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BOOK REVIEWS

R N Iyengar — ***Parāśaratantra: Ancient Sanskrit Text on Astronomy and Natural Sciences,*** Jain University press, Jakkasandra Post, Kanakpura Taluk, Ramanagara District, Bangaluru, 562112 email: ju.publications@jainuniversity.ac.in, pages xix+279; price: Rs.750/ ISBN 9788192099248 First published 2013

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In the History of Saṃskṛta Manuscriptology, some reconstructed works like *Kātyāyana-smṛtisāroddhāra* (ed. P.V. Kane), *Bṛhaspatismṛti*, (ed. Rangaswami Iyengar and others) *Bhāgavṛtti-saṅkalana* (ed. Pt. Yudhishthir Mimamsak), depending on quotations are well known.

Now we have *Parāśaratantra* (here after PT) ed. by Sri R.N. Iyengar of the same genre depending on the quotations from Parāśara's work available in three works: Ballālasena's *Adbhutasāgara*, Utpala's commentary on *Bṛhatsaṃhitā* and Bhāskarayogin's commentary namely *Utpala-parimala* on the same.

Sri Iyengar has meticulously arranged all the available quotations according to the subjects, given full translation and added notes with remarks wherever required. According to the *purovāk* of S.Y.Wakankar, it appears that the readings available in the quotations are *keuṣcit sthaleṣu truṭitāni vigalitapāṭhāni pratibhānti* (in some places broken, while in other places, the text is missing). In spite of this hopeless condition, Sri Iyengar has ventured to introduce the readers the Astronomer Parāśara. This kind of Herculean task demands not only patience and command over the subject but also deep insight.

In the Introduction of PT, all the references of Parāśara are shown. We are informed that some works like *Bṛhat-parāśara- horāśāstra* are written by different authors bearing the name Parāśara.

PT is in prose except a few places of some verses. The style is very clear, always to the point and free from unnecessary ambiguity or jargon.

PT is classified into twenty one chapters. In the first chapter named *Upanayanādhyāya*. Kauśika approaches the sage Parāśara and asks questions like ''we are told that there are twelve Suns in the sky, but only one Sun is seen. How it is possible? How the creation of the seasons starts from the Sun'' etc.. First, the human beings were very powerful. But gradually their power got decreased. (As a result the creation got destroyed) Then the lord Nārāyaṇa got split himself in to 12 Ādityas. As a result, the world came into existence once again. Savitṛ became abode place of all the Ādityas. Next the legends of births of Āditya, Soma, Aṅgāraka, Budha, Bṛhaspati, Bhārgava, Śanaiścara, Saiṃhikeya and Ketu are narrated. Sri Iyengar extracts the meanings skillfully of the legends. For example, he sees reference of falling meteorites in the legend of connection of Mars with the Earth.

When I read that Śanaiścara was from Ravi and Chāyā and Saiṃhikeya is from offspring of Prajāpati and Siṃhikā, I remembered a legend in *Rāmāyaṇa* : Sihikā drags Hanūmat by getting hold of his *Chāyā* (shadow) (albeit it does not have direct connection to what PT says). Hanūmat is related to the Sun, as he is disciple of Sun according to *Uttarakāṇḍa*. Sun is directly related to Garuḍa, as Garuḍa's eldest brother Aruṇa is charioteer of the Sun. This Garuḍa meets Śrīrāma to release him from the bondage of Nāgapāśa. According to the traditional belief, Nārāyaṇa dwells in the orb of Sun. (*dhyeyaḥ sadā savitṛmaṇḍala- madhyavarttī nārāyaṇa sarasijāsana-sanniviṣṭaḥ*). I think anyhow these believes are remotely related.

The interesting and well known story of sage Agastya's moving towards the south is interpreted in this way: Canopus (=Agastya) rises in south and not east.

Second chapter is *Sāṃvatsarasūtrādhyāya* is of measures of time. Here, Sri Iyengar follows *Bṛhat-saṃhitā* closely in arrangement. He could have placed the portion of eligibility of Daivajña in the first chapter itself. (*yathā mantramukho'gniḥ, agnimukhā devāstathā daivajñamukho rājā, rājamukhāśca prajāḥ* etc.) According to Parāśara (as quoted by Ballālasena), in the solar year, growth of a weed namely Śaṅkarasūnu will be excessive. This is very interesting. Sri Iyengar could have given some notes on this particular point.

