



A Historical Perspective on Jesuits' Contribution to Astronomy: From Rachol and Beyond

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“True faith is not hostile to science, but both are like two rays coming from the same Sun which should illuminate our mind by the way of truth” (Angelo Secchi)¹

“Although the spread of the Christian faith was the most important plan of the Jesuits, their activities had a scientific dimension about them also, being the first European men of learning in India” (R. Kochhar)²

Introduction

Humans, from time immemorial have marveled at and tried to comprehend the mystery of the vast celestial cosmos. Even the cosmic elements were put in his own service such as to predict weather for cultivation purpose, for navigational needs or even to know his own relation with the cosmos. This relentless effort to unravel and understand the ‘book of nature’ over the years evolved into a scientific discipline called astronomy. The invention of telescope in 1609 by Galileo Galilei brought revolutionary changes in our understanding

of the universe. College of Rachol, the Rachol Seminary of today, St. Paul's College (Old Goa) and the island of Divar played very important role in the birth of the telescopic astronomy in India. Hence, the first use of this telescope in India is credited to Goa. Thanks to Ramesh Kapoor for bringing to light the importance of this event.³ To understand this unique contribution we will first consider Indian astronomy in antiquity. Next, we shall study Jesuit engagement with science and its first use of telescope in Goa. Following we shall try to understand the revolution it produced in India through Jesuit engagement with astronomy and close with some remarks about faith and astronomy.

1. Indian Astronomy in Antiquity

India has a rich and long tradition of astronomy. It was influenced by Greek and Arab astronomy. The mathematical, or Siddhantic astronomy came with the interaction with Greeks in post-Alexandrian period. This kind of astronomy was concerned with calculation of geocentric planetary orbits and developing algorithms for the solution of the mathematical equations that arose in the process.⁴

Another was, the Zij astronomy. This period was known for the preparation of astronomical tables which can be categorized into three: (i) "*Zij-e-Rashadi* (direct tables) based on actual observations; (ii) *Zij-e-Hisabi* (calculated tables) obtained by correcting observational tables for errors, precession, etc.; and (iii) *Zij-e-Tas'hil* (simplified tables) which were simplified versions of other tables, for example, for the moon alone." It developed in 9th century in Baghdad⁵ and made its debut in India in 14th century.⁶

There were also books on astronomy. The oldest known text is *Vedanga Jyotisha*, dated about 1400 BC.⁷ Other

treatise on astronomy were *Siddhantas* and *Karanas*. Some of the astronomical instruments were *Yasti Yantra*, *Ghatti Yantra*, and *Gola Yantra*. Some of the well-known Indian astronomers of antiquity are Aryabhata I, Latadeva (505), Varahamihira (c.505), Bhaskara I (c.574), Bharmagupta (b.598), Lalla (c.638 or c.768), Manjula or Munjala (932), Shripati (1039) and Bhaskara II (b.1114).⁸

Ancient Indian astronomy laid more stress on computational than observational aspect. There were also a few observational instruments. It was a mixture of astrology and astronomy, which was generally used to know the auspiciousness of events and their timings. However the modern science was introduced in India by the Europeans and in particular the Jesuits.

2. European Engagement: Jesuits as Men of Science

The engagement of Jesuits in scientific activities is to be understood in the historical, social and religious context.

a. Historical Factor: The maritime powers, Portugal and Spain, were on mission of discovering sea-routes, an alternate to the East. The discovery of sea route to India in 1498 started to navigate the European powers to the shores of India. As the navigational needs aroused, it spurred development in science. Beginning from 15th century, astronomy started to develop more on practical lines than pure science in Europe. The overseas expeditions had to meet navigational and geographical requirements, as a result new instruments were invented to aid the mariners and cartographers which resulted in the discovery of astronomical quadrants, sextants, telescopes and chronometers.⁹ Maps became crucial which had to be drawn based on astronomical observations.¹⁰ Therefore, observatories came to be patronized by governments.

