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BOOK REVIEW

Sreeramula Rajeswara Sarma, ***Astronomical Instruments in the Ramur Raza Library***, Published by Dr W. H. Siddiqi, Rampur Raza Library, Rampur, 2003, pp.95, 33 illustrations, ISBN 81-87113-56-1, Price Rs. 850.

A characteristic feature of the West and Central Asian astronomy during the Islamic Middle Ages (hereafter Islamic astronomy) is the promotion and tremendous growth of practical astronomy, which was in fact manifested primarily by the establishment of large number of observatories in the Islamic countries, right from the Abbasid Caliph al-Māmūn (813-833) to the Turkish King Murād III (1574-1595), and by the production of copious literature on astronomical tables (the *zījes*) as well as on astronomical instruments (*ālāt al-raṣad*). For list of observatories, see Aydin Sayili, *The Observatories in Islam*, Turkish Historical Society Series VII, No.38, Ankara, 1960. For *zījes* and tables vide David King and Julio Samso, "Astronomical Handbooks and Tables from the Islamic World (750-1900): and Interim Report, with a Contribution by Bernard R. Goldstein", *Suhayl* (Barcelona), vol. 2 (2001), pp 9-105, reviewed by S. M. R. Ansari, *Mathematical Reviews*, May 2003, No. 2003e:01007. The enormity of the literature on instruments could be gauged by the list of extant works as given by G..P. Matvievskaya and B. Rozenfeld in their Bio-bibliography, *Mathematicians and Astronomers of Muslim Middle Ages and their Works (8-17th Century)*, in Russian, 3 volumes, Moscow, 1983, esp. Vol.3, pp. 147-152 (Revised English Translation edited by B. Rozenfeld and E. Ihsanoglu, Istanbul, 2003). It has listed 349 treatises on astrolabes, 138 on sine-instruments, 81 on quadrants, 4 on sextants and octants, 41 on armillary spheres and celestrial globes, 77 on sundials and again 77 on other instruments; in all 767 treatises. As a matter of fact the instruments developed by Islamic scholars of practical astronomy could be broadly classified into four groups.

i. *Time measuring instruments*, -- sundials, shadow quadrants;
ii. Angle *measuring instruments for determining the astronomical parameters*, -- armilla, dioptre and parallactic rulers;
iii. *Instruments for transformation of system of coordinates and/or solving nomographical problems*, -- astrolabes, quadrants, dastūr instruments;
iv. *Mathematical instruments for evaluating trigonometic functions*, -- sine-quadrants.

Out of these the most important instrument was the astrolabe, which in turn embodies all four groups of instruments to a certain extent, and thereafter quadrant and sine-quadrant (*rub' al-mujayyab*). For a selected list of famous Islamic tracts on astrolabe in particular and astronomical-mathematical instruments in general, see S. M. R. Ansari and S. A. Khan Ghori, "Two Treatises on Astronomical Instruments by 'Abdul Mun'im al-'Amili and Qasim 'Ali al-Qayini in *History of Oriential Astronomy*, Eds. G. Sawarup, A.K. Bag and K. S. Shukla, Cambridge (UK), 1987, pp. 214-225, esp. pp. 214-216. In passing we may add that the word astrolabe in Arabic orthography is *al-aṣṭurlāb* or *al-asṭurlāb*, and which word was identified by the 9th century astrologer Māshā'allāh of Baghbad as originally a Greek word, meaning "taking the stars" (*akhdh al-kawākib* in Arabic and *sitārah yāb* in Persian), whereas al-Bīrūnī (11th c.) translated it as "mirror of the stars" from the Greek word *asṭurlābon*. Al-Bīrūnī says further that he found Greek books on the construction and use of astrolabe "but not by other peoples, and that the people of the East (the Indians) do not know about the astrolabe and use only shadows". David King in his article "The Origin of the Astrolabe according to the Medieval Islamic Sources", *J. History of Arabic Science* (Aleppo), vol. 5 (1981), pp.43-83, esp. pp 44,51 presents excerpts from 34 works of Arab astronomers, with Arabic text and English translation, and examines them critically.