According to the chapter *Āditya-cāra*, the duration of *tu*s is decided by stars and not mere weather (Table is given). Another important observation of PT is on variations in colours of the orb of Sun. The long passage narrating the same starts with words *śiśire tāmraḥ kapilo vā*. Most probably in the days of PT people always watch the celestial bodies with wonder and ever increasing curiosity. Drought of 12 years is indicated by *Mayūra-candrikā* colour in orb of Sun according to PT. Sri Iyengar translations this word by Peacock blue colour. Can't we take this as bluish white? 12 years of drought is well known incident recorded by even Jains. Whether they came to the same conclusion, (when the orb of Sun becomes bluish white in colour, 12 years of drought occurs) one has to see. It is very curious thing to know that our forefathers had keen eyesight to observe even the slightest difference in brightness and colour shades of the Sun. Their proclaiming the effect of colour- difference is in most cases, depends on belief. Author of PT documents effects of the Sun's orb not having any shade of hue (*vivaraṇa*).

I remembered Bāṇa's (7th Cent.) describing a flower blossom in the words *kṛttikā-tārā-stabakānukāriṇī* (imitating cluster of *kṛttikā*-stars) in his *Kādambarī* while reading this chapter.

In the *Candra-cāra* chapter the effects of eclipses (caused by various celestial bodies particularly *grahas*) and various movements of Candra are shown. Comparatively it is very simple. It appears that since observation of orb of Moon does not give any trouble, like seeing the Sun, the Daivajñas like Parāśara did not experience much difficulty in finding link between the geographical incidents and movement of Moon. Immediately I remembered a *śloka*: *apratyakṣāṇi śāstrāṇi vivādāsteṣu kevalam / pratyakcaṃ jyauticaṃ śāstra candrārkau yatra sākṣiṇau //* (All the other scriptures depend on the things that are not in the scope of perception. But the Astronomy alone depends on the things that can be perceived by our sense organs where the witnesses are the Sun and the Moon.

Variegated colours of the orb of Moon during eclipses are expressed by the names like *kṛṣṇa-kapota*, *pāṃśu-dhūmalohita*, *bālārkāṃśu-kapila, hāridra, dūrvākura and pāṭalakusuma*. Mentioning of the subtle differences is really great.

We are told that usually the daivajñas mention only occurrence of four colours during eclipse but PT mentions six.

PT mentions five movements of Mars. Even though one can argue here that anybody who is specialist in anything knows some subtle truths of that particular field. But it is not so easy regarding movements of celestial bodies. We will be wonder struck when we will compare the diagram prepared by NASA (shown in page no.103) with the names like *vyālamukha*, *nistriṃśa-muśala* given to these movements of Mars by PT.

The calculation of Visibility days of Mercury shown in PT is not correct according to Utpala. Utpala's remark shows that our *daivjñas* were always for new findings. But PT's observation is realistic, according to the learned Professor.

Since there is no trace of mentioning of the great red mark of Jupiter in PT, it is obvious that this mark was not visible in the days of PT. The adjective *śvetaraktapītavarṇa* in a passage does not focus on Red mark albeit the word *rakta* is there.

In page 115 mentioning invaders may be of some interest to the historians:

ahaḥ sarvaṃ yadā śukro dśyate'tha
mahāgrahaḥ |
tad' 'nvāgantubhir grāmā bādhyante nagarāi ca ||

anvāgantṛ is the word for invaders.

In the introductory paragraph (written in both Saṃskṛta and English) of the chapter *Ketucāra*, the learned editor informs that since some divergent views are obvious in Parāśara and BS (seen in the quotations of Utpala), he has preferred Ballālasena's quotations .

The number of Ketus is 101 according to PT. It is obvious that the Nomenclature of classifications like *Mṛtyu-niḥśvāsaja*, *vibhāvasuja* etc depend on either their effects on earth or their colour or form.

PT documents not only *Nakṣatra-cakra* but also *ketucakra* (periodical occurrences of star and comets).

In page 149, Indus seals are shown to confirm three headed celestial object. The second figure appears to me as an Octopus!

There is a belief in our country that when Canopus rises, water will be very pure everywhere on earth. But no such reference I saw in PT. It appears the portion which mentions this belief is not available in the quotations.

