموم— زیادت شود; not in SB and NK.

[8] BoL: و آن ایام اگر بر شصت زیادت باشد، شصت می‌کاهیم; DK: و ایام اگر از شصت زیادت شود، شصت از او بیفکنیم; Not in BL, SB, BN, NK, KDT and BML.

[9] BoL and KDT: و فنک‌ها از مجموع بکاهیم; not in BL, SB, DK, BN, NK and BML.

آنچه حاصل آید بعد از زیادت یا نقصان، مبدأی لیجن باشد در سال مطلوب؛ آن را از مبدأی دور ستینی بشمریم؛ و فنک‌ها را از حساب یک روز گیریم؛ به هر موضع که رسد، مبدأی سال مطلوب باشد؛ و تمامت آن سال را به آن [نام][1] نسبت کنند.

مثالش خواستیم که مبدأی سال دهم از دور شانک ون که مطابق سال ششصد و چهل و دوم یزدجردی باشد و آن سال کوی یوو باشد به لغت [قتا][2] و داقوق ییل به لغت ترکان، معلوم کنیم. تفاضل میان سال اصل و سال مطلوب نه عدد بود؛[3] در «سی‌یو» ضرب [کردیم]؛[4] آمد چهل و پنج روز و بیست و یک هزار و نهصد و بیست و چهار فنک بر این صورت مه وه‌کد؛ جهت بیست هزار فنک —یعنی هجلک— دو روز گرفتیم؛ چهل و هفت روز شد؛ و یک هزار و نهصد و بیست و چهار فنک بماند بر این صورت مز ٠لبد؛ پس این مبلغ را بر اصل که یازده روز و هفت هزار و ششصد و شصت فنک است بر این صورت یا بزم، افزودیم، از بهر آنکه سال مطلوب بعد از سال اصل است؛ حاصل آمد پنجاه و هشت روز و نه هزار و پانصد و هشتاد و چهار فنک بر این صورت نح ب‌لطمد؛ و این[5] مبدأی سال مطلوب باشد؛ فنک‌ها را یکی بر پنجاه و هشت افزودیم تا پنجاه و نه روز[6] شد؛ و پنجاه و نهم از دور ستینی ژم‌سو باشد و به ترکی ایت کون.[7] پس معلوم شد

1 Not in BoL and KDT.

2 SB, DK, BN, NK, KDT and BML: قتا; BoL: خطا; BL اهل خطا.

3 BN: یافتیم.

4 BL, SB, DK, BN, NK, KDT and BML: کردیم; BoL: کنیم.

5 BoL, SB, BN, NK, KDT and BML: این; BL and DK: آن.

6 Not in SB, DK and BML.

7 Not in BL, DK and NK.

که اول سال کویِیوو که سال داقوق است، روز ژمسو است که ایت کون باشد. از مبدأی روز نه هزار و پانصد و هشتاد و چهار فنک گذشته بر این صورت بـلطمد؛ و چون آن را در جدول مبادی چاغها و کهها طلب کردیم، یافتیم میان اول و دوم؛ و فضل او بر مبدأی چاغ اول که بـلطـ- مجک باشد، به دو ثلث یک فنک بود. پس دانستیم که مبدأی سال کویِیُوو که داقوق ییل است، در کِه اول باشد از چاغ ژه که چاغ کسکو باشد، از روز ژمسو که روز ایت باشد، (5 الف) بعد از دو ثُلث از یک فنک از آن که. وهم بر این قیاس.

و چون مبدأی سال معلوم شود، اقسام سال برآن مبدأ می‌افزاییم[1] تا مبادی[2] هر [قسم][3] که خواهیم معلوم شود.[4] مثلاً خواستیم که مبدأی لیخه[5] از آن سال معلوم کنیم؛ نگاه کردیم در جدول مبادی اقسام سال‌ها از روزها نود و یک و از فنک‌ها ۰نامط۰ بود؛ آن را بر روزها و فنک‌های سر سال افزودیم؛ حاصل آمد از روزها، صد و چهل و نه روز و از فنک‌ها، جلالج؛ پس از فنک‌ها یک روز[6] —یعنی بـموم— نقصان کردیم؛[7] روزها صد و پنجاه شد؛ و با فنک‌ها بر این گونه شد قن۰مد- نج؛ از روزها شصت شصت [بیفکندیم]؛[8] بماند سی روز؛[9] دانستیم که در روز سی و یکم از دور

[1] BL, SB, DK, BN, NK, KDT and BML: می‌افزاییم; BoL: افزاییم.

[2] BoL, SB, DK, BN, NK, KDT and BML: مبادی; BL: مبدأی.

[3] BL, SB, DK, BN, NK, KDT and BML: قسم; BoL: قسمی.

[4] BoL, SB, DK, BN: شود; BL: می‌شود.

[5] BoL, BL, BN, NK, KDT and BML: لیخه; SB and DK: لیحه.

[6] BL: روزه.

[7] BoL, SB, DK, BN, NK, KDT and BML: نقصان کردیم; BL: نقصان کردیم؛ و یک روز بر روزها افزودیم..

[8] BL, SB, DK, BN, NK, KDT and BML: بیفکندیم; BoL: بیفکنیم.

[9] Not in BL, DK, NK and BML.

ستینی که روز کاوو باشد و به ترکی روز یوند، در کِهِ ششم از چاغ ماو که به ترکی طاوشقن باشد، بعد از هشتاد و نه فنک از آن کِهِ مبدأی قسم لیخه باشد در آن سال. و بر این قیاس.

[و][1] ما جدولی بنهادیم مشتمل بر مبادی سال‌ها در بیست و چهار سال از دور شانک‌ون و جدولی دیگر در مبادی اقسام سال داقوق از جهت مثال را، و آن [جدول] این است.[2]

[1] Not in BoL.

[2] BoL, SB, DK and NK: از جهت مثال، و آن این است; BL: از جهت مثال را، و آن جدول این است; BN: از جهت مثال، و آن دو جدول این است که در صفحهٔ دیگر است; KDT: از جهت مثال،و آن جدول این است که بر آن دیگر صفحه است; BML: از جهت امثال، و آن جدول این است که بر ورق دیگر نسبت آید.

جدول مبادی لیجن در سالی چند						
سالهای	سالهای قتایی	سالهای ترکی	روزهای ستینی		نام مبادی لیجن به قتایی	نام مبادی لیجن به ترکی
خلج	کازه	کسکو	یا	ب ز م	یی خایی	طونغوز
خلد	یی‌چیو	اوط	یز	ا٠ لو	سن صز	ییلان
خله	یین‌یم	بارس	کب	٠ مب یب	یین سو	ایت
خلو	تین‌ماو	طاوشقن	کز	ا کب مح	سن ماو	طاوشقن
خلز	ووچن	لو	لب	ب ج کد	یین شن	بیجین
خلح	کی‌صز	ییلان	لز	ب مد ٠	تین چیو	اوط
خلط	کی‌وو	یوند	مج	٠ لز نو	تین وی	قوی
خم	سن‌وی	قوی	مح	ا اح لب	ژم ژه	کسکو
خما	ژم‌شن	بیجین	نج	ا نط ح	تین صز	ییلان
خمب	کوی‌یوو	داقوق	نخ	ب لط مد	ژم سو	ایت
خمج	کاسو	ایت	د	٠ لج م	وو چن	لو
خمد	یی‌خایی	طونغز	ط	ا ید نو	کوی یوو	داقوق
خمه	یین‌ژه	کسکو	ید	ا ند نب	وو یم	بارس
خمو	تین‌چیو	اوط	یط	ب له کح	کوی وی	قوی
خمز	وویم	بارس	که	٠ کط کد	کی چیو	اوط
خمح	کی‌ماو	طاوشقن	ل	ا ی ٠	کا وو	یوند
خمط	کی‌چن	لو	له	ا ن لو	کی خایی	طونغوز
خنا	سن‌صز	ییلان	م	ب لا یب	کا چن	لو
خنب	ژم‌وو	یوند	مو	٠ که ح	کی سو	ایت
خنج	کوی‌وی	قوی	نا	ا ه مد	یی ماو	طاوشقن
خند	کاشن	بیجن	نو	ا مو ک	کی شن	بیجین
خنه	یی‌یوو	داقوق	ا	ب کو نو	یی چیو	اوط
خند	یین‌سو	ایت	ز	٠ ک نب	سن وو	یوند
خنو	تین‌خایی	طونغوز	یب	اا کح	یین ژه	کسکو
خنز	ووژه	کسکو	یز	ا مب د	سن صز	ییلان

جدول مبادی اقسام سال داقوق موافق خمب یزدجردی				
اسامی اقسام	ایام دور ستینی		اسامی مبادی اقسام به قتایی	اوقات اقسام از موضع آفتاب
لیجن	نح	ب لط مد	ژمسو ایت	اواسط الدلو
ووشی	ید	۰ کط کط	وویم بارس	اوایل الحوت
کنجه	کط	ا ه ند	کوی‌صز بیلان	اواسط الحوت
شون‌فوند	مد	ا مب یط	ووشن بیجین	اولیل الحمل
سینک‌مینک	نط	ب یح مج	کوی‌خایی طونغوز	اواسط الحمل
کووو	یه	۰ ح کح	کی‌ماو طاوشقن	اوایل الثور
لیخه	ل	۰ مد نج	کاوو یوند	اواسط الثور
سیومن	مه	ا کا یح	کی‌یوو داقوق	اوایل الجوزا
منجن	۰	ا نز مج	کاژه کسکو	اواسط الجوزا
شاجر	یه	ب لد ح	کی‌ماو طاوشقن	اوایل السرطان
سیاوشو	لا	۰ کج نب	یی‌وی قوی	اواسط السرطان
دایشو	مو	ا ۰ یز	کن‌سو ایت	اوایل الاسد
لیجوو	ا	ا لو مب	یی‌چیو اوط	اواسط الاسد
چیوشو	یو	ب یج ز	کن‌چن لو	اوایل السنبله
بیلو	لب	۰ ب نب	پین‌شن بیجین	اواسط السنبله
سیوفن	مز	۰ لط یز	سن‌خایی طونغوز	اوایل المیزان
خنلو	ب	ا یه مب	پین‌یم بارس	اواسط المیزان
شون‌کن	یز	ا نب و	سن‌صز بیلان	اوایل العقرب
لیتون	لب	ب کح لا	پین‌شن بیجین	اواسط العقرب
سیاوشه	مح	۰ یح یو	ژم‌ژه کسکو	اوایل القوس
دایشه	ج	۰ ند ما	تین‌ماو طاوشقن	اواسط القوس
دونجن	یح	ا لا و	ژم‌وو یوند	اوایل الجدی
سیوخن	لج	ب ز ل	تین‌یوو داقوق	اواسط الجدی
دایخن	مح	ب مج نه	ژم‌ژه کسکو	اوایل الدلو
لیجن	د	۰ لج م	ووچن لو	اواسط الدلو

(5 با) فصل ششم

در معرفت مبدأی آرام ای به حسب امر وسط در هر سال

اول باید که در یک سال مابین اول آرام[1] ای که سر سال است، و مابین مبدأی ووشی که قسم دوم است از اقسام سال شمسی، معلوم باشد؛ و آن در اول دور شانک‌ون موافق خلج یزدجردی بعد از چهارده روز و چهار هزار و ششصد و هفتاد و شش فنک بوده است که ارقام آن بر این صورت ید ایزنو، و آن بر جدول که خواهد آمد، مذکور است؛[2] و آن را به لغت [قتا][3] «شونجن»[4] خوانند و ما آن را اصل سر سال‌ها[5] می‌خوانیم؛[6]

پس تفاوت میان آن سال و سال مطلوب بگیریم که چندی است؛[7] و آن را در فضل یک سال شمسی بر یک سال قمری که آن ده روز و هشت هزار و هفتصد و شصت و چهار فنک باشد و ارقامش ی بکود،[8] و آن را به لغت [قتا][9] «سویجا»[10] خوانند، ضرب کنیم؛ پس حاصل را بر اصل

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[1] DK and BML: آرام; BoL, BL, KM, BN, NK and KDT: ارام; SB: اورام.