Evidently the purpose of those observatories and development of astronomical instruments was to collect astronomical data over long period of time by a team of astronomers who were naturally supported by the Islamic Caliphs and monarchs. As a matter of fact, that "observatory movement" and instruments making was transmitted to Medieval India, when scholars, particularly of rational sciences, came from Central Asia and Iran and who were associated with the court of rulers in Pre-Mughal and Mughal India. The details may be seen in S. M. R. Ansari, "Promotion of Astronomy by Indian Monarchs

during 15-18th centuries", *Astronomy in the Time of King Sejong* (Proceedings of the International Conference to Commemorate the 600th Anniversary of His Birth, Daejeon, Sept. 1, 1997, eds. Kyung J. Sim and Changbom Park, Korean Astronomical Observatory, 2001, pp.58-75, esp. pp.60-62). This transmission was not confined evidently to practical astronomy alone. The develc pment of theoretical Islamic astronomy was also transmitted during the medieval period and which was patronised by Indian Sultans, Mughal Emperors and even by Maharaja; a brief survey of that transmission has been given elsewhere by S M R Ansari, "On the Transmission of Arabic-Islamic Astronomy to Medieval India", *Archives Internationales d'Histoire des Science*, Vol. 45, 1995, pp. 273-297, esp. Sec. III-IV, pp. 279-286 and George Saliba, *A History of Arabic Astronomy*, (Planetary Theories during the Golden Age of Islam), New York University Press, New York, 1994. In passing we may illustrate this transmission of practical/ observational astronomy by taking the example of astrolabe. Our preliminary survey shows that presently in the Arabic-Persian manuscript collections in various Indian libraries, there are extant more that a dozen different tracts (*Risālah*) on astrolabe with multiple copies, written by medieval Indian scholars, besides several on mathematical instruments. Further, several standard texts on astrolabe (comprising its theory, method of construction and use) are also extant in multiple manuscript-copies; for instance, the detailed treatise in Arabic: *Isti'āb al-wujūh al mumkinah fi san'at al-asturlāb* (An Account of Possible Methods for the Construction of Astrolabe), by al-Bīrūnī (d.1048) in Maulana Azad Library (AMU, Aligarh) and Salar Jang Museum (Hyderabad), and another of his tract *Kitāb fī ikhrāj mā fī qūwat al-asṭurlāb ila l-fi'l* (The Realization of [computational and observational] possibilities of Astrolabe) in Raza Library (Rampur), out of his five known books on astrolabe. More important was the very popular "Twenty Chapters on Astrolabe", by Nasīruddīn al-ṬūsĪ (d.1274), of which 33 manuscript copies are extant in Indian libraries and 26 Mss in Pakistan today. This has been reported by Ansari (1995) referred to above, in Appendix I (pp.288-297), with location of extant manuscripts in Indian and Pakistani libraries. The chapters of Naṣīruddīn were also rendered into Sanskrit in 18th century. Evidently, the afore-mentioned development gave a great flip to the construction of instruments on the Indian subcontinent during the medieval period.

The Astronomical Instruments in the Rampur Raza Library (hereafter *The Catalogue*) by Prof. S. R. Sarma (Aligarh), the book under review, has to be appreciated in the context of the history of practical/observational astronomy in

Medieval India, outlined above. It consists of detailed description of 11 instruments. Sarma has classified the instruments into three groups:

i. Foreign instruments consisting of one Damascene astrolabe (13th c.) and a celestial globe (15th c.), both in Kūfī script (in Arabic *Kufi*); one French/Portuguese Mariner astrolabe (16th c.) and an English celestial globe (19th c.).

ii. Mughal astrolabes and celestial globe, comprising 2 astrolabes, one each in Persian and Sanskrit scripts; and a celestial globe, all three of 17th century.

iii. Indian instruments of the 19th century, of which are extant a celestial globe, a sine quadrant, a perpetual calendar and a device for determining the elapsed daytime (*rūznumā*) and night time (*shabnumā*).

The author has described in his *Catalogue* not only each instrument in details, illustrated with thirty three beautifully done photographs, many of them in colour; but he has also included life sketches of the instrument makers. Moreover, he gives also quite exhaustive information regarding the availability of instruments by each maker extant even in other collections. For example:

a. He compares in a table the details of the Damascene Ibn al-Sirrāj's three astrolabes extant in the collections of Salar Jang Museum (Hyderabad), Raza Library (Rampur) and National Museum, Greenwich (*The Catalogue*, p.25). The labels on these three astrolabes are in Kufic, an early Arabic script. One more Kufic astrolabe by Ibn al-Sirrāj, made in 1328/29 in Aleppo is also known. This specimen is missing in Sarma's table. It is extant in the Benaki Museum (Athens). This astrolabe is "the most sophisticated astrolabe ever made", due to its '*universal*' character, that is, it can be used for *any terrestrial latitude.* The corresponding text of this instrument by Ibn al-Sirrāj has been discovered by David King "Some Remarks on Islamic Astronomical Instruments", *Scientiarum Historia*, 18.1 (1992) 5-23, esp. pp 14-15, and plate 4. It is in the Egyptian National Library (Cairo), see footnote 14, p.14, where King cites his other references for the universal astrolabe. King mentions also the astronomer 'Alī Ibn Khalaf al-Shajjār (11th c.) who first invented the universal astrolabe. However, Sarma does mention three Kufic astrolabes by other instrument

makers *(The Catalogue*, p.26), present in India, one of which is extant in the Red Fort Museum (New Delhi).