One may marvelled to observe that PT clearly says that some stars made of two, some are really clusters of six etc. Their keen eyesight was wonderful. Rohiṇī is made up of five stars, Mṛgaśiras three, Punarvasu two etc.. Even single stars they detected. For example ārdrā is single star.

Our wonder gets increased when we read the concept *Grahayuddha* in the form of breaking, climbing, grazing and confluence of rays.

When I read the sentence *vāyv-abhra-vidyut-stanayitnu- varṣāi meghāḥ* (p.211), I remembered this famous line from Meghadūta: *dhūma-jyotiḥ -salila-marutāṃ sanni-pātaḥ kva meghaḥ ?* albeit it is not directly related to the same.

In page no 215 *aṇāni pipilikaḥ sañcārayanti* is of some interest. In even *Nyāyabhāṣya* this indication of rain is mentioned. When we see the ants take their eggs and move, we may sure that the rain stars shortly. I observed this several times when I was boy (I remember this was more true regarding black ants and not red ants).

Pratisūryaka generates curiosity. In some special atmosphere conditions, second sun may be seen. I think this occurs in Northern part of India particularly some regions of Himālayas.

Regarding *Gandharvanagara*, I remember an article published (in Kastūri) some thirty years ago. Because of some weather peculiarities, the (real) whole city seen in some other part of earth. All the people, flora fauna-everything will be seen. Sometimes it is seen hours together. If I remember correctly it happened so many times in Europe.

One question regarding *dig-dāha*: Can't we take this as aurora? Even though it's occurrence is limited to arctic regions, I read somewhere that this seldom happens even in some part of Europe. Why not in cold regions?

The style of PT is unambiguous. Clear *Anvaya* may seen in every sentence. Some times it reminds *Arthaśāstra* style. Two printing errors are noticed.

In the quoted sentence *śiśiro tāmraḥ kapilo vā* of *Ādityacāra*, *śiśiro* shall be *śiśire*, page 84. Line 2: *raśmivān* shall be *raśmimān.* In the page no. 139 the word *uddālikī* deserves our attention. The meaning according to Sri Iyengar here is, offspring of Uddālaka. In that case, Auddālaki is the correct form.

At last, one can remember this Vedic sentence: *saktumiva titaunā punantaḥ.*

Sources

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Benno von Dalen — ***Islamic Astronomical Tables:Mathematical Analysis and Historical Observations*** Variorum Collected Studies Series. Ashgate Publisher Ltd, Farnham, Surrey, England, 2013, pages xii + 356.ISBN 9781472422385 Published 2013

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A specific feature of the astronomy developed in the Islamic countries (hereafter Islamic astronomy) was the emphasis particularly on the observational astronomy. Even in the early Abbasid period (750–850), astronomical observatories were established, in which practical astronomy was carried out quite diligently. We may recall here the earliest observatories founded by Caliph al–Mā'mūn (d. 833), the ensuing observatory movement which culminated in the establishment of Marāgha Observatory in 1260 (Director, Naṣīruddīn Tūsī), Samarqand Observatory in 1420 (founded by Sulmān Ulugh Bég) and Istanbul Observatory in 1575–1577 (Director, Taqī al-Dīn Muḥammad).[1] Those observatories (*Raṣad Khāne*) and even observational stations by individual astronomers were evidently furnished with naked eye instruments, with the help of which practical/ observational astronomy was carried out, for instance the measurement of the obliquity, the rate of precession, the eccentricity of the solar orbit, position of the solar apogee, planetary conjunctions, observations and prediction of solar and lunar eclipses etc.

An important task at these observatories was the compilation of a *Zīj* (plural *Zijāt*), which are Islamic astronomical–mathematical tables—

manuals/handbooks of sort — which could be used to determine particularly the position of Sun, Moon, and various planets. All *Zījes* in Arabic, Persian, Hebrew and Turkish, contain tables for trigonometrical functions and spherical astronomical functions, and deal also with the following topics: solar and lunar parallax and their eclipses, lunar visibility, gazetteers, star catalogue and tables of ascendants for astrological purpose. To overview Zīj-literature, we may refer to the pioneering classical survey of 125 Zījes by late Edward Kennedy (1956), an updated interim report by David King (Formerly at Frankfurt, Germany) and Julio Samso (Barcelona, Spain), 2001, and the forthcoming comprehensive Zīj-*S*urvey of about more than 200 Zījes by Benno Dalen (originally from Utrecht, worked in Frankfurt and presently in Munich, Germany).

