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# Book Review

S.M. Razaullah Ansari (ed.), ***History of Oriental Astronomy***, Kluwer Academic Publishers, Dordrecht, The Netherlands, 2002, xi+282 pages.

The volume is based on the Proceedings of the Joint discussion (no. 17) at the 23rd General Assembly of the International Astronomical Union organized by the Commission 41 (History of Astronomy) held in Kyoto in 1997. It is a delayed publication, received recently and is taken up for review in view of its importance in traditional and modern aspects of astronomy. It has three major academic sections. Section I deals with Oriental astronomy covering ancient and medieval period (nine papers) and Section 2 with modern astronomy in the orient (seven papers). Section 3 deals with additional contributions (three papers) which were supposed to be presented but not done so because of authors' absence. The volume accounts for 19 papers in all, nine of which are on Chinese astronomy, three on Korean, two on Japanese, four on Indian and one on Australian astronomy.

**Chinese Astronomy**:

Detailed accounts of history of the Chinese astronomy are given by Joseph Needham (vide *Science and Civilization in China*, Vol. 3, Cambridge, 1959), Zhungui Chen (vide *History of Chinese Astronomy*, Vol. 3, rev., ed. Ming Wen, Taibei, 1987; vide also vol. 4) and a few others. The first article (1.1) here in this volume is by Y. Maeyama of the University of Frankfurt who has drawn attention to the Chinese tradition of the two supreme stars, *Thien–i* (Pole star, K. Dra) and *Thai-i* (another star towards South of the *Thien-i*) and their related positions with respect to *Purple Palace* (boundary stars in sky). The names appear to have been derived from Yin people's highest Deity *Ti* or from the names of later emperors going by the same name. The reference to *Thien-i,* and *Purple Palace* together in different documents has made them quite significant. One Chinese school has identified the measurement of the position of *Thien-i* in equatorial co-ordinates by about 70 BC. This corroborates that the Chinese equatorial system with 28 Chinese lunar mansions (*hsius*) was perhaps invented before this date. The Babylonian and Indian interests in stars and constellations center along and near the ecliptic (path of the Sun) which occurred before the Chinese *hsius*. The Chinese system is unique though, it is still to see whether these systems are independent of each other or have a common origin.

Benno Van Dalen of the Institute of History of Natural Science, Frankfurt (1.2) has tried to find the origin of the text, *Huihui li*, a Chinese translation of a standard Islamic astronomical handbook with tables (*zijes*), completed between 1382-1383 AD (Ming Dynasty). Dalen has also drawn attention to a few later versions of this text viz. *Siku quanshu* (Complete Books of the Four Branches of Learning compiled in Qing Dynasty), *Huihui lifa* ( Islamic astronomical system), *Qizheng tuibu* (calculation of the motion of seven luminaries), *Sanjufī nī Zīj* (Arabic ms. dedicated to the Mongol Viceroy of Tibet, deposited in the *Bibliotheque National*, Paris) and Xiy*u lifa tongjing* (Cannon of the western astronomical system), found used by Korean astronomer and a few others. The planetary parameters in *Huihui li,* as informed by Dalen are generally different from the available Arabic and Persian *Zījes* including *Īlkhānī Zīj* of Naṣīr al-Dīn al-Ṭūsī. It also contains the double argument tables for planetary latitudes from which the latitudes could be found directly without any calculation. The method of prediction of eclipses is also different from the standard Ptolemaic, Islamic or even Chinese method. Some versions also contain star table of 277 stars within a band of $10^0$ on either side of the ecliptic with longitude and latitude. The stars of course are indicated by their numbers following Ptolemaic constellations and positions following Chinese tradition.

Yano of the Department of the Cultural Studies, Japan (1.3), on the other hand, has analyzed the first equation table for Mercury based on three mss, *Huihui li*, *Sanjufī nī Zīj* (Tibetan) and *Al-Qānūn al-Masʿūdī* of al-Bīrūnī (1030 AD) sharing more or less the similar features. Usually motions of planets involve two inequalities. In a eccentric epicyclic model, the mean position on the concentric changes due to true position in the deferent. Then the correct true position is obtained due to conjunction with the Sun. The net correction is obviously obtained from the combination of both the mean anomaly and the mean argument. Theon (in his *Handy Tables)* and a few other later scholars preferred to give the combined value. But such a formula is unsuitable for computation of tables. Ptolemy, Hindu and a few central Asian scholars preferred to calculate two corrections separately from practical considerations and then combine them to obtain the true longitude. Al-Bīrūnī is the only exception who instead of addition, subtracted second from the first. Yano has shown that the tradition of al-Bīrūnī is followed in *Huihui li* and *Sanjufīnī Zīj.* This according to him is a remarkable flaw on the part of al-Bīrūnī.