[2] BoL: در اول دور شانک‌ون موافق خلج یزدجردی بعد از چهارده روز و چهار هزار و ششصد و هفتاد و شش فنک بوده است که ارقام آن بر این صورت ید ایزنو، و آن بر جدول که خواهد آمد، مذکور است; NK: و آن جدولی که خواهند آمدن، مذکور است; not in BL, KM, SB, KDT and BML.

[3] KM, SB, DK, BN, KDT and BML: قتا; BoL and BL: خطا.

[4] BoL, BN and BML: شونجن; BL: شونحن; SB and NK: شوحن; DK: شوجن.

[5] BL, KM, SB, BL, KR, KDT and BML: اصل سر سال‌ها; BoL and DK: اصل سر سال..

[6] Between و ما آن را «اصل سر سال» می‌خوانیم and پس تفاوت میان آن سال و سال مطلوب بگیریم که چند است; DK: و آن در اول شانک‌ون موافق خلج ید روز و ایزنو فنک بوده است; NK: و آن در اول شانک‌ون موافق خلج چهارده روز و چهار هزار و ششصد و هفتاد و شش فنک بوده و ارقامش این است ید ایزنو; BN: و آن در سال اول از دور شانک‌ون بعد از چهارده روز و چهار هزار و ششصد و هفتاد و شش فنک بوده است که ارقام آن بر این صورت بود ید ایزنو و آن در جدولی که خواهند آمدن مذکور است; KDT: در اول دور شانک‌ون موافق خلج چهارده روز و چهار هزار و ششصد و هفتاد و شش فنک بوده و ارقامش آن است ید ایزنو.

[7] BoL, BL, KM, SB, DK and NK: چندی است; KDT and BML: چند است; not in BN.

[8] BoL, BL, KM, SB, DK, NK, KDT and BML: ی بکود; BN: ی بکود باشد.

[9] BL, KM, SB, DK, BN, NK, KDT and BML: قتا; BoL: ختا.

[10] BoL, BL, BN, KDT and BML: سوجا; KM and NK: سویجا; SB: سوحا; DK: شوجا.

سر [سال‌ها] افزاییم، اگر سال مطلوب بعد از آن [سال] بود؛[1] و مدت یک ماه قمری اوسط و آن بیست و نه روز و پنج هزار سیصد و شش فنک باشد بر این صورت کط اکح کو و به لغت [قتا][2] [آن را][3] «شوجه»[4] خوانند؛ اگر از حاصل ضرب با شونجن[5] نقصان توان کرد، نقصان می‌کنیم تا کمتر از مدت یک ماه بماند؛ و هر یک بار که تقصان کنیم، در آن سال‌ها که تفاوت باشد میان سال اصل و سال مطلوب، یک بار ماه «شون» افتده باشد؛- و سال سیزده ماه شده.

و اگر پیش از آن باشد، آن را از اصل سر [سال‌ها] –اگر نقصان توان کرد—نقصان کنیم؛ و اگر نقصان نتوان کرد، چندان بار مدت یک ماه بر اصل سر [سال‌ها] افزاییم که چون حاصل ضرب از او نقصان کنیم، کمتر از یک ماه بماند.[6]

پس آنچه بماند کمتر از مدت یک ماه، مابین اول آرام ای و اول ووشی باشد در سال مطلوب؛ و آن اصل سر آن سال باشد؛ پس ایام ووشی بگیریم در هر سال؛[7] و مابین اول آرام و اول ووشی از

[1] BoL: پس حاصل را بر اصل سر سال افزاییم، اگر سال مطلوب بعد از آن سال بود; BN: و حاصل را بر اصل سر سال‌ها افزاییم، اگر سال مطلوب بعد از آن سال باشد; NK: از «شونجن» بکاهیم، اگر سال مطلوب بر سال اصل مقدم باشد؛ و اگر از «شونجن» نتوان کاست، مقدار یک ماه قمری اوسط را بر «شونجن» افزایم؛ یک بار یا بیشتر یا چندان گردد که حاصل ضرب از او توان کاست; KDT and BML: پس از فنکات زاید بر ب‌موم تضاعیف ب‌موم می‌کاهیم؛ و به عدد هر یک بار که بکاهیم، روزی بر ایام می‌افزاییم تا فنکات کمتر از فنکات شبانروزی گردد [و] «شونجن» بر او افزاییم; not in BL, KM, SB and DK.

[2] BL, KM, SB, DK, BN, NK and KDT: قتا; BoL: خطاییان; BML: قتائی.

[3] Not in BoL.

[4] BL, KM and BML: شُوجَه; SB, DK, BN, NK and KDT: شوجه; BoL: سوجه.

[5] BoL: از حاصل ضرب با «شونجن»; BL, KM, DK, KDT and BML: حاصل ضرب ; SB, BN and NK: آن مجموع.

[6] BoL: و هر یک بار که تقصان کنیم، در آن سال‌ها که تفاوت باشد میان سال اصل و سال مطلوب، یک بار ماه شون افتده باشد؛ و سال سیزده ماه شده؛ و اگر پیش از آن باشد، آن را از اصل سر سال –اگر نقصان توان کرد—نقصان کنیم؛ و اگر نقصان نتوان کرد، چندان بار مدت یک ماه بر اصل سر سال افزاییم که چون حاصل ضرب از او نقصان کنیم، کمتر از یک ماه بماند; BN: اگر سال مطلوب پیش از آن باشد، چندان بار مدت یک ماه قمری بر اصل سر سال افزاییم که چون حاصل ضرب از آن کاهیم، باقی کمتر از مدی یک ماه بود؛ به هر یک بار که نقصان کرده بایشیم، به این افزوده و اگر پیش از آن not in BL, KM, SB, DK, NK, KDT and BML after در آن سال‌ها که تفاوت باشد میان سال اصل و سال مطلوب، یک بار ماه شون افزوده باشد، و سال سیزده ماه شده باشد، آن را از اصل سر سال –اگر نقصان توان کرد—نقصان کنیم؛ و اگر نقصان نتوان کرد، چندان بار مدت یک ماه بر اصل سر سال افزاییم که چون حاصل ضرب از او نقصان کنیم، کمتر از یک ماه بماند.

[7] BoL, BL, KM, DK, KDT and BML: در هر سال; BN: در آن سال; NK: در سال مطلوب.

او نقصان کنیم؛ اگر نقصان توان کرد، و إلاّ شصت بر ایام ووشی افزاییم؛ و از مبلغ (6 الف) نقصان کنیم؛ آنچه باقی باشد، مدخل مبدأی آرام باشد به حسب امر اوسط از دور ستینی؛ پس آن را با مدخل مبدأی لیجن در آن سال نگاه کنیم تا معلوم شود که کدام مقدم باشد چه تفاوت میان هر دو مبدأ لامحاله کمتر از [مدت یک قسم سال شمسی باشد].[1]

فصل هفتم

در معرفت حصهٔ آفتاب و حصهٔ ماه در اول هر سال

اما حصهٔ آفتاب را مابین اول آرام و اول ووشی در هر سال از سُدس مدت یک سال شمسی که آن شصت روز هشت هزار و هفتصد و چهل فنک باشد و به ارقام س بکهم و آن را «کیجا»[2] خوانند، نقصان کنیم؛ آنچه بماند، حصهٔ آفتاب باشد به[3] اول آن سال.

و اما حصهٔ ماه را باید که اصل حصهٔ ماه[4] در مبدأی یک سال معلوم باشد؛ و آن در اول سال شانکون موافق خلج هفتاد و هشت روز و سه هزار ونهصد و چهل و هشت فنک بوده است،

[1] BL, KM, SB, DK, BN, NK, KDT and BML: مدت یک قسم سال شمسی باشد; BoL: مدت قسم یک سال شمسی باشد.

[2] BL, KM, NK, KDT and BML: کیجا; BoL: کیخا; SB: کنجا; DK and BN: کجا.

[3] BoL, BL, KM, SB, DK, NK, KDT and BML: به; BN: تا.

[4] BoL, BL, KM, SB, DK, BN, KDT and BML: اصل حصهٔ ماه; NK: اصل حصهٔ ماه را که محفوظ اول خوانیم.

ارقام آن عح اهمح [1] و به لغت [قتا][2] آن را «جونجونکا»[3] خوانند؛ پس تفاوت[4] میان آن سال و سال مطلوب بگیریم؛ و آن را در هفت روز و سیصد و سی و هشت فنک که ارقام آن این است ز۰هلح و آن را به لغت [قتا][5] «جونجا»[6] خوانند— و ظن من آن است که آن فضل مدت یک سال شمسی است بر سیزده دور قمری اوسط—[7] ضرب کنیم؛ [و حاصل را بر اصل حصهٔ ماه افزاییم، اگر سال مطلوب بعد از آن باشد؛ و إلّا بکاهیم، به آن طریق که در فصل ششم گفته ایم آنچه حاصل آید، آن را محفوظ اول خوانیم؛][8] پس مابین اول آرام و اول ووشی را[9] از آن مبلغ نقصان کنیم؛ اگر نقصان نتوان کرد، شصت[10] بر روزها افزاییم و نقصان کنیم؛ آنچه حاصل آید،[11] آن را محفوظ دوم خوانیم؛ پس مدت یک دور حصهٔ ماه که مقدار آن بیست و هفت روز و پنج هزار و پانصد و پنجاه و شش فنک باشد و ارقامش این است کز البلو و آن را «جنجون»[12] خوانند، از محفوظ دوم نقصان می‌کنیم تا کمتر از

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1 BoL: و آن در اول سال شانک‌ون موافق خلج هفتاد و هشت روز و سه هزار ونهصد و چهل و هشت فنک بوده است، ارقامش عح اهمح; DK: و آن در اول شانک‌ون که موافق خلج یزدجردی کج روز و ۰مزیو فنک بوده است; KDT: و آن در اول شانک‌ون بیست و سه روز و دو هزار و هشتصد و سی و شش فنک بوده و ارقامش کج ۰مزیو است; BN: و آن در اول شانک‌ون بیست و سه روز و دو هزار و هشتصد و سی و شش بود و ارقامش این است کج ۰مزیو; not in BL, KM, SB, NK and BML.