b. Social Factor: During this period of the modern science, the Jesuit Society was born in 1534. Therefore, disciplines like mathematics and astronomy became part of Jesuit training, knowing the social demands and importance in apostolic work.¹¹ The *Constitutions* and the *Ratio Studiorum* mentions the benefit of studying the liberal arts and the natural sciences as intellectual preparation for the study of theology,¹² to teach philosophy, as apologetic argument for those seeing Church as against science, to counter superstitious practices, etc.

c. Religious Factor: Steven J. Harris explains the involvement of Jesuits in scientific endeavors as an “apostolic spirituality”. The Jesuits see scientific activities as service to God through the apostolic ministry to men and knowledge leading to the path of salvation. They hold learning in esteem, believing that it leads to sanctification.¹³ Jesuits believe “finding God in all things” therefore whether observing galaxy or drawing maps all such profane activities is form of spirituality to Jesuits. Therefore, when science was considered alien to religion, Jesuits ventured in this field to show its compatibility with science as a vehicle to find God. And observatories became their ‘parishes’¹⁴

The Jesuits who came to India were astronomers, cartographers, geographers, and architects. They engaged in science in many ways such teaching scientific disciplines, involving in public debates and carrying out astronomical observations, etc.

3. Tryst with Telescope in Goa: Birth of Telescopic Astronomy in India

The men of cloth being men of science would carry not just Gospel but also European science. In a similar fashion, a Jesuit priest from Kadan, Wenceslaus Pantaleon Kirwitzer

(ca. 1589–1626), a member of the *Collegium Romanum*, was in Goa while on his sojourn to China.¹⁵ Kirwitzer who was part of the mission destined for China was one among the group of 22 missionaries, who had set sail from Lisbon on April 1618 led by Nicolas Trigault (1577–1628) which included some priest-astronomers Giacomo Rho (1592–1638), Johannes Schreck-Terrentius (also Terrenz; 1576–1630) and Adam Schall von Bell (1592–1666). They had carried with them a few telescopes, some measuring instruments, and a large number of books. They entered Goa on 4 October 1618. While this halt was made, two great comets appeared in the morning skies of November in quick succession. Since this would require joint efforts and astronomical instruments, Kirwitzer wrote to his fellow Jesuits: Fr. Jacobus Rho at Goa and Fr. Antonius Rubinus at Cochin. Hence, in Goa, the observations were done at *Collegio Rachol*, Insula Ivari (Divar) and at St. Paul College (Old Goa). Kirwitzer mentions that he made use of the telescope to observe the comets but the type of telescope used is not known. It could have been Galilean telescope with a mount or hand-held one with draw-out tubes. These Jesuits also made use of other astronomical instruments namely astrolabe and astronomical radius, i.e., cross-staff.¹⁶

The first comet was observed from 10th to 30th November. However, on certain days it was not possible due to the cloudy sky. Kirwitzer made the observation from Divar and Old Goa while Fr. Jacobus Rho observed it from Rachol and Old Goa. The second comet was seen on 24th November. On the same day it was observed by Fr. Johannes Terrentius from the fields of Rachol College. This particular comet was observed till 12th January 1619.¹⁷

What did the observers saw and measured? Namely, the altitudes and azimuths, angular distance from stars like Spica etc. in grad (degrees), and the observers' visual impressions, including difficulty from illumination due to the moon and sunlight. Later, these observations were collated and published in a monograph titled *Observationes Cometarvm Anni 1618. In India Orientali Factae a Societatis iesv Mathematicis in Sinese Regnum Nauigantibus ex Itinere eo Delatis*.¹⁸ This was published by Schönwetter in Ursellis, in the year 1620.¹⁹

These comets were also independently observed by the fourth Mughal Emperor of India Jahāngīr (1569–1627) with the use of astronomical instruments namely astrolabes, accurate water-driven clocks (clepsydras), sundials and sand-glasses.²⁰