The volume under review is the *Collection* of nine already published papers of Benno van Dalen.[2] These papers are divided into two groups: 1. Methods of Analysing Astronomical Tables (5 papers)[2]. Studies of Zījes (4 papers). Each paper in the contents is marked by a Roman numeral sequentially keeping the original pagination of the paper same as in the earlier published reference, except for papers VI and IX which are furnished with new pagination. The original bibliographical references of Dalen'spapers (I– IX) are listed in the Appendix. In the following we cite only their titles.

Paper I is on "Statistical Method of Recovering unknown Parameters form Zījes". The main concept is to find statistical estimators using all values of a given table, and to employ them to find the unknown parameter and also the accuracy with which the tabular values were calculated in a Zīj. Dalen asserts that "estimators constitute an objective criterion for determining which values of the parameter could have been used for the computation of a particular table" (p.113). In this way the interdependence of various tables or Zījes can be studied. For instance , Dalen found that the tables of right ascension and oblique ascension in *Sanjufīnī Zīj*[3] were calculated by using the obliquity $\varepsilon = 23° 25'$ and $23° 32' 30''$ respectively.Similarly tables for the solar equation in the *Shāmil Zīj*[4] were compiled using the eccentricity $e = 2° 4^1 35^o 30^{1o}$, but neither $2° 4' 35''$ nor $2° 4' 36''$, the rounded values. Another important parameter is longitude of the solar apogee λA. .

Paper II is "On Ptolemy's Table for the Equation of Time". Dalen applies the method of least squares estimation (given in Appendix pp. 144–145) to find out values of the underlying parameter of tables of equation of time in Ptolemy's *Almagest* and *Handy Tables*. His findings are, Ptolemy's parameters are $\varepsilon = 23° 51' 20''$, the solar eccentricity $e = 2° 30'$ (rounded), $\lambda A = 66° 0'$ (rounded). On the basis of his mathematical analysis of Ptolemy's table for the equation of time, Dalen concludes that the independent variable for the table is the true solar longitude, and the epoch constant c was chosen in such a way that the value of the minimum equation of time was equal to zero (p. 135). The constant $c = 0$ implies that both ecliptical and equatorial mean suns pass over the vernal equinox simultaneously. The reader is referred to Dalen's excellent recomputation of Ptolemy's table of equation of time (p.134) to appreciate the accuracy of the above mentioned mathematical analysis.

Paper III is on "A Table for the True Solar Longitude in the *Jāmi*[6] *Zīj*", which was compiled by Kūshyār ibn Labbān from Jīlān (Iran) in ca. 962–964. He is also renowned for his tract on Indian arithmetic.[5] Dalen applied his mathematical – statistical method to find out values of the underlying parameter of the table and to recalculate the function λ (λM), where λM is the longitude of the mean sun. His findings are: Kūshyār's tabular values for the true solar longitude λ in his *Jāmi*[6] *Zīj* (Ms. in Berlin) are derived from the *Ashrafī Zīj* attributed to Yaḥyā ibn Manṣūr.[6] The parameter values were $\varepsilon = 23°$

51′, the minimum solar equation is 1° 59¹ 56º and the solar apogee λA = 82° 40′; the actual value 82° 39′ was observed at Baghdad by a group of astronomers headed by Yāḥyā ibn Manṣūr in 829 (p. 182).

Paper IV is on "al–Khwārizmī's Astronomical Tables Revisited: Analysis of the Equation of Time". For the life and works of Muḥammad Ibn Mūsā al–Khwārizmī (*circa* 780–850), see the article by Sonja Brentjes in Hockey (2007, Vol. I, pp. 631–633).7 This Zīj is actually renowned as *Sindhind*, since it is based on Indian methods. The Arabic original is not extant; available only is Adelard of Bath's Latin translation of the Arabic recension by Maslama al–Majrīmī of Cordoba (d. 1007), for whose life and work, see J. Casulleras's entry in Hockey (2007, Vol. II, pp. 727–728). An Arabic commentary on *Zīj al–Sindhind* by Ibn al–Muthanna (10th century) is also non-extant. However its Latin translation by Hugo of Santalla (12th century) is extant.