2 BL, KM, DK, SB, NK, KDT and BML: قتا; BoL: خطاییان; not in BN.

3 DK, BN, NK, KDT and BML: جونجونکا; BoL: خونخونکا; BL, KM and SB: جونخونکا.

4 BoL, BL, KM, SB, DK, NK, KDT and BML: پس تفاوت; BN: و جهت دیگر سال‌ها، عدد تفاوت.

5 BL, KM, SB, DK, BN, NK, KDT and BML: قتا; BoL: خطاییان.

6 KM, NK, KDT and BML: جونجا; BoL: خونجا; BL: جونچا: SB: حونجا; DK: جوجا; BN: جونحا.

7 BoL and BML: و ظن من آن است که آن فضل سیزده دور قمری اوسط است بر مدت سال شمسی; BL, KM, SB, DK, BN, NK and KDT: و ظن من آن است که آن فضل مدت یک سال شمسی است بر سیزده دور قمری اوسط.

8 BoL, NK, KDT, and BML: و حاصل را بر اصل حصهٔ ماه افزاییم، اگر سال مطلوب بعد از آن باشد؛ و إلّا بکاهیم، به آن طریق که در فصل ششم گفته ایم آنچه حاصل آید، آن را محفوظ اول خوانیم; BN: آنچه حاصل آید، آن را محفوظ اول خوانیم; BL, KM, SB and DK: آنچه حاصل آید؛ حصهٔ اصل ماه بر او افزاییم؛ و آن را محفوظ اول خوانیم.

9 BoL: BL, KM, SB, DK, BN, NK and KDT; مابین اول آرام و اول ووشی را; BML: مابین اول آرام و اول ووشی را —یعنی سونجن--.

10 BoL, BL, KM, SB, BN, NK, KDT and BML: شصت; DK: دور قمری.

11 BoL, KM, SB, DK, BN, NK, KDT and BML: حاصل آید; BL: بماند.

12 BL, BN and BML: جنجون; BoL: حنجون; KM and NK: جنحون; DK: حجون.

یک دور بماند؛ آنچه بماند، تُسع اصل حصهٔ [ماه][1] باشد؛ آن را در نه ضرب کنیم تا حصهٔ ماه در اول سال مطلوب حاصل شود؛ [اگر از دویست و چهل و هشت روز زیادت باشد، آن را از او نقصان کنیم. آنچه بماند، حصهٔ ماه باشد در اول سال مطلوب.][2]

(6 با) و ما جنجون را در اعداد ضرب کرده، در جدول نهادیم تا به آسانی از آنجا بر می‌گیرند. و نیز تمامیت آنچه در فصل ششم و در این فصل گفته آمد، در مدت دو دور از ادوار دوازده‌گانه از مبدأی دور شانک‌ون در جدول نهادیم از جهت مثال. و جدول این است.[3]

		جدول دو دور مذکور از مبدأی شانک‌ون که به جهت مثال نهاده شد										
	سالهای یزدجردی	سالهای قتا	سالهای ترکی	مابین اول آرام و ووشی و آن اصل سر سالها است		مدخل ووشی		مدخل آرام به حسب امر اوسط		سالها که آرام بر لیجن مقدم بود	حصهٔ آفتاب در سر سالها	
	خلج	کازه	کسکو	ید	ایزنو	کو	ب‌مده	یب	اکزط		مو	ازمد
شون	حلد	یی‌جیو	اوط	که	٠نزک	لب	٠لحا	و	بکزکا	ق	له	اکحک
	خله	پین‌یم	بارس	و	اندنخ	لز	ایحلز	ل	بییط		ند	٠لمب
	خلو	تین‌ماو	طاوشقن	یز	الدکب	مب	انطیج	که	٠کدنا	ق	مج	٠نایح
شون	خلز	ووجن	لو	کح	اجمو	مز	بلطمط	یط	اکوج	ق	لب	ایاند
	خلح	کی‌صز	ییلان	ط	بیاکد	نج	٠لجمه	مج	اطا		نا	٠یدیو
شون	خلط	کن‌وو	یوند	ک	انکح	نخ	ایدکا	لز	بیلح	ق	م	٠لهیب

[1] Not in BoL.

[2] DK and NK: اگر از دویست و چهل و هشت روز زیادت باشد، آن را از او نقصان کنیم. آنچه بماند، حصهٔ ماه باشد در اول سال مطلوب; not in BoL, BL, KM, SB, BN and BML.

[3] BoL and BL: از جهت مثال؛ و آن جدول این است که بر صفحهٔ دیگر است; BML: از جهت مثال؛ و آن جدول این است; KM, SB, DK and NK: از جهت مثال؛ و جدول این است; not in BN.

ب‌كجند	نخ		انجيا	ا	اندنز	ج	٠امو	ب	قوى	شن‌وى	خم	
ب‌مدل	مز		٠زمج	نو	ب‌له‌لج	ح	ب‌كزن	يب	بيجين	ژم‌شن	خما	
٠يج‌كو	لز	ق	اح‌نه	ن	٠كط‌كط	يد	ب‌زبد	كج	داقوق	كوى‌يوو	خمب	شون
ب‌زكح	نه		٠نانج	يد	اى‌ه	يط	٠يح‌يب	ه	ايت	كاسو	خمج	
ب‌كح‌د	مد	ق	انجمه	ح	اناكا	كد	ب‌مديو	يه	طونغوز	يى‌خايى	خمد	
٠ب٠	لد	ق	٠زلز	ج	ب‌لايز	كط	ب‌كج‌م	كو	كسكو	پين‌زه	خمه	شون
اناب	نب		ب‌لزيه	كو	٠كه‌يج	له	٠لدلح	ح	اوط	تين‌جيو	خمو	
ب‌يالح	ما	ق	٠نامز	كا	اهمط	م	٠يدب	يط	بارس	وويم	خمز	شون
ايد٠	س		٠لدمه	مه	اموكه	مه	ايام	٠	طاوشقن	كى‌ماو	خمح	
الدلو	مط		الزنز	لط	ب‌كزا	ن	٠ناد	يا	لو	كن‌جن	خمط	
انه‌يب	لح	ق	ب‌لزط	لج	٠ك‌نز	نو	٠ل‌كح	كب	ييلان	شن‌صز	خن	شون
٠نزلد	نز		ب‌ك‌ز	نز	االج	ا	اكح‌و	ج	يوند	ژم‌وو	خنا	
ايحى	مو		٠لدلط	نب	امبط	و	ازل	يد	قوى	كوى‌وى	خنب	
الحمز	له	ق	اله‌نا	مو	ب‌كب‌مه	يا	٠موند	كه	بيجين	كاسن	خنج	شون
٠ماح	ند		ايحمط	ى	٠يوما	يز	امدلب	و	داقوق	يى‌يوو	خند	
اامد	مج	ق	ب‌كا	د	٠نزيز	كب	اكج‌نو	يز	ايت	پين‌سو	خنه	
اكب‌ك	لب	ق	٠لدلج	نط	الزنج	كز	اج‌ك	كح	طونغوز	تين‌خايى	خنو	شون
٠كدمب	نا		٠يزلا	كج	بيح‌كط	لب	ب٠لح	ط	كسكو	ووزه	خنز	
٠مه‌يح	م	ق	ايحمج	يز	ب‌نطه	لز	ام‌كب	ك	اوط	كى‌جيو	خنح	

حصهٔ قمر		تتمّهٔ اصل حصهٔ قمر		مخطوط دوم		مخطوط اول		سالهای یزدجردی
٠نزک	عط	بیو٠	ح	بلدلب[4]	سج[3]	اهمح[2]	عح[1]	خلج
بومو	مد	بمبید	د	٠یدو[8]	س[7]	ایاکو[6]	فه[5]	حلد
بلحمب	کز	٠یزلح	ج	بحمو[12]	فه[11]	ایزد[10]	صب[9]	خله
االب	رما[17]	بیوکح	کو	بله٠[16]	فا[15]	اکبمب[14]	صط[13]	خلو
بىنخ[23]	رو[22]	بمبمب	کب	٠یدلد[21]	عح[20]	اکحک[19]	قو[18]	خلز
بمبند	ط[4]	٠یحو	ا[3]	بطید[2]	فج[1]	الجنخ[25]	قیج[24]	خلح

[1] SB and NK: کج.

[2] SB and NK: ٠مزیو.

[3] SB and NK: ح.

[4] SB and NK: بیو٠.

[5] SB and NK: ل.

[6] SB and NK: ٠نبند.

[7] SB and NK: د.

[8] SB and NK: بمبید.

[9] SB and NK: لز.

[10] SB and NK: ٠نخلب.

[11] SB and NK: ل.

[12] SB and NK: انید.

[13] SB and NK: مد.

[14] SB and NK: ادی.

[15] SB and NK: کو.

[16] SB and NK: بیوکح.

[17] SB and NK: یه.

[18] SB and NK: نا.

[19] SB and NK: اطمح.

[20] SB and NK: کب.

[21] SB and NK: بمبمب.

[22] SB, NK and BML: قف.

[23] SB and NK: بىلح.

[24] SB and NK: نخ.

[25] SB and NK: ایهکو.

اهم	قنه	٠مدم[9]	يز	بلهمح[8]	صط[7]	الطلو[6]	قک[5]	خلط
الزلو	قلح	اوكد	يه	امجكح[13]	قكه[12]	امهيد[11]	قكز[10]	خم
٠٠كب	قد	البلح	يا	بطمب[17]	قكا[16]	اننب[15]	قلد[14]	خما
اطمح[22]	سط	انحنب	ز	بلهنو[21]	قيز[20]	انول[19]	قما[18]	خمب
امامد	نب	بكنو	ه	امجنو[26]	قمج[25]	ببح[24]	قمح[23]	خمج
٠دل	يح	٠٠ل	ب	ب‌ى‌ى[30]	قلط[29]	بزمو[28]	قنه[27]	خمد
ايد٠	رلا	انطک	كه	بلوكد[3]	قله[2]	بيجكد[1]	قسب[31]	خمه

[1] SB and NK: مح.

[2] SB and NK: انمب.

[3] BL, KM, SB, DK, BN, NK and BML: كا.

[4] BL, KM, SB, DK, BN, NK and BML: قصط.

[5] SB and NK: سه.

[6] SB and NK: اكاد.

[7] SB and NK: مد.