Kazuhiko Miyajima of the Doshisha University, Kyoto (Japan), has analyzed (1.5) the projection methods, followed in three Chinese star maps, first a circular map found in Chunyou Stone Inscription and the other two (one circular and other rectangular) in the *Xin yixiang fayao* , both belonging to the Song Dynasty (11th century AD). The rectangular map is drawn in four successive pages and accounts for four quadrants: third ($12^h$ to $18^h$), fourth ($18^h$ to $0^h$), first ($0^h$ to $6^h$) and second ($6^h$ to $12^h$) respectively. The *Xin yixiang fayao* has recorded 1464 stars in the map and was based on the observation on determinative stars though there was no specification for identifying them. *For rectangular maps*, cylindrical projection for right ascension was followed from $a = ax+b$ ($a = -8.2933$, $b = 180.23$) with ecliptic not crossing the equator and autumnal equinox as the starting point, and $x = 0$ is on the right edge of each quadrant of the map. The cylindrical equidistant projection for polar distance p was found from $p = c.y. + d$ (where d = declination, $c = -8.0030$, $d = 89.91$), showing polar distance almost equal to $90^0$, and $y = 0$ stands for the equatorial line.This is contrary to Needham's suggestion that it followed Mercator's method i.e. $y = c \log \tan (p/2)$. As regarding *circular map* the azimuthal equidistant projection w.r.t to north pole as the center of the figure were followed from $p=e.r$ (p=polar distance, e=size of the map), and $\alpha = \theta + h$ (h = right ascension of the arbitrary line drawn parallel to y-axis), and $(r, \theta)$ of course being the polar co-ordinates of the determinative stars w.r.t. center (i.e. north pole). Miyajima's methods are applicable to determinative stars, but also useful for other stars. The Chinese projection method is basically numerical unlike star maps of the Greek, Islamic and Hindu methods which follow stereographic projection (geometrical).

K. Y. Chen of the University of Florida noted (1.6) that the Chinese had a system of measuring gnomon-shadow lengths of the Sun at noons on both summer and winter solstice days. The Chinese gnomon was generally of height 8- chi, though 9-chi and 40-chi gnomons were found to have been used in Jianking and Beijing. The summer and winter pair of shadow lengths were for finding latitude, zenith distance and eccentricity of ecliptic or the equator, the main objective was to establish relation between calculated and geographical latitude or calculated latitude and zenith distance of the Sun. For such calculation the methodology is based on modern formulae without any historical basis.

Kevin D Pang, a member of the National Science Foundation Commission to China (1985) alongwith Kevin K. Yau (Jet Propulsion Laboratories, UK) and Hung-hsiang Chou (University of California, USA) have examined (1.9) 13 Shang Dynasty Oracle Bone Eclipse Records (14-12 century BC) on the basis of Royal Geneology, *Bambo Annals Xia Dynasty Chronology* and found that they match with six solar and seven lunar eclipses. His future researches to establish a detailed absolute chronology for the Xia, Shang and Zhou Dynasties in China before the starting of accurate historical period in 841 BC will be of great interest to the scholars in that field.