The significance of this event is twofold: firstly, it was the first modern astronomical observation in India and secondly, the first use of optical device (telescope) for astronomical observation in India, dated November 10th 1618 – this makes Goa the birth place of telescopic observation in India and not Surat as was previously believed.²¹

This has put Goa and Rachol Seminary in particular on the world map for its scientific contribution. What is more interesting is that if Fr. Kirwitzer, a Jesuit priest from Europe came and contributed to the Indian astronomy in the past; today we have our very own Goan Jesuit priest Fr. Richard D'Souza working at the Vatican observatory and contributing at a universal level. He had stormed the headlines last year by discovering a long-lost sibling galaxy of the Milky Way.

Rachol Seminary, continues to promote science through various ways such as seminars, publications and has even

produced stalwarts in the field of science like late Fr. Antonio Francisco Souza. Fr. Victor Ferrão, former student and currently a professor in the Rachol Seminary became the first person in India to do his doctorate in the field of science and religion.

4. Astronomical Principles in Religious Architecture of Goa

As part of broader evangelization mission, Jesuits raised religious architecture. Sarvesh Sinai Borkar, a local archo-astronomy enthusiast and researcher opines that those Churches that are east-west facing, constructed between 16-17th centuries has made use of astronomical principles in their architecture in various ways. For instance, use of controlled light to illumine certain portions, on specific days of the year, at a particular time.²² This type of astronomical marvel was witnessed in the Holy Spirit Church, Margão which is a Jesuit construction. A beam of light was shining before sunset on equinox, on the image of Holy Spirit on the main altar and two other side altars.

Some of the Churches even served as practical observatories that based on the rising and setting of the sun aligned on the equinox and solstice day with the western and eastern entrance.²³ Many Churches even had astronomical instruments like sun-dial watches. Such watches are seen in Jesuit built Churches even today such as Lotoulim and Verna. Rachol Seminary which is also a Jesuit architecture has two such sun-dials one painted on the seminary courtyard and another made of stone.

The reasons for incorporating such astronomical principles probably was to show relation of human activities to

the cosmos, to maintain time, to determine the day of the equinox and for other religious purpose.

5. India as an Observatory: Involvement of Jesuits in India

As we have seen, Jesuits who came to the “mission fields” were trained in practical astronomy²⁴ and considered India as “theater for their apostolic work”.²⁵ Known for their scientific scholarship, Jesuits soon found favour with the Mughal emperors and local rulers in their courts such as Emperor Akbar (1542-1605) and king-astronomer of Ajmer, Raja Jai Singh II. By 17th cent. telescopes were available in India. Jesuits were involved in exploring the hinterland as they had expertise, time and opportunity, unlike the European traders.²⁶ Jesuits had to explore local astronomical traditions, document their methods and search sightings of historical astronomical events. Reports of all their activities and observations had to be sent to the *Padroado* authorities²⁷ which are known as *Annual Reports and Edifying Letters*, which became a mine of information for the scientist and academies of sciences.²⁸ The missionaries who provided the knowledge of Asian world was benefited by the Europeans in several ways irrespective of the Jesuit intention. The French Jesuits were involved more in astronomical observation than the Portuguese Jesuits due to their intellectual traditions and social orderings.²⁹ Many were members of the *Academia des Sciences*.

It is also to be noted that the Jesuits were constrained or could not bring to India all the advanced knowledge of science due to the certain Church ideologies it held on to.³⁰ Therefore, the knowledge of Copernican heliocentrism was not introduced.³¹ It is also said that with the exception of few like Boudier and Tieffenthaler, Jesuits in India were not so

great astronomers. Historian of science S.N. Sen states that the contribution of Jesuits in modern astronomy to China is comparatively more than India. However, Dhruv Raina, is of the opinion that these hypothesis needs revision. He says that though it was on grand scale in China, French Jesuits in India provided impetus and historical inquiry into ancient Indian astronomy. Also the efforts of Jesuits, in China and India, complemented each other.³² Dhruv, also says that, the critique that Jesuits of India were not the best scientists and were not in contact with the leading scientists of Europe comparatively to Chinese counterparts is an overstatement. The reports of French Jesuit scientist in India became a source material for the French astronomers for three generations.