[8] SB and NK: بيزيو.

[9] BL, KM, SB, DK, BN, NK and BML: ٠مدک.

[10] SB and NK: عب.

[11] SB and NK: اكومه.

[12] SB and NK: ع.

[13] SB and NK: اكدنز.

[14] SB and NK: عط.

[15] SB and NK: البک.

[16] SB and NK: مو.

[17] SB and NK: انای.

[18] SB and NK: فو.

[19] SB and NK: الزنح.

[20] SB and NK: سب.

[21] SB and NK: بيبكد

[22] SB, DK and NK: اهمح.

[23] SB and NK: صج.

[24] SB and NK: امجلو.

[25] SB and NK: نخ.

[26] SB and NK: اكهكد.

[27] SB and NK: ق.

[28] SB and NK: امطيد.

[29] SB and NK: فد.

[30] SB and NK: انامح.

[31] SB and NK: قز.

امهنو	ريد	بكاكد	كج	امدكد[7]	قسا[6]	بيطب[5]	قسط[4]	خمو
٠حمب	قف	٠٠نخ	ك	بىلح[11]	قنز[10]	بكدم[9]	قعو[8]	خمز
٠ملح	قسج	٠كجب	يح	ايحلح[15]	قفج[14]	بليح[13]	قفج[12]	خمح
اند	قيح[21]	٠مطيو	كد[20]	امدنب[19]	قفط[18]	بلهنو[17]	قص[16]	خمط
٠يبن	صد	ايهل	ى	بياو[25]	قعه[24]	بمالد[23]	قصز[22]	خن
٠مدمو	عز	الزلد	ح	ايطو[29]	را[28]	٠٠لب[27]	ره[26]	خنا
انديب	مب	بجمح	د	امهك[2]	قصز[1]	٠وى[31]	ريب[30]	خنب

1 SB and NK: اندنب.

2 SB and NK: ف.

3 SB and NK: بيزنب.

4 SB and NK: قيد.

5 SB and NK: ب٠ل.

6 SB and NK: قو.

7 SB and NK: اكهنب.

8 SB and NK: قكا.

9 SB and NK: بوح.

10 SB and NK: قب.

11 SB and NK: انبو.

12 SB and NK: قكح.

13 SB and NK: بيامو.

14 SB and NK: قكح.

15 SB and NK: ا٠و.

16 SB and NK: قله.

17 SB and NK: بيزكد.

18 SB and NK: قكد.

19 SB and NK: اكوك.

20 BL, KM, SB, DK, BN, NK and BML: يد.

21 BL, KM, SB, DK, BN, NK and BML: قكح.

22 SB and NK: قمب.

23 SB and NK: بكجب.

24 SB and NK: قك.

25 SB and NK: انبلد.

26 BL, KM, DK and BN: رد; SB and NK: قمط.

27 BL, KM, DK and BN: بمزيب; SB and NK: بكحم; not in BML.

28 SB and NK: قمو.

29 SB and NK: ا٠لد.

30 BL, KM, DK and BN: ريا; SB and NK: قنو; not in BML.

31 BL, KM, DK and BN: بنبن; SB and NK: بلديح; not in BML.

٠يوخ	ح	بلب	٠	بيالد[5]	قصج	٠يامح[4]	ريط[3]	خنج
٠محخ	رلط[10]	الحب	كو	ايطلد[9]	ريط[8]	٠يزكو[7]	ركو[6]	خند
انحكد	رد	بديو	كب	امهمح[14]	ريه[13]	٠كجد[12]	رلج[11]	خنه
٠كاى	قع	بلل	يح	بيبب[18]	ريا[17]	٠كحمب[16]	رم[15]	خنو
٠نجو	قنج	٠هند	يز	اكب[22]	رلز[21]	٠لدك[20]	رمز[19]	خنز
ببلو[30]	و[29]	بدمو[28]	٠[27]	امويو[26]	قطج[25]	٠لطخ[24]	ريد[23]	خنح

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[1] SB and NK: قمب.

[2] SB and NK: اكومح.

[3] BL, KM, DK, BN: ريح; SB and NK: قسج.

[4] BL, KM, DK, BN and BML: بنحكح; SB and NK: بلطنو.

[5] SB and NK: انجب.

[6] BL, KM, DK, BN and BML: ركه; SB and NK: قع.

[7] BL, KM, DK, BN and BML: جدو; SB and NK: بمهلد.

[8] SB and NK: قسد.

[9] SB and NK: ااب.

[10] BL, KM, SB, DK, NK and BML: رلح.

[11] BL, KM, DK, BN and BML: رلب; SB and NK: قعح..

[12] BL, KM, DK, BN and BML: جطمد; SB and NK: ٠دلب.

[13] SB and NK: قس.

[14] SB and NK: اكزيو.

[15] BL, KM, DK, BN and BML: رلط; SB and NK: قفه.

[16] BL, KM, DK, BN and BML: ريهكب; SB and NK: ٠ىى.

[17] SB and NK: قنو.

[18] SB and NK: انجم.

[19] BL, KM, DK, BN and BML: رمو; SB and NK: قصب.

[20] BL, KM, DK, BN and BML: ٠جكا; SB and NK: ٠يهمح.

[21] SB and NK: قفب.

[22] SB and NK: ااال.

[23] Not in SB and NK.

[24] Not in SB and NK.

[25] Not in SB and NK.

[26] Not in SB and NK.

[27] Not in BL, KM, SB, DK, BN, NK and BML.

[28] Not in BL, KM, SB, DK, BN, NK and BML.

[29] Not in BL, KM, SB, DK, BN, NK and BML.

[30] Not in BL, KM, SB, DK, BN, NK and BML.

فصل هشتم

در استخراج تعدیل آفتاب

حصهٔ آفتاب به اول سال بگیریم؛ و مدت یک ماه قمری[1]— و آن بیست و نه روز و پنج هزار و سیصد و شش فنک باشد و ارقامش[2] کط اکحکو و به لغت [قتا][3] آن را «شوجه» خوانند— بر او می‌افزاییم تا حصّهٔ ماه‌های [یکی بعد از دیگر][4] معلوم می‌شود؛ و هرچه حصه از مدت یک شمسی که شسه٠ملو است زیادت گردد، این مبلغ از او بکاهیم؛ آنچه بماند، حصه باشد؛[5] و اگر از میانهٔ سال حصهٔ ماهی معین خواهیم، عدد ماه‌ها که مابین اول سال و ماه مطلوب باشد، در شوجه ضرب کنیم؛ و حاصل بر حصهٔ آفتاب [به][6] اول سال افزاییم تا حصهٔ سر آن ماه حاصل شود. ما حاصل ضرب شوجه در اعداد تفاوت ضرب کرده، در جدول نهادیم تا از آنجا برمی‌گیرند.

و چون حصهٔ آفتاب معلوم شود، اگر عدد روزهای بی‌اعتبار فنک‌ها از نیمهٔ دور که آن صد و هشتاد و دو [است][7] که آن را «بیجوتن»[8] خوانند کمتر باشد، آن را از صد و هشتاد و دو بکاهیم تا

[1] BoL, BL, KM, SB, BN, NK and BML: قمری; DK: قمری اوسط.

[2] BML: این است.

[3] BL, KM, SB, DK, BN, NK and BML: قتا; BoL: خطا.

[4] BL, KM, DK, BN and BML: یکی بعد از دیگر; BoL: یکی از بعد از یکی دیگر; SB and NK: یکی بعد از دیگری.

[5] BoL and NK: و هرچه حصه از مدت یک شمسی که شسه٠ملو است زیادت گردد، این مبلغ (را) از او بکاهیم؛ آنچه بماند، حصه باشد; not in BL, KM, SB, DK, BN and BML.

[6] BL, KM, SB, DK, BN, NK, KDT and BML: به; BoL: با.

[7] Not in BoL, KM, DK, BN and NK.

[8] BL and BML: بیجوتن; BoL: تـجوتن; KM: ـحوتن; SB and NK: ـحوـن; DK and BN: ـجوتن.

تمامش بماند؛ پس حصه را در تمام حصه ضرب کنیم؛ و حاصل را مضاعف کنیم؛ و تسع مبلغ بگیریم؛ حاصل تعدیل آفتاب باشد؛ و زاید باشد و زاید را[1] «نو» خوانند.

و اگر روزهای حصه از صد و هشتاد و دو زیادت باشد، فضلش بر صد و هشتاد و دو بگیریم؛ و حصه را از ضعف صد و هشتاد و دو که تمام دور باشد، نقصان کنیم؛ و فضل را در باقی از نقصان ضرب کنیم؛ و حاصل را مضاعف کنیم؛ و تُسع مبلغ بگیریم؛ آنچه حاصل آید، تعدیل آفتاب باشد؛ و ناقص باشد و آن را «تیاوو» خوانند یعنی ناقص. و تعدیل آفتاب را «تایانکـژکی»[2] خوانند.

و ما تعدیل آفتاب را جدولی[3] نهادیم و فنک‌های مرفوع تعدیل به ازای حصه در آن جدول نهادیم تا به ازای حصهٔ سر ماه‌ها از آن جدول برمی‌گیرند.

فصل نهم

در استخراج تعدیل ماه

حصهٔ ماه به اول سال بنهیم؛ و آن را به لغت [قتا][4] «جونجونکا»[5] خوانند؛ و جهت دیگر ماه‌ها، هفده روز و هفت هزار و هفتصد و پنجاه و چهار فنک [که][6] ارقامش این ست بز بـطید و آن را

[1] Not in DK.

[2] BoL, KM, SB and NK: تایانکـژکی; BL and BML: تایانکـژِکی; BL: تایانکـزکی; DK and BN: تاـانکـژکی.

[3] KM, SB, DK, BN, NK and BML: جدولی; BoL: در جدول; BL: در جدولی.

[4] BL, KM, SB, DK, BN, NK and BML: قتا; BoL: خطا.

[5] BN, NK and BML: جونجونکا; BL: جوجونکا; KM: حوحونکا; SB: حوحوـکا; DK: جوـجوـکا.

[6] Not in BoL.