Dalen gives an excellent concise excursus of al–Khwārizmī's *Zīj*: sources for its study and survey of previous results, viz. mean motions, solar , lunar and planetary equations, solar declination, etc., in which sections he discusses particularly values for the parameters from the Indian sources (pp. 196–218). He analyses then the tables by his least square method, which he explains in details. His conclusions (pp. 245–246) are as follows. The argument or the independent variable of the table is the true solar longitude and *not* the mean solar longitude. The underlying parameters are: ε = 23° 51′, which is actually the rounded value of Ptolemy, 23° 51′ 20″. The solar apogee λ_A = 82°39′, the then observed value as mentioned above. The Indian value λ_A = 77° 55′ (given by al-Majrīmī is the same as used by Brhamagupta), and λ_A (Ptolemy) = 65° 30′ were not used for calculating the true solar longitude. For more details, cf. the original paper.

Paper V is on "Origin of Mean Motion Tables of Jai Singh". Dalen is concerned here with the *Zīj-i Muḥammad Shāḥī* (hereafter as ZMS). These are astronomical mathematical tables compiled by order of Mughal Emperor Muḥammad Shāḥ (reign1719 –1749) under the supervision of Raja Sawā'i Jai Singh (d. 1743), and authored by Mirza Khairullāh Khān (d. c.1747), who was the grand son of Aḥmad Ma'mār, the architect of Taj Mahal (Ansari , 2013/14).

It has been known for quite some time that copy of Philippe de La Hire's *Tabularum astronomicarum Ludovici magni,* (second edition, Paris 1702) were brought from Europe for Jai Singh and his astronomers (Forbes 1982, Mercier 1993 and also Pingree 2002). It was claimed that tables in ZMS were derived actually from La Hire's Tables. It is a matter of great pleasure for me to thank here Benno v. Dalen, who agreed to my request for applying his mathematical analysis rigorously to the 20 planetary mean motion tables in ZMS. His conclusions are (p.61): The dependence of ZMS on La Hire's tables is confirmed. Since the tabular values in ZMS are in four to five sexagesimal fractional digits, while in La Hire's tables only to seconds only, the *precise* method for computing mean motions in ZMS was also determined. To that end, a new mathematical technique was employed, viz. *The Least Number of Errors Criterion* (LNEC), see Dalen (1993, sec.2.5). He presents a summary of his findings, i.e. a variety of computational techniques were used by Jai Singh's astronomers to compile tables in ZMS, for details of which cf. pp.51–54.

Paper VI is on "The *Zīj-i Nāṣirī* by Maḥmūd ibn 'Umar. The Earliest Indian Islamic Astronomical Handbook with Tables and its relation with the '*Alā'ī Zīj*" *Zīj-i Nāṣirī* (hereafter as ZN) is actually the *first Zīj* of the Sultanate period of Indian History, hence its importance. The compiler Maḥmūd ibn 'Umar al–Rāzī dedicated it to Nāṣiruddīn Maḥmūd bin Sultan Shamsuddīn

Iltutmish, who ruled in Delhi during 1246–65. Its complete unique manuscript is extant in Mar'ashī Library (Qum).[8] ZN could be dated as follows. In chapter 56, fol.111a, 65 fixed stars (*Thawābit*) are catalogued for the year 615 Yazdigird (AD 1246). In one of his numerical examples (fol.10b) the given date is Thursday 22 Sha'bān AH 641 / 4 Feb. AD1244. In fact, his examples lie mostly between 1235–1245, which seems to be the duration of the compilation of ZN. To note is that ZN was compiled in Delhi (India) before the famous *Zīj-i Ilkhānī* completed in the year AD 1271 at Marāgha Observatory (director, Naṣīruddīn al–Tūsī).

Dalen has concentrated in this paper mainly on the calculation of planetary longitude, in order to investigate the place of ZN in the history if Islamic astronomy. Following late Edward Kennedy (*Survey of Zījes*, 1956), David King and Benno v. Dalen (formerly at Goethe University, Frankfurt) worked on a project to study about 200 Zījes, compiling their contents, and particularly to prepare a database of the planetary parameters. The idea was to study the historical development of Islamic astronomy and to identify the anonymous Zījes. Dalen lists 17 Zījes, compiled between AD 830 –1366 (pp. 3–4), in which ZN is No. 13.

