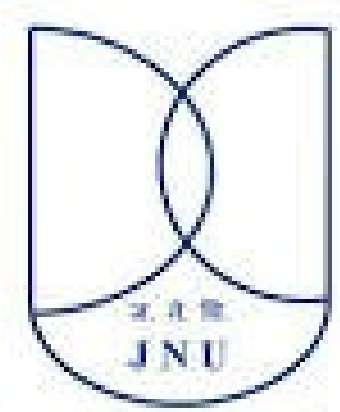


# An Analytical Study of Traditional Knowledge in Indian Astronomy during Ancient and Medieval Period



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## Introduction

- India has a rich legacy in astronomical traditions dating back more than two millennia.
- The remarkable contributions by Aryabhata, Varahamihira, Brahmagupta, Bhaskara-I and Bhaskara-II glorify heritage in Indian astronomy.
- It is interesting to note that of all science disciplines, astronomy is the first stepping stone towards the scientific mission of systematic observations followed by mathematics.
- The astronomy here indicates only observational or positional astronomy, which introduced the concept of linking movement of celestial objects and seasons on the earth.

## Ancient & Medieval Indian Astronomy

- The main observatories were at Ujjain, Banaras, Mathura, Jaipur and Delhi. The first two were the old observatories.
- The one at Delhi was first organized by Humayun (16<sup>th</sup> Cen.) at Sher Mahal. A few observational posts were erected at the time of Firoze Tughlaq (14<sup>th</sup> Cen.) and finally by Raja Sewai Jai Singh II of Jaipur (18<sup>th</sup> Cen.).
- Astronomical knowledge is recorded in the Jyotish Vedanga and Pancha Siddhantas. They were Paitamaha, Vasistha, Paulisa, Romaka and the Surya-Siddhanta.
- Surya-Siddhanta had a major influence on Indian Astronomical tradition and all the later contributors and other scientific works owe much, if not all, to it.

## Indian Astronomical Traditions and Noted Astronomers

(As listed on Wikipedia)

### Ancient

- Baudhayana sutras (fl. c. 900 BCE)
- Yajnavalkya (700 BCE)
- Manava (fl. 750–650 BCE)
- Apastamba Dharmasutra (c. 600 BCE)
- Pāṇini (c. 520–460 BCE)
- Kātyāyana (fl. c. 300 BCE)
- Akspada Gautama (c. 600 BCE–200 CE)
- Bharata Muni (200 BCE–200 CE)
- Pingala (c. 3rd/2nd century BCE)

### Classical

(Post-Vedic Sanskrit to Pala period Mathematicians, (2<sup>nd</sup> Cen. BCE to 11<sup>th</sup> Cen. CE)

- Bhadrabahu (367 – 298 BCE)
- Umasvati (c. 200 CE)
- Yavaneśvara (2nd century)
- Vasishtha Siddhanta (4th century CE)
- Aryabhata (476–550 CE)
- Yatirvrsabha (500–570)
- Varahamihira (505–587 CE)
- Yativṛṣabha, (6th-century CE)
- Virahanka (6th century CE)
- Brahmagupta (598–670 CE)
- Bhaskara I (600–680 CE)
- Shridhara (between 650–850 CE)
- Lalla (720–790 CE)
- Virasena (792–853 CE)
- Govindasvāmi (800 – 860 CE)
- Prithudaka (830–890 CE)

### Classical (Cont.)

- Śāṅkaranārāyaṇa, (840 – 900 CE)
- Vaṭeśvara (born 880 CE)
- Mahavira (9th century CE)
- Jayadeva (9th century CE)
- Aryabhata II (920 – 1000 CE)
- Vijayanandi (940–1010 CE)
- Halayudha (10th Century CE)
- Śrīpati (1019–1066 CE)
- Abhayadeva Suri (1050 CE)
- Brahmadeva (1060–1130 CE)
- Pavuluri Mallana (11th century CE)
- Hemachandra (1087–1172 CE)
- Bhaskara II (1114–1185 CE)
- Someshvara III (1127–1138 CE)

### Medieval Period (1200–1800 CE)

#### • Kerala School of Mathematics and Astronomy

- Madhava of Sangamagrama
- Parameshvara (1360–1455 CE), discovered drk-ganita, a mode of astronomy based on observations
- Nilakantha Somayaji (1444–1545 CE), mathematician and astronomer
- Shankara Variyar (c. 1530)
- Jyeshtadeva (1500–1610 CE), author of Yuktibhāṣā
- Achyuta Pisharati (1550–7 July 1621), mathematician and astronomer
- Melpathur Narayana Bhattathiri (1560–1646/1666)

### MATHEMATICS

WRITER	WORKS
ARYABHATA	Aryabhatiya, Arya-siddhanta
BAUDHAYANA	Shulba Sutras, Shrauta Sutra, Dharmasutra
BHASKARA I	Aryabhatiyabhaṣya, Mahabhaskariya, Laghubhaskariya
BHASKARA II	Siddhanta Shiromani (four volumes: Lilavati, Bijaganita, Grahaganita and Goladhyāya)
BRAHMAGUPTA	Brahmasphutasiddhanta
HALAYUDHA	Mrtasanjivani
MAHAVIRA (MATHEMATICIAN)	Ganit Saar Sangraha
PARAMESHVARA	Bhatadipika, Karmadipika, Paramesvari, Sidhantadipika, Vivarana, Drgganita, Goladipika, Grahanamandana, Grahanavyakhyadipika, Vakyakarana
VARAHAMIHIRA	Pancha-Siddhantika, Brihat-Samhita, Brihat Jataka, Daivaigya Vallabha, Laghu Jataka, Yoga Yatra, Vivaha Patal
VIRASENA	Dhavala
BAUDHAYANA RISHI	Baudhayana Sutras, Baudhāyana Sulbasūtra, Baudhāyana Dharmasūtra