Keizo Hashimoto, Professor of History and Philosophy of Science and Technology, Kansai University, Osaka, Japan (2.4) examines the time of introduction of Kepler's Laws in China found in a ms. *Lifa wenda* (Dialogue on Astronomy) as early as 1710 AD. The paper gives reflection of Foucquet's summary of Kepler's Laws as described in his *Astronomia philolaica* (1645) and Foucquet's Cartesian basis for physics. Kepler's Laws and Copernican system are discussed on the background of discussion put forwarded by Riccioli, Boullian and others. It refers that Kepler's account of eccentricity of planetary orbits was perhaps derived from Tycho Brahe's observations of opposition from the orbit of Mars on the basis of magnetic mechanism, though Boullian and others believed it as a fall out of uniform circular motions of planets. *Lifa wenda* also reports about Huygen's determination of Saturn's ring during 1655-56, Cassini's telescopic observations of Jupiter's surface including dark spot (1690-91), discrepancy in observational results and theoretical calculations and the necessity of introduction of ecliptic orbits alluding to Certesian physics. It explains ecliptic motions and area rule of the planets but did not accept the analogy, rather depended more on *Almagestrum novum* of G.B. Riccioli. It also has reproduced the tables of De La Hire (1702), compiled over a long period of time at the Paris Observatory. It also reflects about improved astronomical parameters, telescope mounted with micrometer, horizontal parallax of the Sun etc. As regards Copernicanism which places Sun at the center, *Lifa wenda* gives Roemer's planetary mode which is based on the heliocentric concept in the appendix. The Jesuit missionaries in China who were incharge of astronomical observatories in Beijing followed Riccioli's choice which is anti-Copernican. Though the work faithfully explains, different models, it appears that Sun remains still without any motion at the Centre of the Jupiter like that of the Earth. The text appears to have followed the Cartesian basis for planets keeping Sun at the center of the planetary orbits, role of ether and oblique transmission in explaining the motion of planets based on Descarte and Huygens. This is undoubtedly a phase of pre-modern state of astronomical observations which most of the countries including India passed through.

Qu Anjing (3.1) of the Northwest University, Xian (China re-examined the nature of solar shadow difference table of a gnomon of 8-chi (Chinese feet), as appeared in *Dayan li* compiled by Yi-xing (also known as I-hsing, a Chinese Buddhist who came to India in 724 AD). The table is rechecked from that of *Xuanming li* compiled by Xu Ang in 822 AD. Anjing observed that the table of shadow difference table has a theoretical basis only and is not based on direct observations. The original version of *Xuanming li* was taken to Korea and Japan and was popular among the Tang dynasty calendar makers of the 9th century AD. In *Dayan li,* Yi-xing gives an alogorithm of difference-measures for construction of shadow tables corresponding to the zenith distances. It says that' there is no shadow at noon , first shadow is 1379 *feng* (1chi=1000 *feng*), then the difference increase by one *feng* each upto 25th, then it increases by two each upto 40th, increase by 6 each upto 44th, increase by 68 for 45th, then further increase by 2 each upto 50th, increase by 7 each upto 55th, increase by 19 each upto 60th, increase by 60 for 61st, increase by 33 each upto 65th, increase by 36 each upto 70th, then increased by 39 each upto 72th, increase by 260 for 73rd, then increase by 440, 1060, 1860, 2840, 4000, 5340 respectively upto 79th. The zenith distance is given in *du* (Chinese degree). The tables are constructed on the basis of this data. The *Xuanming li* gives polar distance and shadow length at noon for 24 *qi* (equinoxes, solstices, besides other times) which also agree with those of *Dayan li.* The algorithm used in the *Xuanming li* likewise is not based on any observations, but follows the earlier traditional method having great influence on calendar makers of Tang Dynasty. Needham and his collaborators of course considered the shadow lengths of summer solstice as observed data and those of winter solstice and equinoxes as calculated data on the basis of tangents and supported by others.

Li Qibin of the Beijing astronomical observatory and Chen Meidong of the Institute for History of National Sciences, CAS (3.2) give a small survey of the last ten years activities in Chinese history of astronomy in the areas like collection of ancient records and documents, chronology of astronomical events, origin of lunar mansions and collection of star catalogues, early astronomical instruments, astronomers and calendars, place of astronomy in social culture and publication of astronomy series . The documentations perhaps is the major aim of this review.