«جنجونشا»[1] خوانند، بر حصهٔ سر سال [می‌افزاییم][2] و چون حصه از رمجِ زیادت گردد، رمجِ [را] از او باید کاست، و باقی را ثبت کرد[3] تا حصهٔ سر یک [یک][4] ماه حاصل می‌شود. و ما جدولی مشتمل بر ضرب آن در هر عدد نهادیم تا آنچه به ازای عدد تفاوت [یابند]،[5] بر حصهٔ سر سال [می‌افزایند][6] تا حصهٔ سر ماه که خواهند، حاصل [می‌شود]؛[7]

و ایام حصه اگر از صد و بیست و چهار که آن را «بنجوشا»[8] خوانند، کمتر بود، آن را از صد و بیست و چهار نقصان کنیم تا تمامش بماند؛ و ایام را در تمامش ضرب کنیم؛ آنچه حاصل‌آید، تعدیل ماه باشد؛ و «نو» باشد یعنی زاید. و اگر از صد و بیست و چهار زیادت باشد، فضلش بر صد و بیست و چهار در تمامش بعد از نقصان از دویست و چهل و هشت ضرب کنیم؛ آنچه حاصل آید، تعدیل ماه باشد؛ و «تیاوو» باشد یعنی ناقص. و تعدیل ماه را «تایانک‌ژچون»[9] خوانند. و ما تعدیل ماه را جدولی نهادیم (7 الف) تا به ازای حصهٔ سر ماه‌ها از آن جدول برمی‌گیرند و جدول‌ها این است.[10]

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1 BML: جنجونشا; BoL: حنچویشا; BL: جونحونشا; KM: حونحونشا; SB and NK: حنحونشا; DK: حجونشا; BN: ححونشا.

2 BL, KM, SB, DK, BN, NK and BML: می‌افزاییم; BoL: افزاییم.

3 BoL and NK: و چون حصه از رمجِ زیادت گردد، رمجِ را از او باید کاست، و باقی را ثبت کرد; not in BL, KM, SB, DK, BN and BML.

4 Not in BoL.

5 BL, KM and BML: یابند; BoL: بمانند; SB: باشد; DK and BN: بابد; NK; باسد.

6 BL, KM, SB, DK, BN, NK and BML: می‌افزایند; BoL: می‌افزاییم.

7 BL, KM, SB, DK, BN, NK and BML: می‌شود; BoL: شود.

8 NK: بنجوشا; BoL: تنجوشا; BL, KM and DK: سنجوشا; SB: سنحوشا; BN: سجوشا; BML: بینجوشا.

9 BoL and BN: تایانک‌ژچون; BL and BML: تایانک‌ژجون; KM: تاانک‌ژجون; SB: تایانک‌رجون; DK: تایاک‌ژحون; NK: تایانک‌رُجون.

10 BoL, BL and DK: جدول‌ها این است; این است ; BN: جدول‌ها در صفحهٔ دیگر است; BML: آن جدول‌ها این است که بر ورق‌های دیگری است; not in SB and NK.

جدول تعديل آفتاب که آن را تایانکژکی می‌خوانند														
زايد		تعديل آفتاب	ناقص		زايد		تعديل آفتاب	ناقص		زايد		تعديل آفتاب	ناقص	
حصة آفتاب			حصة آفتاب		حصة آفتاب			حصة آفتاب		حصة آفتاب			حصة آفتاب	
٠	قفب	٠ ٠ ٠	قفب	شسد	ل	قنب	٠ يو نج	ريب	شلد	س	قكب	٠ كز ز	رمب	شد
ا	قفا	٠ ٠ م	قفج	شسج	لا	قنا	٠ يز ک	ريج	شلج	سا	قكا	٠ كز ک	رمج	شج
ب	قف	٠ ا ک	قفد	شسب	لب	قن	٠ يز مز	ريد	شلب	سب	قک	٠ كز لج	رمد	شب
ج	قعط	٠ ا نط	قفه	شسا	لج	قمط	٠ يح يح	ريه	شلا	سج	قيط	٠ كز مو	رمه	شا
د	قعح	٠ ب لح	قفو	شس	لد	قمح	٠ يح لح	ريو	شل	سد	قيح	٠ كز نخ	رمو	ش
ه	قعز	٠ ج يز	قفز	شنط	له	قمز	٠ يط ج	ريز	شكط	سه	قيز	٠ كح ى	رمز	رصط
و	قعو	٠ ج نه	قفح	شنح	لو	قمو	٠ يط كح	ريح	شكح	سو	قيو	٠ كح كا	رمح	رصح
ز	قعه	٠ د لب	قفط	شنز	لز	قمه	٠ يط نب	ريط	شكز	سز	قيه	٠ كح لب	رمط	رصز
ح	قعد	٠ ه ط	قص	شنو	لح	قمد	٠ ک يو	رک	شكو	سح	قيد	٠ كح مج	رن	رصو
ط	قعج	٠ ه مو	قصا	شنه	لط	قمج	٠ ک لط[1]	رکا	شكه	سط	قيج	٠ كح نج	رنا	رصه
ى	قعب	٠ و كب	قصب	شند	م	قمب	٠ كا ب[2]	رکب	شكد	ع	قيب	٠ كط ب	رنب	رصد
يا	قعا	٠ و نخ	قصج	شنج	ما	قما	٠ كا كه[3]	ركج	شكج	عا	قيا	٠ كط يا	رنج	رصج
يب	قع	٠ ز لج	قصد	شنب	مب	قم	٠ كا مز	ركد	شكب	عب	قى	٠ كط ک	رند	رصب
يج	قسط	٠ ح ح	قصه	شنا	مج	قلط	٠ كب ح	ركه	شكا	عج	قط	٠ كط كح	رنه	رصا
يد	قسح	٠ ح مج	قصو	شن	مد	قلح	٠ كب كط	ركو	شک	عد	قح	٠ كط لو	رنو	رص
يه	قسز	٠ ط يز	قصز	شمط	مه	قلز	٠ كب ن	ركز	شيط	عه	قز	٠ كط مج	رنز	رفط
يو	قسو	٠ ط ن	قصح	شمح	مو	قلو	٠ كج ى	ركح	شيح	عو	قو	٠ كط ن	رنح	رفح
يز	قسه	٠ ى كج	قصط	شمز	مز	قله	٠ كج ل	ركط	شيز	عز	قه	٠ كط نز	رنط	رفز
يح	قسد	٠ ى نو	ر	شمو	مح	قلد	٠ كج مط	رل	شيو	عح	قد	٠ ل ج	رس	رفو
يط	قسج	٠ يا كج	را	شمه	مط	قلج	٠ كد ح	رلا	شيه	عط	قج	٠ ل ح	رسا	رفه
ک	قسب	٠ يب ٠	رب	شمد	ن	قلب	٠ كد كز	رلب	شيد	ف	قب	٠ ل يج	رسب	رفد
كا	قسا	٠ يب لا	رج	شمج	نا	قلا	٠ كد مه	رلج	شيج	فا	قا	٠ ل يح	رسج	رفج
كب	قس	٠ يج ب	رد	شمب	نب	قل	٠ كه ب	رلد	شيب	فب	ق	٠ ل كب	رسد	رفب
كج	قنط	٠ يج لج	ره	شما	نج	قكط	٠ كه يط	رله	شيا	فج	صط	٠ ل كو	رسه	رفا
كد	قنح	٠ يد ج	رو	شم	ند	قكح	٠ كه لو	رلو	شى	فد	صح	٠ ل كط	رسو	رف

[1] BL, KM, SB, DK, BN, NK and BML: ٠کم.

[2] BL, KM, SB, DK, BN, NK and BML: ٠کاج.

[3] BL, KM, DK and BN: ٠کاکب.

رعط	رسز	٠ ل لب	صز	فه	شط	رلز	٠ كه نب	قكز	نه	شلط	رز	٠ يد لب	قنز	كه
رعح	رسح	٠ ل له	صو	فو	شح	رلح	٠ كو ح	قكو	نو	شلح	رح	٠ يه ا	قنو	كو
رعز	رسط	٠ ل لز	صه	فز	شز	رلط	٠ كو كج	قكه	نز	شلز	رط	٠ يه ل	قنه	كز
رعو	رع	٠ ل لح	صد	فح	شو	رم	٠ كو لح	قكد	نح	شلو	رى	٠ يه نح	قند	كح
رعه	رعا	٠ ل لط	صج	فط	شه	رما	٠ كو نج	قكج	نط	شله	ريا	٠ يو كو	قنج	كط
رعد	رعب	٠ ل م	صب	ص										
رعج	رعج	٠ ل م	صا	صا										

جدول تعديل ماه و آن را تايانكژچون خوانند

ناقص		تعديل ماه	زايد		ناقص		تعديل ماه	زايد	
حصهٔ ماه			حصهٔ ماه		حصهٔ ماه			حصهٔ ماه	
ريو	قنو	٠ مط د	صب	لب	رمح	قكد	٠ ٠ ٠	قكد	٠
ريه	قنز	٠ ن ج	صا	لج	رمز	قكه	٠ ب ج	قكج	ا
ريد	قنح	٠ نا ٠	ص	لد	رمو	قكو	٠ د د[1]	قكب	ب
ريج	قنط	٠ نا نه	فط	له	رمه	قكز	٠ و ج[2]	قكا	ج
ريب	قس	٠ نب مح	فح	لو	رمد	قكح	٠ ح ٠	قك	د
ريا	قسا	٠ نج لط	فز	لز	رمج	قكط	٠ ط نط[3]	قيط	ه
رى	قسب	٠ ند كح	فو	لح	رمب	قل	٠ يا مح	قيح	و
رط	قسج	٠ نه يه	فه	لط	رما	قلا	٠ يج لط	قيز	ز
رح	قسد	٠ نو ٠	فد	م	رم	قلب	٠ يه كح	قيو	ح
رز	قسه	٠ نو مج	فج	ما	رلط	قلج	٠ يز يه[4]	قيه	ط
رو	قسو	٠ نز كد	فب	مب	رلح	قلد	٠ يط ٠	قيد	ى
ره	قسز	٠ نح ج	فا	مج	رلز	قله	٠ كمج	قيج	يا
رد	قسح	٠ نح م	ف	مد	رلو	قلو	٠ كب كد	قيب	يب
رج	قسط	٠ نط يه	عط	مه	رله	قلز	٠كدج	قيا	يج
رب	قع	٠ نط مح	عح	مو	رلد	قلح	٠ كه م	ق	يد

1 BL, KM, SB, DK, BN, NK, and BML: ٠دب.

2 BL, KM, SB, DK, BN, NK, and BML: ٠وا.

3 BL, KM, SB, DK, BN, NK and BML: ٠طنه.

4 BL, KM, SB and NK: ٠يويه.

را	قعا	ا ٠ يط	عز	مز	رلج	قلط	٠ كز يه	قط	يه
ر	قعب	ا٠ مح	عو	مح	رلب	قم	٠ كح مح	قح	يو
قصط	قعج	اا يه	عه	مط	رلا	قما	٠ ل يط	قز	يز
قصح	قعد	اا م	عد	ن	رل	قمب	٠ لا مح	قو	يح
قصز	قعه	ا ب ج	عج	نا	ركط	قمج	٠ لج يه	قه	يط
قصو	قعو	ا ب كد	عب	نب	ركح	قمد	٠ لد م	قد	ک
قصه	قعز	ا ب مج	عا	نج	ركز	قمه	٠ لو ج	قج	كا
قصد	قعح	ا ج ٠	ع	ند	ركو	قمو	٠ لز كد[1]	قب	كب
قصج	قعط	ا ج يه	سط	نه	ركه	قمز	٠ لح مج	قا	كج
قصب	قف	ا ج كح	سح	نو	ركد	قمح	٠ م ٠	ق	كد
قصا	قفا	ا ج لط	سز	نز	ركج	قمط	٠ ما يه	صط	كه
قص	قفب	ا ج مح	سو	نح	ركب	قن	٠ مب كح	صح	كو
ققط	قفج	ا ج نه	سه	نط	ركا	قنا	٠ مج لط	صز	كز
ققح	قفد	ا د ٠	سد	س	رک	قنب	٠ مد مح	صو	كح
ققز	قفه	ا د ج	سج	سا	ريط	قنج	٠ مه نه	صه	كط
ققو	قفو	ا د د	سب	سب	ريح	قند	٠ مز ٠	صد	ل
					ريز	قنه	٠ مح ج	صج	لا

[1] DK: ٠لوكد.