### Medieval Period (1200–1800 CE) (Cont.)

- **Navya-Nyāya (Neo-Logical) School**
- Raghunatha Siromani (1475–1550)
- Gangesha Upadhyaya (first half of the 14th century)
- **Others**
- Munishvara (17th century)
- Kamalakara (1657)
- Narayana Pandita (1325–1400)
- Mahendra Suri (14th century)
- Mulla Jaunpuri (1606–1651)

## Discussion

The footstep of modern astronomy in India was in tow with the Europeans. The earliest recorded use of a telescope in India was by Jeremiah Shakerley (1626-1655), who viewed the transit of Mercury in 1651 from Surat in western India. In 1689, Jesuit priest Father Jean Richaud (1633-1693) discovered from Pondicherry that the bright star Alpha Centauri is a double-star. In 1764, Major James Renell (1742-1830) was appointed as the East India Company surveyor and astronomy was hitherto used in the process of surveying. This particular application of astronomy paved the way towards the institutionalisation of modern astronomy in India. In 1787, Madras Observatory was initiated by William Petrie, an officer of the East India Company with the use of two 3" achromatic telescopes, two astronomical clocks and a transit instrument. Around hundred and ten years later in 1899, astronomical activity of the observatory was shifted to Kodaikanal and Madras observatory became a purely meteorological observatory.

The systematic solar observations were commenced at Kodaikanal Observatory in early 1901. As per B. K. Sen, there were 103 observatories in India in 1878, which was increased to 128 in 1885.

## Conclusion

- There is a need prepare a compendium of works of Indian Astronomers and Mathematicians and preserve the Indian Traditional Knowledge in the domains of Mathematics, Astronomy and Astrophysics.
- There is a need for popularizing concepts and ideas of Indian Mathematicians, Astronomers, and Astrophysicists amongst the school and college going students and general public.

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# **An Analytical Study of Traditional Knowledge in Indian Astronomy during Ancient and Medieval Period**

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## **1. Introduction**

The basic idea of all branches of science essentially includes the concept of natural laws to visualize the natural phenomena as an ordered sequence of events linked together by a chain of cause-and-effect relationships. It is interesting to note that of all science disciplines, astronomy is the first stepping stone towards the scientific mission of systematic observations followed by mathematics. The astronomy here indicates only observational or positional astronomy, which introduced the concept of linking movement of celestial objects and seasons on the earth. India has a rich legacy in astronomy dating back more than two millennia. The remarkable contributions by Aryabhata, Varahamihira, Brahmagupta, Bhaskara-I and Bhaskara-II glorify heritage in Indian astronomy. However, the footstep of modern astronomy in India was in tow with the Europeans. The earliest recorded use of a telescope in India was by Jeremiah Shakerley (1626-1655), who viewed the transit of Mercury in 1651 from Surat in western India. In 1689, Jesuit priest Father Jean Richaud (1633-1693) discovered from Pondicherry that the bright star Alpha Centauri is a double-star. In 1764, Major James Renell (1742-1830) was appointed as the East India Company surveyor and astronomy was hitherto used in the process of surveying. This particular application of astronomy paved the way towards the institutionalisation of modern astronomy in India. In 1787, Madras Observatory was initiated by William Petrie, an officer of the East India Company with the use of two 3" achromatic telescopes, two astronomical clocks and a transit instrument. Around hundred and ten years later in 1899, astronomical activity of the observatory was shifted to Kodaikanal and Madras observatory became a purely meteorological observatory. The systematic solar observations were commenced at Kodaikanal Observatory in early 1901. Apart from the study of the sun to which the observatory was primarily devoted, magnetic, meteorological and seismological observations were also carried out there since inception. As reported by B. K. Sen, there were 103 observatories in India in 1878, which was increased to 128 in 1885. All these observatories carried out observations, and many of them brought out varieties of periodic publications, though any periodical or journal solely devoted to astronomy did not appear in India before the year 1902.

## **2. Objectives**

This paper intends to present some glimpses of the traditional knowledge of Indian astronomy during ancient and medieval periods.

### **3. Methodology**

The study will be carried out using the secondary sources of information, including the Web of Science, Scopus, Google Scholar and other bibliographic databases.

### **4. Results and Significance of the work**

The first research articles on modern astrophysics were published in Asiatic Researchers. Nearly 70 research articles on modern astrophysics were published from India up to independence. The article highlights the significant works carried out by the Indian astronomers during the ancient and medieval period, emphasizing the prominent ones as reflected in the the books of History of Indian Science.

**References** (Font size 10, Bold, Single spacing). Include the original texts, research articles, web links, etc.

1. Das, G., Das, A. K., & Dutta, B. (2021). Exploring 120 years of Indian physics and astronomy journals. *Annals of Library and Information Studies*, 68(3), 238-257.
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