### Korean Astronomy :

Nha Il-Seong, Professor Emeritus of Yonsei University, Seoul (1.4), analysed the nature of transmission of western astronomy to the Korean tradition on the basis of three star maps in the 18th century, brought out by Korean contacts, even though there is dispute on exact dates of making for these maps. The first type of star map is *Honchon Jondo* (circular map) appearing in wood-cut prints. The *Honchon* circular star-map has plotted as many as 3083 stars in twelve equal regions divided by twelve straight lines with a north celestial pole as centre, the angular separation being 30 degrees. The stars are plotted in equatorial co-ordinates and their brightness according to magnitudes are marked by double circles, circle with a dot, open circle and asterisk etc. It had also provided with sketches and astronomical data of the Sun, Moon and the five planets (Mercury, Mars, Venus, Jupiter and Saturn), diagrams of solar and lunar eclipses, and tables of sunrise and sunset times. The relative sizes (diameter) of the planets vary substantially when compared with modern data. The screen star maps of the type 1 had been on eight folding panels, copies of which attest from Nanbang Bunkakang (Osaka, Japan), Whipple Museum (Cambridge, UK) and National Folk Museum (Kyongbok Palace, Seoul, Korea). It depicts general maps of 1395 stars in ecliptic co-ordinates, and diagrammes of Sun, Moon and five planets at the left. It also depicts screen maps of type 2 in which the size of the star maps on eight fold panel for both hemispheres is larger and is given in ecliptic co-ordinates with diagrams of Sun, Moon and the planets in the right, alongwith the names of officials engaged in the map-making. These maps were examined before by Needham and his collaborators. Since equatorial co-ordinate system is older than the ecliptic system in China and Korea, it is presumed that *Honchou* is older than the screen maps.

In another paper (2.6), Nha Il-Seong gives a summary of programme of his family Museum of Astronomy attached to the Yonsei University since 1982. It is built on a small hill top at Yechon Prefecture ( $\lambda = 128^0\ 28'$ E, $36^0\ 39'$ N) and about 200 km south of Seoul, Korea. It has a 40 cm Ritchey Telescope fitted with a photometer, and has a collection of 150 star maps, old photographs, replcas/reconstruction and other collection etc.) and about 70 sundials (photographs of old West and Arabic sundial reconstruction and reflection). It has also designed programmes for star gazers and arrangements of public lectures and lecture programmes for advanced students like all other planetariums.

F. Richard Stephenson of the University of Durham (3.3) examines the accuracy and reliability of the eclipse records found in the *Koryo-sa,* the Korean history which follows the pattern of typical Chinese Official history. The document records as many as 135 solar eclipses between 1012 AD to 1391 AD referring to their occurrence, totality, ceremony, prediction and also failure to correct prediction, obscured eclipses due to cloud or rains etc. It is reported that out of 135, not more than 106 are visible in the Korean capital. Nine visible, three invisible eclipses are reported, and as many as seven had escaped notice. The interesting part is that almost all the dates of the solar eclipses are accurately recorded, discrepancy occurs at most for a day (between observed and calculated days in Julian measure). The document records about 2115 lunar eclipses during 1009 AD to 1392 AD of which 20 are recorded as total with no details of prediction to eclipses and failure for correct predictions (time occurrence), failure to see the eclipses because of rain and cloud etc. All lunar eclipses have now been computed and compared with the record. Computation reveals that about 340 lunar eclipses will be visible in Korea, however 188 of these events are actually recorded. Completeness of this record is very uneven, though the date differ by a day. It is presumed that the *Koryo-sa* owe their origin to a possibly faulty prediction.

**Japanese Astronomy** :

Shigeru Nakayama is well known for his work on *Japanese Astronomy : Chinese background and Western Impact* (Harvard Univ. Press, Cambridge, Mass., 1969). He extended homage here (2.7) to his teacher K. Yabuuti who made a major critical assessment of traditional official Chinese calendars and their computing system, and assessed its impact on Chinese exact sciences. Needham's first two volumes on *History of Chinese Science and Civilization* were also criticized for not including Japanese contribution to the History of Chinese Science. The Chinese *Fu-tien* calendar is known for its algebraic representation, and Nakayama believes that Chinese system is basically algebraic, not having geometric or trigonometric approach. He guessed that Central Asia and Turkish's astronomical remnants might have played as intermediaries in the travel of astromical ideas from Central Asia to China. Since Turkish peoples were active in West China, Nakayama requested Aydin Sayili to investigate who prepared accordingly a document of about 100 pages in English and 108 pages in Turkish to prove his point before his death in 1914. Sayili narrated algebra of al-Khwārīzmī and their connection with Turkish and Chinese algebra and its role in the transmission of paper technology, Buddhism , decimal place value system with no mention of India's role in the field of transmission. The contribution though considered useful, the final picture is yet to emerge in the role of transmission.