b. Muhammad Ibn Ja' far's five extant instruments: 2 astrolabes, one each in Rabat (Morocco) and Kunstindustrimuseet (Copenhagen) and 3 celestial globes, one each in Institut du Monde Arabe (Paris), British Museum (London) and Raza Library (Rampur). The last one is in Kufi Arabic script and dated 1430-31 (*The Catalogue*, p.60).

c. Another interesting example is the perpetual calendar constructed by Joshi Dharm Chand, whose five instruments are also mentioned: 1. quadrant cum astrolabe with legends in both Sanskrit and Persian, extant in Linden Museum (Stuttgart/ Germany); 2. perpetual calendars in Persian, one each in Raza Library (Rampur) for the year 1861/62 and in National Museum (New Delhi) for 1872/73, and one undated in Victoria and Albert Museum (London) signed in English; also a part of a surveying instrument with his name both in English and Persian, extant again in Victoria and Albert Museum, London (*The Catalogue*, p.78).

So far as the Rampur astrolabes are concerned, Sarma has listed all the ('fixed') stars on the *rete* (the spider, in Arabic '*ankabūt*) with their Arabic names and has identified them by their modern names; the same for the globes also. He has tabulated also the geographical gazetteer, the tympans (plates) for various geographical latitudes and astrological data, i.e., the limits and the regents of the Zodical signs. Besides, all Arabic/Persian inscriptions on the instruments are transliterated in Roman and also translated into English quite well. In short, his description of instruments is admirably thorough and detailed.

In addition to the excellently produced Instruments Section of the *Catalogue* as sketched above, Sarma's comprehensive knowledge of astronomical-mathematical instruments in general and of Indian instruments in particular is reflected actually in his *Introduction* of 24 pages. Primarily, it is a concise historical account of the astrolabe and celestial globe. Defining the astrolabe as a device for measuring astronomical coordinates of celestial bodies and explaining its various parts, he deals with the topics, such as astrolabe and celestial globe in antiquity, their development in the Islamic world, and their transmission to Europe and India. He traces the use of astrolabe in India from

the time of Fīrūz Shāh Tughlaq (himself an astrolabe maker) down to the Lahore family of astrolabe and celestial globes makers — the School of Alāhadād (established during the reign of Mughal emperor Humayun). The major schools of astrolabists in the Islamic world are known to-date: in Baghdad (9-10th c.), Andalusia/Muslim Spain (11th c.), Isfahan/Iran (11-13th c.), Marrakesh and Seville (early 13th c.), Damuscus and Cairot (13th c.), Northern Iran and Central Asia (14-15th c.), Isfahan and Mashhed (16 -19th c.); and Lahore (16-18/19th c.), see David King, *loc cit.* (footnote 11), pp 21-23. Seven descendents or four generations of Alāhadād "signed their names on about 100 astrolabes and 25 celestial globes". The tradition of this School continued till the 19th century by Lālah Bahlūmal of Lahore and his disciple Ghulām Qādir of Kapurthala (*The Catalogue*, pp. 7-10). Besides the work of this School, Sarma has also devoted a section each on astrolabes and globes with labels in Sanskrit. We may mention that the he has dealt very well the anonymous and undated Sanskrit astrolabe extant in Rampur in all its details. According to him, very few Sanskrit astrolabes with multiple tympanes have survived, and hence adds importance to this Rampur astrolabe (*The Catalogue*, p. 53-57, esp. 53).

Further, he discusses the quadrant, horary quadrant and the sine-quadrant, the last rarely found in India. Sine-quadrant is in fact a sort of computer for solving trigonometric problems. To not is that Raza Library (Rampur) possesses a rare dated sine quadrant (in Arabic *rub' al-mujayyab*), made in 1856/57 by Jamāluddīn Muḥammad al-Ḥusaynī (*The Catalogue*, p.76).