Employing his method of Least Number of Errors Criterion (LNEC), Dalen studied the daily solar, lunar and planetary mean motions and equations. His conclusion are: 1. Maḥmūd ibn 'Umar calculated values in Bmean motion tables in ZN "with a very high accuracy"(p.7). 2. By comparing Maḥmūd's values of daily mean motions with those of the parameter database of Islamic Zījes by Kennedy, it turned out that the source of Maḥmūd's daily motions in longitude and in anomaly is '*Alā'ī Zīj* of al–Fahhād (of Shīrwān, ca. 1175), the Greek version of which by Byzantine astronomer Gregory Chioniades is only extant (p.30).[9] 3. Maḥmūd's values for equations agree well with those by Chioniades version of '*Alā'ī Zīj* (p.31). Dalen has compared also the data in ZN with those in other related Islamic Zījes (p. 9 *et seq.*). For detailed contents of ZN, see Ansari (2015) forthcoming paper.

Paper VII is on " A Second Manuscript of the *Mumtaḥan Zīj*" by Yaḥyā ibn Abī Manṣūr (d. AD 830–832). Its complete title is *Az–Zīj al–Mumtaḥan ar–Raṣadī al–Mām'ūnī*. In Arabic *Mumtaḥan* means examiner and *Raṣad* means observations. The author was a renowned astronomer and mathematician and was in the service of Vizier al–Fal bin Sahl and Abbasid Caliph al–Mā'mūn, who entrusted him the task of re-examining the astronomical data and observations in the *Almagest* of Ptolemy, for instance. This Zīj is therefore the result of those investigations. Its only copy , though incomplete, was known to be extant in Escorial Library (Spain), Arabic collection. According to Dalen the Zīj is important for being a mixture of Indian, Iranian, and Ptolemaic tabular material of planetary motion and of spherical astronomy, and actually the first systematic attempt of its kind. Dalen discovered its *second complete* manuscript in the University Library, Leipzig (Germany). In this paper he has given a sufficiently detailed content of this 'disorderly' manuscript arranged by topics, the differences between the two manuscripts and the sources of the author, viz. Zījes of Ḥabash al–Ḥāsib (d.869) , al–Battānī (d. 929) and ibn al–'ālam (d. 985). As an example of Indian material, I cite the following. "The oblique ascension for table for Baghdad (latitude 33°) ... turns out to be based on the Indian obliquity value 24° 0′ and latitude 33° 0′ in the Leipzig Ms., while the table in Escorial Ms. was computed for obliquity 23° 35′ and latitude 33° 25′, used by al–Nayrīzī and Abu'l Wafā' in the tenth century" (p.19).

In short, the study of Leipzig manuscript by Dalen is quite significant particularly in tracing the sources of Yaḥyā ibn Abī Mancūr. For details see the original paper.

Paper VIII is on " Re-editing the Tables in the *Ṣābī Zīj* ". This Zīj was compiled by Abū 'Abdallāh Muḥammad al–Battānī al–Ḥarrānī al–bābi'(d. 929). He belonged to Ḥarrān in Anatolia and belonged to the pagan community of Sabians, but he was himself a Muslim. Al–Battānī was a well known astronomer, famous for the accuracy of his observations. His father had been an instrument maker and al–Battānī had private observatory for carrying out his observations, which spanned a period from 877 to 918.10 For instance, his solar eccentricity e = 2° 4′ 45″, obliquity ε = 23° 35′; for the year 880, ε (actual) = 23° 35′6″. His *al–Zīj al–bābi*' (hereafter ZS), the epoch of which is AH 267/ AD 880, was used in the Islamic world extensively, e.g. al–Bīrūnī wrote even a tract on it. It was also well known through its two Latin translations in medieval Europe and was used , e.g. by Tycho Brahe, Kepler and even Copernicus quotes him in the chapters of his book concerning with the problems of solar motion and of precession (Hartner 1970).

The Arabic manuscript of ZS is extant in Escorial Library (near Madrid). The text was edited, translated and commented comprehensively in Latin by the Italian Arabist Carlo Alfonso Nallino (1872–1938) and published, see bibliography for details. This work has been characterized by the late German scholar Willy Hartner (Frankfurt) as *magnum opus*. He further opines that"this third Latin translation, written eight centuries after the first two, will always stand as one of the masterpieces of the history of science"(Hartner 1970). I have given here in short some information about the scientific life of al–Battānī, so that reader could appreciate the importance of his Zīj. Despite the above-mentioned praise by Hartner, Dalen has made a case for the critical edition of al–Battānī's tables. He writes:

> "The purpose of this article is to make an inventory of the problems attached to Nallino's transcription of al–Battānī's tables and to pave the way for a possible new, critical edition that takes into account all relevant additional sources, in particular some later Arabic and Persian *zījes* that adopted tables from al–Battānī, the Castilian translation of the *bābī Zīj* prepared about 1260 for [King] Alfonso X (1221–1284), and the Latin tradition of the Toledan Tables. For this purpose we shall present an edition of al–Battānī's table of the solar declination and full apparatus for a number of other tables".(p. 406)."