تضاعیف شوجه یعنی مدت یک ماه قمری				
اعداد	روزها	فنکها		
		مرفوع مرتین	مرفوع مره	فنکها
ا	کط	ا	کح	کو
ب	نط	٠	ی	یب
ج	فح	ا	لح	لح
د	قیح	٠	ک	کد
ه	قمز	ا	مح	ن
و	قعز	٠	ل	لو
ز	رو	ا	نط	ب
ح	رلو	٠	م	نح
ط	رسه	ب	ط	ید
ی	رصه	٠	نا	٠
یا	شکد	ب	یط	کو
یب	شند	ا	ا	یب

تضاعیف جنجون یعنی سیر یک ماههٔ قمری				
اعداد	روزها	فنکها		
		مرفوع مرتین	مرفوع مره	فنکها
ا	کز	ا	لب	لو
ب	نه	٠	یح	لب
ج	فب	ا	نا	ح
د	قی	٠	لز	د
ه	قلز	ب	ط	م
و	قسه	٠	نه	لو
ز	قصب	ب	کح	یب
ح	رک	ا	ید	ح
ط	رمح	٠	٠	د

مقدار مجموع نیم‌شب یک نیم‌روز در هر ماه تقریب		
ماهها		فنکها
جقشاباط	بریکزمنج	ا نو م
آرام	اونونج	ب ٠ ٠
ایکندی	طوقسونج	ب ج ک
اوجونج	سکسینج	ب و م
تورتونج	یتینج	ب ی ٠
بیشینج	التینج	ب یج ک

تضاعیف جونجونشا یعنی سیر حصهٔ قمر در یک ماه				
اعداد	روزها	مرفوع مرتین	مرفوع مره	فنکها
ا	یز	ب	ط	ید
ب	له	ا	لا	مح
ج	نج	٠	ند	کب
د	عا	٠	یو	نو
ه	فح	ب	کو	ی
و	قو	ا	مح	مد
ز	قکد	ا	یا	یح
ح	قمب	٠	لج	نب
ط	قنط	ب	مج	و
ی	قعز	ب	ه	م
یا	قصه	ا	کح	ید

اعداد	تضاعیف فنکهای شبانروز		
ا	ب	مو	م
ب	ه	لج	ک
ج	ح	ک	٠
د	یا	و	م
ه	یج	نج	ک
و	یو	م	٠

يب	ريج	۰	ن	مح	ز	يط	كو	م
يج	رلا	۰	يج	كب	ح	كب	يج	ک
يد	رمح	ب	كب	لو	ط	كه	۰	۰

(7 با) فصل دهم

در معرفت اوایل ماه‌ها از هر سال[1] که خواهیم، و تعیین ماه شون [در سالی] که واقع باشد[2]

از حصهٔ آفتاب در اوایل ماه‌ها تعدیل او معلوم کنیم. و زاید و ناقص بدانیم. و از حصهٔ ماه در اوایل ماه‌ها تعدیل ماه نیز معلوم کنیم. و زاید و ناقص بدانیم. و هردو تعدیل اگر زاید یا ناقص باشند، جمع کنیم. و الاّ فضل یکی بر دیگری[3] بگیریم و آن را تعدیل مرکب[4] خوانیم. اگر[5] هردو زاید بوده باشند یا فضل زاید را باشد، تعدیل مرکب زاید باشد. [و اگر هردو ناقص بوده باشند یا فضل ناقص را باشد، تعدیل مرکب ناقص باشد.][6] پس مدخل آرام به حسب امر اوسط در اول [سال][7] بگیریم؛ و مقدار یک ماه که بیست و نه روز و پنج هزار و سیصد و شش فنک است و ارقامش یطاكحكو یعنی «شوجه»، بر مدخل [آرام می‌افزاییم؛ و هرچه ایام از شصت زیادت باشد، شصت می‌افکنیم تا

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[1] BoL, BL, SB, BN, NK and BML: سال; KM and DK: سالی.

[2] BL, DK and BN: ماه شون در سال که واقع باشد; SB and KR: ماه شون در سالی که واقع شود; KM: ماه شون که واقع باشد; BoL: ماه شون در سالی که واقع باشد; BML: ماه شون که واقع باشد در سال.

[3] BoL, SB, DK and NK: دیگری; BL, KM, BN and BML: دیگر.

[4] BoL, KM, SB, DK, BN, NK and BML; مرکب; BL: مرکت.

[5] BoL, KM, SB, DK, BN, NK and BML: اگر; BL: پس اگر.

[6] BL, KM, DK, BN, NK and BML: اگر هردو زاید بوده باشند یا فضل زاید را باشد، تعدیل مرکب زاید باشد. و اگر هردو ناقص بوده باشند یا فضل ناقص را باشد، تعدیل مرکب ناقص باشد; SB: اگر هردو زاید بوده باشند یا فضل زاید را باشد، تعدیل مرکب تاقص باشد; BoL: اگر هر دو زاید بوده باشند یا فضل ناقص را باشد، تعدیل مرکب زاید باشد.

[7] BL, KM, SB, DK, BN, NK and BML: سال; not in BoL.

مدخل][1] هر ماهی به حسب امر اوسط حاصل می‌شود؛ [پس][2] تعدیل مرکب اگر زاید باشد، در اول هرماهی بر مدخل آن ماه می‌افزاییم؛ و اگر ناقص باشد، می‌کاهیم تا مدخل هرماه به تحقیق معلوم می‌شود؛ و فنک‌ها را اگر از مقدار نیم شب و یک روز کمتر باشد، آن را یکی می‌گیریم؛ و بر روزها می‌افزاییم؛ و اگر زیادت باشد، آن را دو می‌گیریم؛ و بر روزها می‌افزاییم. پس حاصل را در جدول [دور][3] ستینی می‌آوریم[4] تا مدخل هرماه از آن دور معلوم می‌شود؛ و از مدخل هر ماه و مدخل ماهی که بعد از او باشد، معلوم شود که ماه اول سی روز باشد یا بیست و نه روز؛ و باید که زیادت از دو ماه متوالی بیست و نه نگیرند، و زیادت از سه ماه متوالی سی نگیرند. پس مدخل اقسام سال شمسی [را][5] که واقع باشد در هر ماه، اعتبار می‌کنند؛ اگر سال شون باشد که سیزده ماه در وی افتاد، هر ماه که مدخل یک قسم از اقسام سال شمسی تنها در وی افتاد، ماه[6] شون باشد؛ و هر ماه که مدخل دو قسم در وی افتاد، شون نباشد.

و ما از جهت مثال ماه‌های سال دهم از دور شانک‌ون که آن سال کوی‌یو باشد و به ترکی داقوق ییل و به حساب فارسی[7] سال ششصد و چهل و دوم یزدجردی باشد،[1] استخراج کردیم. و این عمل‌ها به تفصیل در این جدول نهادیم تا بر آن قیاس می‌کنند. و آن جدول این است.

[1] BL, KM, SB, BN, NK and BML: آرام می‌افزاییم؛ و هرچه ایام از شصت زیادت باشد، شصت می‌افکنیم تا مدخل; DK: آرام می‌افزاییم؛ و هرچه ایام از شصت زیادت شود، شصت می‌افکنیم تا مدخل; not in BoL.

[2] Not in BoL.

[3] Not in BoL.

[4] BoL, BL, KM, SB, DK, NK and BML: می‌آوریم; BN: می‌آریم.

[5] Not in BoL.

[6] BoL and SB: ماه; BL, KM, DK, BN, KR and BML: آن ماه.

[7] BoL and SB: فارسی; BL, KM and DK: ـارسی; BN: پارسی; NK and BML: بارسی.

جدول تقویم سال دهم که آن کوی‌یو باشد که داقوق ییل است موفق خمب یزدجردی که به جهت مثال نهاده شد[2]

شهور	حصهٔ شمس		تعدیل الشمس	حصهٔ قمر		تعدیل قمر	تعدیل مرکز
آرام	لز	٠ یج کو	یط نب	سط	ا ط مح[3]	ا ج یه	ا کج ز[4]
ایکندی	سو	ا مو نب	کح کا	فز	٠ لب کب[5]	٠ نج نط[6]	ا کب ک[7]
اوجنج	صو	٠ کح لح	ل له[8]	قد	ب ما لو[9]	٠ لد م	ا ه یه[10]
تورتونج	قکه	ا نز د	کو کج	قکب	ب د ی[11]	٠ د د[12]	٠ ل کز[13]
بیشینج	قنه	٠ لح ن	یه ل	قم	ا کو مد[14]	٠ کح مح	٠ یج یح
التینج	قفد	ب ز یو	ا ک	قنح	٠ مط یح[15]	٠ نا ٠	٠ نب ک
شون	رید	٠ مط ب	یز مز	قعو	٠ یا نب[16]	ا ب کد	ا ک یا
یتینج	رمج	ب یز کح	کز ک	قصج[17]	ب کا و[18]	ا ج یه[19]	ا ل له[1]

1 Not in BL.

2 BN: جدول سال تقویم سال دهم که آن کوی‌یو باشد که داقوق ییل است موفق خمب یزدجردی که به جهت مثال نهاده شد.

3 SB and DK: اه‌مح.

4 BL, KM, SB, DK and BML: اکجو.

5 BL, KM, SB and DK: ٠کج‌کب.

6 SB, DK and BML: ٠نج‌لد; BN: ٠نج‌لط.

7 BL, KM, SB, DK, BN and BML: اکب٠.

8 BL, KM, SB, DK and BML: لنج.

9 BL, KM, SB and DK: بلزلو.

10 BL, KM, SB, DK, BN and BML: اه‌لج.

11 BL: ب٠ط; SB and DK: ب٠ی.

12 BL and KM: ٠دی; SB: ٠ود; DK: ٠وی; BN and BML: ٠دب.

13 BL: ٠لب‌کز; KM: ٠لدکز; SB, DK and BN: ٠کب‌کز.

14 BL, KM, SB and DK: اکب‌مد.

15 BL, KM, SB and DK: ٠مه‌یح.

16 BL, KM, SB and DK: ٠زنب.

17 BL, KM and SB: قصد.

18 BL, KM, SB and DK: بیزو.

19 BL, KM, SB, DK and BN: اج٠.

سكسينج	رعج	٠ نط يد	ل م[2]	ريا[3]	ا مج م[4]	٠ نج لط[5]	ا كد يط[6]
طوقسونج	شب	ب كز م	كز لج	ركط[7]	ا و يد[8]	٠ لج يه[9]	ا ٠ مح[10]
اونونج	شلب	ا ط كو[11]	يز مز	رمز	٠ كج مح[12]	٠ ب ج	٠ يط ن[13]
بريكزمنج	شسا	ب لز نب	ا نط	يو	ب لح ب[14]	٠ كح مح[15]	٠ كو مط[16]
جقشاباط	كو	٠ لط ب	يه ا	لد	ب ٠ لو[17]	٠ نا ٠[18]	ا و ا
آرام	نه	ب ز كح	كه نب	نب	ا كج ى[19]	ا ب كد	ا كح يو[20]

[1] BL, KM, SB, DK and BN: الک.