David De Vorkin of the Smithsonian Institution (2.3) narrates how the Japanese scholar Toshio Takamine ( 1885-1959) of the Kyoto University made several visits to the western laboratories and came into contact with Indian scientist Meghnad Saha for his interest in spectroscopic studies. Takamine entered the school of studies after graduation in 1909-1911 to study optics and spectroscopy. In 1912 he started working under Nagaoka on the spectrum of mercury and resolution of lines under Zeeman effect. During 1917-21 he joined Kyoto university and collaborated the study on Stark effect. Towards the end of 1919 he joined the newly established institute of physical and chemical research (Tokyo), where Nagaoka was the Head of the Department of Physics. With his guidance he left for the Pasadena laboratories of USA, a premier astrophysical institute and worked with J. A. Anderson at George Ellery Hale's Mount Wilson Solar Observatory which is known for its largest telescope. His work with Anderson centered on short focus plane-grating spectrograph, developed by Anderson, and examined metallic spectra using magnetic field strength. Here he tried to find a co-relation between Stark effect and Pole effect (viewed near the pole tips of large electro-magnets). During 1921, he returned to Tokyo via Europe. On his way he visited the observatories of T.R. Merton (Oxford), Alfred Fowler in South Kensington where he met Meghnad Saha, the discoverer of *Ionisation Equilibrium* in the Atmosphere of Sun and Stars. He also visited Bohr's Institute (Copenhagen) where he worked on the Stark effect on the mercury lines, Balmer series of hydrogen using Stark effect. After his return to the Institute in Tokyo he began to refine his technique for studying Stark and Zeeman effect and their use in the analysis of spectra. The new equipment procured by him for the purpose which however, damaged in the earthquake of 1st September 1923. He was of course rewarded with Imperial Prize (1923) for his work on the Stark effect. He further planned to visit labs in USA and other places with the prize money. In order to get support for a small solar observatory in Tokyo he wrote to his friends in USA and was advised to look for Japanese sources. He wrote several letters to Saha and renewed his contact during 1937 and got interested in the work of extreme ultraviolet sunlight on the upper atmosphere. With Saha's advice he was also inclined to build up a UV chronometer to search for wavelengths. In 1939 he was awarded Carnegie Fellowship to work in Wilson observatory. He continued his work on molecular nitrogen, helium and neon spectra including vacuum ultra violet spectra. From 1941 onwards, his work was disrupted due to second world war and he expired in 1959. He was basically a product of Meiji restoration and had a strong nationalist feelings to build up a solar observatory in Tokyo and to refine his techniques on Stark, Zeeman and Pole effect in the analysis of spectra. He was very much impressed with the freedom of research in USA and compared that with the limitation he had in his country which shows that he loved freedom in research. He always earned love and respect for his hard labour and sincere work among his colleagues in Europe.

## Indian Astronomy :

Yukio Ohasi (1.7) has reexamined Pingree's hypothesis of Mesopotamian influence over *Vedāṅga Jyotiṣa* of Indian astronomy during Achaemenid occupation. Ohasi observed that the *Vedāṅga* astronomical elements are based on astronomical observations in North India. He said that there is recorded evidence of *Vedāṅga* astronomy having a year of 366 civil days or 367 sidereal days which is different from 365 civil days of Mesopotamian astronomy. The length of daytime in the *Vedāṅga Jyotiṣa* was regulated by a zig zag function (12+2/61 n) *muhūrtas* (one *muhūrta* = 1/30th of the day) which fixes the day-night time ratio of the winter solstice at 12:18. i.e. 2:3, this being a latitude of 35° N i.e. Kashmir region, a central place in the post-vedic period, not a place in Mesopotamia. The number n indicates the number of days after or before the winter solstice. There is also other traditional evidence that the change in sunrise and sunset timings and even seasonal changes of important phenomenon were obtained from the observations around the equinoxs but not at solstices. The day length formula according to Ohasi was possibly extrapolated for one *muhūrta* or two *muhūrtas* difference in day time during one or two solar months after the equinox at a latitude of 23° or 29° N, and the tradition continued in a region from 35° N to 27° N. The measurements of annual and diurnal variation at summer solstices were also recorded from first century AD in the same regions from 27° N to 21° N where *Vedāṅga astronomy* was current. The formula for diurnal variation of gnomon shadow : $d/2t = s/g + 1$ (where s=shadow length, g=gnomon height and t/d=fraction of day time elapsed since sunrise or remaining till sunset) was used during this period in this region. The Indian data is closer and parallel to actual shadow length than the Mesopotamian data which followed from $t=c/s$ (where t=time after sunrise, s=shadow lengths and c=60, 75,90 at winter, equinox and summer solstice respectively). There is of course no doubt that the Greek influence along with the Greek astrology specially moon's motion along zodiacal signs started flowing during this period and *Vedāṅga and later Indian astronomy* flourished with this modification.