The whole essay is a master piece of manuscriptology or method of preparing critical edition of a text. His sample edition has shown clearly what strategies or devices Nallino employed to circumvent the editorial difficulties. Dalen recommends a new edition of al–Battānī's tables from ZS by drawing especially the Castilian version of Zīj and the Toledan tables.

Paper IX is on "Dates and Eras in the Islamic World: Era Chronology in Astronomical Handbooks". It is an essay on Calendars used in Islamic Countries, particularly in Zījes. Since it has been publish in *Encyclopaedia of Islam* (EI), I need not summarize it. The essay in this volume is user friendly, since Dalen has changed some of the peculiar diacritical marks of the EI–scheme into the prevalent ones.

Appendix

List of Original References of Benno van Dalen's Papers

I. On Ptolemy's Table for the Equation of Time. *Centaurus 32*, 1989, 85–145.

II. On Ptolemy's Table for the Equation of Time. *Centaurus 37*, 1994, 97–153.

III. A Table for the True Solar Longitude in the *Jāmi'Zīj*. *Ad Radices. Memorial Volume for the Completion of Fifty Years of the Institute of History of Science , Johann Wolfgang Goethe University, Frankfurt a. M.* Stuttgart 1994. Franz Steiner Verlag, pp.171–190.

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ENDNOTES

1. See for details Sayili (1960) chapters II, VI and VIII.

2. For the general reader I may add that in Dutch 'van' is similar to German 'von'. They are qualifiers and are normally part of a surname. The letter v here is pronounced as f.

3. The compiler was Abū Muḥammad 'Amā of Samarqand who wrote it in AD 1366, but the *Zīj* is dedicated to the Mongol Viceroy of Tibet. For the importance of this Zīj, see Kennedy(1987/88).

4. This Zīj is in Arabic and is anonymous, the epoch of the mean motion tables is A D 1231.

5. This is a short arithmetical tract: " Principles of Hindu Reckoning"(*Uṣūl Ḥiṣāb al–Hind*), in Arabic. The tract has been translated into English by Levy & Petruck (1965), into French by Mazaheri (1975) and also into Persian by Bagheri(1988), cf. Bibliography.

6. The importance of *Ashrafī Zīj* (Ms. in Paris) can be appreciated by the fact that it contains mean motions parameters and planetary equations of a large number of earlier Zījes. It is in Persian, and was compiled by Muḥ. Sanjar al–Kamālī (of Shiraz) in 1300 according to Dalen, p.181, f.n. 15.

7. Besides the *Zīj*, al–Khwārizmī is also renowned for a short tract on "Indian Reckoning", the Arabic text has not been discovered to-date. However, excerpt from its Latin translation was known for quite sometime. In 1997 the German historian of mathematics, Menso Folkerts (Munich) discovered its complete Latin text in the Hispanic Society of America, New York, see Bibliography for exact reference. I thank here Prof. Folkerts to present its copy to me.

8. Persian MS. 9176, comprising 165 folios, copied close to the time of the author. For the early history of other manuscripts, see Ansari (2008, pp. 62–63). I thank the director of the Mar'ashī Library to present to me a copy of this Zīj.

9. 'Abd al-Karīm al-Fahhād al-Shīrwānī wrote *Zīj al-'Alā'ī al–Raṣadī* in Arabic in ca. 1175/76, the Persian version of which was carried out by Shams al-Dīn al-Bukhārī , under whom a Byzantine scholar Gregory Chioniades studied in Tabrīz in 1295/96. Later Chioniades prepared in Constantinople (now Istanbul) its Byzantine Greek version which is extant. The edition of the Greek text was prepared by Pingree (1985–86). It may be added that an excerpt of the *Zīj al-'Alā'ī* in Persian is extant in Salar Jung Museum Manuscripts Library (Hyderabad).

10. For details of life and works of al–Battānī, see Hartner (1970) and Dalen (2007a).