[2] BL, KM, SB, DK and BN: لح.

[3] BL, KM and SB: ريب.

[4] BL, KM and DK: الطم; SB: اطم.

[5] BL, KM; SB, DK and BN: ٠نبمح.

[6] BL, KM, SB, DK and BN: اكجكو.

[7] SB and DK: ركح.

[8] BL, KM, SB and DK: ابيد.

[9] BL, KM, SB, DK and BN: ٠لامح.

[10] BL, KM, SB, DK and BN: ٠نطكا.

[11] BML: اەكو.

[12] BL, KM and SB: ٠كدمح; DK: ٠كحمد.

[13] DK: ٠يطنا.

[14] BL, KM, SB, DK and BML: ٠طنو; BN: ٠ى٠.

[15] BL, KM, SB, BN and BML: ٠ليط.

[16] BL, KM, SB, DK, BN and BML: ٠كحک.

[17] BL, KM, SB, DK and BML: بيطى; BN: بيطمد.

[18] SB: ٠ناو.

[19] BL, KM, DK, BN and BML: امامد.

[20] SB: ابكد; BML اكحو.

شهور	مدخل شهور به حسب امر اوسط		مدخل شهور حقیقی		اعداد ایام شهور	اسامی مدخل	آنچه مقادیر سال شمسی در هر ماه واقع باشد			
آرام	ن	ا ح نه	ن	ب لب ب[1]	کط	یی‌ماو	ح	ژم‌سو	کج[2]	ووچیو[3]
ایکندی	یط	ب لز کا	ک	ا یج ا[4]	ل	کاشن	ی	کوی‌صز	که	ووشن
اوجنج	مط	ا یط ز	مط	ب کد کب[5]	کط	کایم	ی	کوی‌خایی	کو	کی‌ماو
تورتونج	یط	٠ ٠ نج	یط	٠ لا ک[6]	کط	کوی‌وی	یب	کاوو	کز	کی‌یوو
بیشینج	مح	ا کط یط[7]	مح	ا یو ا[8]	ل	ژم‌ژه	یج	کاژه	کح	کی‌ماو
التینج	یح	٠ یا ه	یز	ب ه که	کط	ژم‌وو	ید	یی‌وی	کط	کی‌سو
شون	مز	ا لط لا[9]	مز	٠ یط ک[10]	کط	سن‌خایی	یه	یی‌چیو		
یتینج	یز	٠ کا یز	یو	ا لز کب[11]	ل	کن‌چن	ا	کن‌چن	یز	پین‌شن
سکسینج	مو	ا مط مج	مو	٠ که کد[12]	ل	کن‌سو	ب	سن‌خایی	یز	پین‌یم
طوقسونج	یو	٠ لا کط	یه	ب یز کا[13]	کط	کن‌چن	ب	سن‌صز	یز	پین‌شن
اونونج	مه	ا نط نه	مه	ا م ه	ل	کی‌یوو	د	ژم‌ژه	یط	تین‌ماو
بریکزمنج	یه	٠ ما ما	یه	ا ح ل[14]	ل	کی‌ماو	د	ژم‌وو	یط	تین‌یوو
جقشاباط	مد	ب ی ز[15]	مه	٠ کط مح[16]	ل	کی‌یوو	د	ژم‌ژه	ک	ووچن
آرام	ید	٠ نا نج	ید	ب ک ط		کی‌ماو				

[1] BL, KM, SB, DK and BML: بلبا.

[2] BL, KM, SB, DK, BN and BML: کد.

[3] BL, KM, SB, DK, NK and BML: وویم.

[4] BL, SB, DK, BN and BML: ایبما; KM: انبما.

[5] BL, KM, SB, DK, BN and BML: بکدم.

[6] BL, KM, SB, DK and BN: ٠لجک.

[7] SB: اکطیو.

[8] SB, DK and BN: امبلز.

[9] SB and DK: اکطلا.

[10] SB and DK: ٠طک.

[11] BL, KM, SB, DK and BN: الزلو.

[12] BL, KM, SB, DK and BN: ٠کویز.

[13] BL, KM, SB, DK and BN: بیحمح.

[14] BL, KM, SB, DK, BN and BML: ای‌ا.

[15] BL, KM, SB, DK and BML: بی‌د.

[16] BL, KM, SB, DK and BML: ٠کطل.

(8 الف) فصل یازدهم

در معرفت دور چهارم

اهل [قتا][1] [را][2] دوری دیگر است که در اختیار روزها برآن اعتماد می‌کنند. و آن دور هم بردوازده می‌گردد. و نام‌های آن دوازده این است: اِ کِن[3] بِ چُو[4] جِ مَن دِ پِن[5] هِ تِن وِ چِه[6] زِ پُو[7] حِ وِی طِ چِن[8] یِ شیو یاِ خایِ یبِ پِی.[9] از این جمله، چهار عدد «خِی»[10] باشد یعنی سیاه. و آن مایل باشد به تباهی، و آن کن و من و پن و شیو باشد. و چهار «خُونک»[11] باشد یعنی زرد. و آن مایل به نیکی باشد، و آن چو و تن و چه و وی باشد. و دو «پَه»[12] باشد یعنی سفید[13]. و آن به غایت نیک باشد، و آن چن و خایِ باشد. و دو «هُون» باشد یعنی به غایت تباه،[14] و آن پو و پِی باشد. و روزهای اقسام سال شمسی بر همان ترتیب که به اول[15] گفتیم، [می‌شمرند].[16] و چون[17] نوبت به اقسام طاق

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[1] KM, SB, DK, BN, NK and BML: قتا; BoL and BL: خطاء.

[2] Not in BoL.

[3] BL and KM: کِن; BN and BoL: کَن; SB, DK, NK and BML: کن.

[4] BL and KM: چُو; SB and NK: چو; BoL and DK جو; BN and BML: جیو.

[5] BL, BN and BML: پِن; SB: پن; KM: بِن; BoL, DK and NK : بن.

[6] BL, KM, NK and BML: چِه; BoL, SB: چه; DK and BN: جه.

[7] BL, KM, NK and BML: پُو; BoL and SB: پو; DK: بو; BN: پوو.

[8] BL: چِن; BoL, SB and NK: چن; KM, BN and BML: جِن; DK: حن..

[9] SB, BN, NK and BML: پِی; BoL: پو; BL: بِی; KM and DK: ی.

[10] BL and KM: خِی; BoL, SB, DK, BN and BML: خی; NK: خَی.

[11] BL and KM: خُونک; BoL: حیزک; SB, BN, NK and BML: خونک; DK: خوک.

[12] BL: پَه; BoL, SB, DK, BN, NK and BML: په; KM: پُه;

[13] BoL: سفید; BL, SB and KR: سبید; KM, DK and DK: سید; BML: سپید.

[14] BoL, BL, KM, SB and NK: یعنی به غایت تباه; DK: یعنی اغبر. و آن به غایت تباه باشد; BN and BML: یعنی به غایت تباه است.

[15] BoL, KM, SB, DK, BN, KR and BML: به اول; BL: اول.

[16] KM, SB and DK: می‌شمرند; BoL, BL, BN, NK and BML: می‌شمارند.

[17] BL, KM, SB, DK, BN, NK and BML: و چون; BoL: و آن چون.

رسد مانند لیجن که اول است، و کنجه که سوم[1] است، و سینک مینک که پنجم است، روز مبدأی آن قسم و روز مقدم بر آن قسم هر دو را یکی [شمرند][2]: یعنی آنچه در روز مقدم نوبت به او رسیده باشد، در روز مبدأی قسم مکرر [شود].[3] باقی بر ترتیب باشد.

و ما آنچه در اوایل سال‌های دو دور[4] از اول دور شانک‌ون نوبت به آن رسیده باشد، یاد کنیم تا از آنجا بر ترتیب می‌شمارند. و برابر هر سال آنچه نوبت به او رسیده باشد روز اول لیجن نهادیم. و هر سال که بعد از آن باشد، در ششم آن نام روز نوبت به او رسید. و اگر سال کبیسه باشد، در هفتم نوبت به او رسید. و سال‌های کبیسه را علامت «ک»[5] در برابر نهادیم. و بر این قیاس باید کرد.

[1] BoL, BL, KM, BN and BML: سوم: SB, DK and KR: سیم.

[2] BL, KM, SB, DK, BN and KR: شمرند; BoL: می‌شمارند; BML: می‌شمرند.

[3] BL, KM, SB, DK, BN, KR and BML: شود; BoL: می‌شود.

[4] BoL, BL, KM, SB, DK, KR and BML: دو دور; BN: در دو دور.

[5] Not in BN.

سالها که کبیسه	نوبت اول سال دور	سالهای ترکی	سالهای یزدجردی	سالها که کبیسه افتد	نوبت اول سال دور لیجن	سالهای ترکی	سالهای یزدجردی
ک[3]	چه[2]	اوط	خمو	ک[1]	شیو	کسکو	خلج
[5]	پی	بارس	خمز	[4]	پن	اوط	خلد
[6]	تن	طاوشقن	خمح		چن	بارس	خله
	شیو	لو	خمط		چو	طاوشقن	خلو
ک	من	ییلان	خن	[7]	پو	لو	خلز
	چن	یوند	خنا	ک[8]	پی	ییلان	خلح
	چو	قوی	خنب	[10]	چه[9]	یوند	خلط
[11]	پو	بیچین	خنج		خاپی	قوی	خم
ک[14]	پی[13]	داقوق	خند		پن[12]	بیچین	خما
	چه	ایت	خنه	ک[15]	چن	داقوق	خمب
[17]	خاپی	طونغوز	خنو	[16]	من	ایت	خمج
	پن	کسکو	خنز		وی	طونغوز	خمد
				[18]	کن	کسکو	خمه

[1] Not in DK and BN.

[2] BL: پی.

[3] Not in SB and BN.

[4] DK: کبیسه; BN: ک.