Kim Plofker of Brown University (1.8) has examined the nature of plane and spherical triangles used in the method of finding declination based on only two rules from the *Tantra Saṅgraha* of Kerala astronomer, Mādhava (1500 A.D.). She believes that this technique has never been fully developed in Indian tradition. In this context, she has also scrutinized the materials followed by Mahendra Sūri (1317), Padmanābha (1423), Nityānanda (1639), Muniśvara (1646) and Kamalākara (1658) belonging to North Indian Graeco-Islamic tradition. In fact the South Indian tradition placed five elements — altitude, hour angle, declination, azimuth and latitude as important features of astronomical triangles, and their objective was as to how to find two from five elements. The problem was always a matter of great interest to Kerala astronomers and Nīlakantha has placed ten such cases to tackle this problem. There is however, a need to study history and development of this method before a sweeping remark is made.

David Pingree (2.1) of the Brown University, USA has referred to the *Tabulae astronomicae* of Philippe de la Hire as to how it was brought to Jayasiṃha's Court in India in 1730 AD in the new city of Jayapura and how it was made available in two copies for the use among the Muslim and Sanskrit group of scholars for giving final shape to the *Zīj-i-Muḥammad Shāhī*. The *Tabulae astronomicae* which used logarithms, logs of trigonometrical functions was not understood initially. Another problem Jayasiṃha faced was regarding the model of the Moon, since no diagram was put forwarded by de le Hire on second and third lunar corrections e.g. *annual equation*, and *evection* respectively. On his invitation, the French missionaries Father Boudier and Pons arrived from Chandannagar in West Bengal to Jayapura and began associating themselves with the observations from August 1734. The *Zīj-i-Muḥ ammad Shāhī* however is completed in 1737 AD and its mean-motion tables of the Sun, Moon and planets are believed to have been based on those of de la Hire's *Tabulae astronomicae* suitably modified, and chronological tables, tables of trigonometry spherical astronomy, star catalogues are derived mostly from Ulug-Beg's *Zīj-i-Jadīd*. The Sanskrit version likewise of the *Zīj-i-Muḥammad Shāhī*, *Siddhāntasindhu* of Nityānanda, prepared in Jayapura in 1727AD, is compared with another version (ms. Kasmohor 5183), prepared during the period 1727 to 1737 in respect of lunar longitudes and it was noted that the results were improved dramatically, which according to him was due to understanding of the use of de la Hire's tables. Pingree identified two other manuscripts of *Phiraṅgī Candrachedyakopayogika* (incomplete ms: Khasmohar 5295, 5609, Rajasthan Oriental Research Institute, Kota) which give 10 diagrams involving conic sections, de la Hire's heliocentric model (Sun fixed) except superior planets and an illustration of third lunar equation (e.g. *evection*), a lunar eclipse of Sunday, 28th May 1732 Julian and a solar eclipse. The features of activities of these two groups as found in Sanskrit and Persian versions are somewhat confirmed by Father Pont in a letter written in 1740 AD.