Very important information is presented in the section on "The Celestial Globe in India" (*The Catalogue*, pp. 18-20) namely,

i. The earliest celestial globe manufactured by 'Alī Kāshmīrī in 1589 (during Akbar's reign),

ii. 16 globes manufactured by Ḍiyāuddīn Muḥammad (of the Lahore school) during 1645-1680, and one of them could be even illuminated from inside and was especially made for emperor Aurangzeb.

iii. Globes made by instrument makers not belonging to Lahore school, viz., by Muhammad Sālīh of Thatta (in 1663), Lutfullāh ibn 'Abd al-Qādir (in 17th c.), Nand Rāma of Rajasthan (in 1767), Ghulām Husayn Jaunpūrī (in 1816) and Muḥammad Na'īuddīn Murādabādī (in1841). To note is the fact that "out of 58 extant globes made by Islamic instrument makers...35 are Indian

products" (*The Catalogue* p.19). Sarma describes in details the four globes, extant in Raza Library, explaining also the different techniques of their construction.

Notwithstanding the thorough compilation and excellent production of this *Catalogue*, for which both the author and the printer must have invested plenty of time, it is a pity that there are some orthographic as well as linguistic mistakes. We mention only some of the corrections, referring the corresponding page numbers in parentheses.

Farwardīn instead of *arvardin; al-'iḍāda* for *alidade* (p.13); *burūj* instead of *burūz* for Zodiac (p.29); on p.33, col.2: *ma'kūs* instead of *ma'khūs*, *ṣan'at* instead of *ṣan'at* (second line from below) and *quṭb*; *al-jawzā* (pp. 37,66, the reading *jawjā*, which has been used almost through out the text, is not correct; the exception being the entry 18, p.30); Raḥmān (p.64); jayūb-i ma'kūs, *zill-i ma'khūs* (p.76); '*abduhū ... 'afi'anhu* (p.77, col.2); *shabnumā/roznumā* (p.85), From the table 2.1 for the list of stars, pp. 37-38, we may pick up the following — table entries marked by their serial number. We use here R.H. Allen, Star *Names, their Lore and Meaning*, Dover, New York, 1963, and also Manṣur Jardāq, *Astronomical Dictionary, the Zodiac & the Constellations* (with star-names, their meaning, translation and pronunciation), in Arabic and English, *Jāhiza*, undated. This dictionary has been arranged according to Roman alphabet, with an Arabic index of star-names and proper names. As regards No.2 (table no 2.1), *rijl al-musalsalah* without the word *kaffah*, foot of the chained [woman], for γ Andromedae, almac (modern name). Entries of different columns in the *Catalogue* are marked here simply by commas. No.8. '*azal[al-dajājah]*, the tail(hind part) of the swan, π-cygni, azelfage(modern). This seems to be plausible, if the word 'azal is read correctly. No.9. '*ayyūq* means pretty, dandy. No.41. Since *kaff al-khaḍīb* is β Cassiopeiae (No.3 of the table), the Arabic star name of this entry should be something else. Actually only Arabic names for five/six stars of this constellation are given in our references, viz, α,β,δ,ε,θ/μ, but not ρ. It is interesting to note that ρ Cas is the last (13th) star of this constellation, which has been listed by Ulugh Beg in his *Catalogue of Stars*. But he does not give any Arabic name for this star; hence lies the importance of the correct reading of the name of this star.

We recommend that both tables 1.2 and 2.1 may be revised for the correct reading and transliteration of star-names in Arabic, besides correcting the diacritical marks in general. Further, for the sake of using this book also as a reference tool, an index of Arabic as well as of Sanskrit words particularly and

a general index — a standard practice today — may also be included in any future edition of this important publication.

Finally we congratulate Dr Viqar Siddiqi, the publisher, for sponsoring this excellent publication and also Mr. Tanzim Raza Qureshi, the printer, for his superb production and printing comparable to any international publication. Moreover, it is our ardent wish that other Indian Libraries, such as Khuda Bakhsh Library (Patna) and Salar Jang Museum Library (Hyderabad), might emulate by engaging Prof. S. R. Sarma to compile a similar catalogue of instruments extant in their collections. Sarma has already worked on them and even published preliminary surveys of those instruments. Last but not the least, all historians of Indian astronomy look forward eargerly for the publication of the comprehensive, authoritative and unique *Catalogue of Indian Astronomical and Time Measuring Instruments*, which Sarma has been compiling all alone for sometime. We wish him all success in this tremendous task.

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