[5] BN: کبیسه.

[6] SB: کبیسه.

[7] BN: ک.

[8] Not in BN.

[9] KM: چن.

[10] BN: ک.

[11] BN: ک.

[12] SB: تن.

[13] BL: من.

[14] Not in BN.

[15] Not in SB.

[16] SB: کبیسه.

[17] BN: ک.

[18] BN: ک.

فصل دوازدهم

در معرفت تاریخ قتایی[1] از تاریخ عربی

چون نزدیک منجمان ما تاریخ هجری مشهورتر است، از اول عهد جنکز[2] خان تا مدت صد سال، سال‌ها و ماه‌های هجری در جدول نهادیم. سال از جانب راست، و ماه‌ها بر سر جدول، و ماه‌های مغولی در میان جدول به رقوم، و نام سال ترکی گشاده، و شون گشاده، و بر بالای جدول مدخل ماه عربی، و در شصت مدخل ماه [قتایی]،[3] و عدد روزهای ماه.[4] و جدول این ست که در صفحهٔ دیگر است.[5]

[1] BL, KM, BL, KM, SB, DK, BN, NK and BML: قتایی; BoL: ختایی.

[2] BoL: جنکز; BL and BN: حنکر; KM: حنکز; SB: حکر; DK: حکر; NK: جنکز; BML: جنکیز.

[3] BL, KM, SB, DK, BN, NK and BML: قتایی; BoL: خطایی.

[4] و عدد روزهای ماه; not in KM.

[5] BoL and BL: که در صفحهٔ دیگر است ; BML: که بر صفحات ورق‌های دیگر است; not in KM, SB, DK, BN and NK.

Appendix: Chinese Technical Terms

Here, the Persian transcriptions of the Chinese terms are listed in arphabetical order, along with the Chinese characters and meanings.

Banjūshā: ban zhou-xian 半周限 (puɜan tʂiau-hian), the parts of the half-cycle, or 124. The cycle of an anomalistic month is divided into 248 parts in this calendar, so that the half-cycle consists of 124 parts (section 9).

Baylū: bai-lu 白露 (pai-lu), the fifteenth solar division (section 3).

Bījūtin: ban zhou-tian 半周天 (puɜan tʂiau-thiɛn), or the Celestial Half-Circle. The approximate half-period of the solar anomaly, 182 days (section 8).

Chih: zhi 執 (tʂi), the sixth of the twelve-presage cycle (section 11).

Chin: chen 辰 (tʂhian), the fifth terrestrial branch (section 1).

Chin: cheng 成 (tʂiaŋ), the ninth of the twelve-presage cycle (section 11).

Chīu: chou 丑 (tʂhiau), the second terrestrial branch (section 1).

Chīu-Shū: chu-shu 處暑 (tʂhiu-ʂiu), the fourteenth solar division (section 3).

Chū: chu 除 (tʂhiu), the second of the twelve-presage cycle (section 11).

Dāy-Khan: da-han 大寒 (tai-han), the twenty-fourth solar division (section 3).

Dāy-Shih: da-xue 大雪 (tai-siuɛ), the twenty-first solar division (section 3).

Dāy-Shū: da-shu 大暑 (tai-ʂiu), the twelfth solar division (section 3).

Dūnjin: dong-zhi 冬至 (tuŋ-tʂɪ), the twenty-second solar division (section 3).

Funk: fen 分 (fuan), a ten-thousandth of a day (section 1).

Jūnjā: zhuan-chai 轉差 (tʂiuɛn-tʂha) means the excess of a solar year over thirteen anomalistic months, 7.0338 days (section 7).

Junjūn: zhuan-zhong 轉終 (tʂiuɛn-tʂiuŋ) literally means the Revolution Terminal Constant, i.e., an anomalistic month (section 7).

Jūnjūnkā: zhuan-zhong ying 轉終應 (tʂiuɛn-tʂiuŋ iaŋ), the time from the beginning of the last anomalistic month preceding the *wūshī* to the *wūshī* itself. The value is 78.3948 days in the epoch year (section 7).

Junjūnshā: zhuan-zhong chai 轉終差 (tʂiuɛn-tʂiuŋ tʂha) means nine times the excess of a lunar month over an anomalistic month (27.5556 days, in this case), i.e., 17.7754 days (section 9).

Jūnk-Wan: zhong-yuan 中元 (tʂiuŋ-iuɛn), the Middle Epoch, the middle of the three sixty-year cycles (section 4).

Kā: jia 甲 (kia), the first heavenly stem (section 2).

Khā'ī: hai 亥 (hai), the twelfth terrestrial branch (section 1).

Khā'ī: kai 開 (khai), the eleventh of the twelve-presage cycle (section 11).

Khanlū: han-lu 寒露 (han-lu), the seventeenth solar division (section 3).

Khā-Wan: xia-yuan 下元 (hia-iuɛn), the Inferior Epoch, the last of the three sixty-year cycles (section 4).

Kī: ji 己 (ki), the sixth heavenly stem (section 2).

Kih: ke 刻 (khiai), a unit of time equal to one eighth of a *chāgh*, a double-hour (section 1).

Kīja: qi-ce 氣策 (khi-tʂhai), the length of the twenty-four equal divisions of a solar year, each 15.21848333... days long (section 3).

Kījā: qi-chai 氣差 (khi-tʂha) is the interval between the twenty-second solar division (the winter solstice) and the *wūshī*, namely one-sixth of a solar year, is 60.8740 days (section 7).

Kījū: qi-shou 氣首 (khi-ʂiau) denotes the beginning of the first division of any solar year (section 5).

Kin: geng 庚 (kiaŋ), the seventh heavenly stem (section 2).

Kin: jian 建 (kiɛn), the first of the twelve-presage cycle (section 11).

Kin-Jih: jing-zhe 驚蟄 (kiŋ-tʂi), the third solar division (section 3).

Kūwū: gu-yu 穀雨 (ku-iu), the sixth solar division (section 3).

Kūy: gui 癸 (kui), the tenth heavenly stem (section 2).

Lījun: li-chun 立春 (li-tʂhiuan), the first solar division (section 3).

Lījū'u: li-qiu 立秋 (li-tshiau), the thirteenth solar division (section 3).

Līkha: li-xia 立夏 (li-hia), the seventh solar division (section 3).

Lītūn: li-dong 立冬 (li-tuŋ), the nineteenth solar division (section 3).

Māh-i Shūn: a combination of the Persian term *māh* with Chinese *run* 閏 (ɽiuan), which means an intercalary month (section 6).

Man: man 滿 (muɜn), the third of the twelve-presage cycle (section 11).

Manjun: mang-zhong 芒種 (muaŋ-tʂiuŋ), the ninth solar division (section 3).

Māu: mao 卯 (mau), the forth terrestrial branch (section 1).

Nū: nu 朒 is used for the slow phase of the luminaries. Here, it means "additive," as applied to the solar and lunar equations (section 8).

Pī: bi 閉 (pi), the twelfth of the twelve-presage cycle (section 11).

Pīn: bing 丙 (piaŋ), the third heavenly stem (section 2).

Pin: ping 平 (phiaŋ), the fourth of the twelve-presage cycle (section 11).

Pū: po 破 (phuɜ), the seventh of the twelve-presage cycle (section 11).

Shājir: xia-zhi 夏至 (hia-tʂɿ), the tenth solar division (section 3).

Shānk-Wan: shang-yuan 上元 (ʐǐaŋ-iuɛn), the Superior Epoch, the first of the three sixty-year cycles (section 4).

Shin: shen 申 (ʂian), the ninth terrestrial branch (section 1).

Shīnk-Mīnk: qing-ming 清明 (tshiaŋ-miaŋ), the fifth solar division (section 3).

Shīu: shou 收 (ʂiau), the tenth of the twelve-presage cycle (section 11).

Shūja: shuo-ce 朔策 (ʂau-tʂhai), a mean synodic month, 29.5306 days (section 6).

Shūn-Fūnd: chun-fun 春分 (tʂhiuan-fuan), the fourth solar division (section 3).

Shūnjan: run-ying 閏應 (ɽiuan-iaŋ) represents the interval from the mean first month (*ārām ay*) to the *wūshī* for any particular year (section 6).

Shūn-Kūn: shuang-jiang 霜降 (ʂaŋ-kiaŋ), the eighteenth solar division (section 3).

Sin: xin 辛 (sian), the eighth heavenly stem (section 2).

Siyāu-Shih: xiao-xue 小雪 (siau-siuɛ), the twentieth solar division (section 3).

Siyāu-Shū: xiao-shu 小暑(siau-ʂiu), the eleventh solar division (section 3).

Siyū-Fan: qiu-fun 秋分 (tshiau-fuan), the sixthteenth solar division (section 3).

Siyū-Khan: xiao-han 小寒 (siau-han), the twenty-third solar division (section 3).

Siyū-Man: xiao-man 小滿 (siau-muan), the eighth solar division (section 3).

Ṣiz: si 巳 (sï), the sixth terrestrial branch (section 1).

Sū: xu 戌 (ʂiu), the eleventh terrestrial branch (section 1).

Suijā: sui-chai 歲差 (sui-tʂha) denotes the difference between the solar year and twelve mean lunar months, 10.8764 days (section 6).

Suijū: sui-zhou 歲周 (sui-tʂiau), the length of a solar year, taken as 365.2436 days (section 3).

Suiyū: sui-yu 歲餘 (sui-iu) indicates the excess of a solar year over 360, specifically 5.2436 days (section 5).

Tāyānk-Zhichūn: tai-yin ru-zhuan 太陰入轉 (thai-iam ɽi-tʂiuɛn) is the lunar equation (section 9).

Tāyānk-Zhikī: tai-yang ru-qi 太陽入氣 (thai-iaŋ ɽi-khi) is the solar equation (section 8).

Tīn: ding 丁 (tiaŋ), the fourth heavenly stem (section 2).

Tin: ding 定 (tiaŋ), the fifth of the twelve-presage cycle (section 11).

Tiyā'ū: tiao 朓 is used for the fast phase of the luminaries. Here, it means "subtractive," as applied to the solar and lunar equations (section 8).

Wī: wei 未 (vui), the eighth terrestrial branch (section 1).

Wī: wei 危 (ui), the eighth of the twelve-presage cycle (section 11).

Wū: wu 午 (u), the seventh terrestrial branch (section 1).

Wū: wu 戊 (vu), the fifth heavenly stem (section 2).

Wūshī: yu-sui 雨水 (iu-ʂui), the second solar division (section 3).

Yī: yi 乙 (i), the second heavenly stem (section 2).

Yim: yin 寅 (ian), the third terrestrial branch (section 1).

Yū'u: you 酉 (iau), the tenth terrestrial branch (section 1).

Zhih: zi 子 (tsï), the first terrestrial branch (section 1).

Zhim: ren 壬 (ɽiam), the ninth heavenly stem (section 2).

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