S. M. Razaullah Ansari (from Aligarh, India) has referred (2.2) to six Indian scholars as disseminators of European astronomical knowledge to Indo-Persian writings. They are Mīr Muḥammad Ḥussain ( a famous Hakim and poet of Murshidabad, travelled to London during 1774-77), Mirzā Abū Ṭālib (an employee of Nawāb Āṣaf ad-Dawlah of Awadh, travelled to Europe during 1799-1803), 'Abdul Qādir Jaunpūrī (a Munshi in the office of the East India Company, Calcutta c.1728), Ghulām Ḥussain Jaunpūrī( a court astronomer of Raja Khan Bahadur Nusrat Jang in Tikari, South Bihar, fl. 1850), and Rāja Ratan Singh Zakhīm (an employee of East India company in Calcutta, later joined the service of Awad rulers in Lucknow, c. 1803). The works written by these scholars are available in the collection of M.A. Library (Aligarh Muslim University), Raza Library (Rampur) and other Libraries which reported on mariner's compass, telescope, bright rings around the planet Saturn and no. of satellities of Earth, Jupiter and Saturn, changing shape of Venus like the moon, sunspots, great comet of 1680AD, heliocentic planetary system, of pure air, nature of colours, motion of the earth, the reasons for solar and lunar eclipse, distance of Jupiter and Saturn from the sun, 40 yard telescope, transit of Mercury and Venus with the Sun etc. The last scholar mentioned about the astronomical work and discoveries of Copernicus, Tycho Brahe, Kepler, Galileo, Newton, Hevelius, Flamsteed, John Herschel, Cassini and others and mentioned about the telescopes and micrometer with cross-wires and other instruments. The scholar also supplied geometry of occurrence of eclipses, tables for obliquity, lunar and solar eclipses. It is not clear what impact this new knowledge actually made on the traditional Madrasa or other educational systems or the public in general.

## **Australian Astronomy**:

Wayne Orchiston of the Anglo-Australian Observatory, Australia, (2.5) presents a very interesting and contrasting pictures of two nineteenth century Australian astronomers – John Tebbutt (an amateur in a private observatory near Windsor,1834-1916) and Henry Chamberlain Russel (Govt. astronomer and Director of Sydney Observatory, 1836-1907). Both of them rose to fame in the second half of nineteenth century. The second half witnessed also the growth of about eight professional observatories (in Williams town, Flagstaff, Melbourne, Sydney, Adelaide, Brisbane, Hobart and Perth), and about 60 amateur scientists flourished during the same period (in Adelaide, Sydney, Windsor and other places). The Russel belongs to the former professional group which mostly concentrated on metrology, time keeping, geomagnetism, seismology, tidal studies and trignometrical survey work. With colonial observatory instruments, this group undertook observations and recordings of eclipses of Sun, Moon, lunar occultation of planets, transits of Mercury and Venus, mounting of position and appearance of comets, separation and position angle of double stars, appearance of planets and star positions. Tebbutt belongs to the alternative amateur group which had also the telescopic facilities of the refractor and reflector types and did the same observational activities besides involvement as a supplier of astronomical information, offered public viewing of nights, contributed news reports, prepared booklets, books or chapters of books, delivered public lectures etc. The amateur scientists had also great reputations in public. They represented public groups and occupied highest positions in astronomical societies like those of the professional groups, and their articles were published in all standard astronomical journals. Tebbutt published as many as 388 articles in astronomical journals, transactions, astronomical society publications, and about 94 newspaper articles during the second half of the 19th century. Russell on the other hand, published only half the number. They were however, very good friends and exchanged collaborations and good wishes roughly upto the end of 1880. Their understanding detoriorated and went down to such a label that Tebbutt received no congratulations from Russell when he discovered the Great Comet of 1881. Even Russell's historical paper, "Astronomical and Meterological Works in New South Wales, 1988-1860" find no mention of Tebbutt. Russell was also attacked for 60% Govt. grant spending only on observatory's meterological function at the expense of astronomy. This rivalry went on till to the year 1907 when Russell died. The paper is an excellent survey of works, rivalary and power politics between two professionals based on huge data and documentation in the scean of Australian astronomy.

The Proceedings end with a full programme of joint discussion on oriental astronomy followed by details of contributors. The idea originally of IAU Commission was to take a stock of the astronomy in Asia and the Far East.

The programme committee however changed the title of the discussion to History of Oriental Astronomy with general approval of the Commission. The word, 'oriental' is somewhat offensive and unclear which the editor clarifies that it attempts to include 'besides Greek, the contribution of the Chinese, Indian, Islamic, Japanese and Korean traditional astronomy in ancient and medieval phases, and transmission of European astronomy into non-European countries in the modern phase'. The volume has no contribution from the Greek astronomy nor there is any contribution from the Islamic tradition. The Australian astronomy likewise, is in no way fit in the definition of oriental astronomy. Whatever be the connotation, the volume is on the whole a very useful addition to Asia and Far East in the 'Section of Astronomy'. The quality of papers are mostly of a very good standard. We are indeed thankful to the Editor and the Kluwer Academic Publishers for presenting such an important volume to the scholarly world. All libraries having interest in the field might consider this volume as a proud possession.

A.K. BAG