I would like to highlight some of the contribution of the Jesuit priests. Fr. Anthony Monserrate (1536-1600), was a first Jesuit geographer in India. Based on his astronomical observations, he formed a partial map of India.³³ Fr. Jean-Venant Bouchet (1655-1732) surveyed the peninsula, and his interior map is considered as “the first map of any merit”, dated 1722.³⁴ Fr. Jean Richaud is credited for the first astronomical discovery from India. He discovered in 1689 the bright southern star Alpha Centauri. Fr. Claude Stanislaus Boudier (1686-1757) was a “skilled telescopic observer”³⁵ determined latitudes and longitudes of around 60 Indian cities.³⁶ Fr. Joseph Tieffenthaler (1710-1785), carried out astronomical observations in different part of India including Goa.³⁷ He observed the transit of Mercury in Goa on 4 November, 1743.³⁸

Jesuits made important contribution in the field of positional astronomy and cartography. As a result of Jesuits introduction of telescopic astronomy many observatories

came up in India, which was later institutionalized by East India Company. It also gave rise to photographic and spectroscopic astronomy attracting European solar physicist.³⁹ Based on the contribution of Jesuits India has made great progress in the field of astronomy.

6. Engagement or Estrangement: Importance of Astronomy in Religion

The Church Fathers were against astronomy for the reasons that it does not benefit one's salvation but rather limits God's omnipotence and hence the knowledge should be reserved only to God.⁴⁰ However, the Jesuit astronomers proved it to be beneficial as it gives the knowledge of God. Some Jesuit-astronomers like Christopher Clavius says astronomy leads men to God. Giovanni Battista Riccioli states it is a noble science that leads to the habitation of God while Franciscus Levera says it strengthens love of God as well as abolishes idolatry.⁴¹ Johannes Kepler concurs with similar thoughts that astronomy gives 'knowledge, admiration and worship of the omniscient God'⁴² also, exploring heavens leads man to his original mission that is *imago dei*. Philosopher Francis Bacon is of the opinion that studying the cosmos is a recovery of power and sovereignty man once possessed in the paradise.⁴³

What does the contribution of the Jesuit missionaries in astronomy suggest? That faith and science can harmoniously exist together and both can enrich each other in the understanding of God and cosmos. It is often portrayed that there is a warfare between religion and science. Infact, modern science is an invention of medieval Christianity. In his speech in Regensburg, Germany on September 12, 2006, Pope Benedict XVI said that it was due to Christianity's emphasis on the importance of reason that science developed in

Europe, in the civilization then called as Christendom. Many of the scientists were clergymen like Georges Lemaitre, a priest-astronomer from Belgium who first proposed the “Big Bang Theory” for the origin of universe and Gregor Mendel an Augustinian monk who is considered as “father of modern genetics”. Similarly many of the towering figures of science such as Nicolaus Copernicus, Galileo Galilei, Johannes Kepler, Tycho Brahe and others were Christians. Scholar Dinesh D’Souza in his work *What’s So Great About Christianity* poses for us a question: “Where would modern science be without these men?”⁴⁴

Church still engages and promotes science, hence we have ‘Pontifical Academy of Sciences’ and the ‘Vatican Observatory’ at Holy See, established to promote true science. Therefore, what biologist Joshua Lederberg said is true “what is incontrovertible is that a religious impulse guides our motive in sustaining scientific inquiry.”⁴⁵

Conclusion

Rachol Seminary has a distinct place for its contribution in the field of astronomy and an institution that has fostered scientific culture. It will be remembered in history as an institution that has endured exchange between Europe and India, the East and West. One cannot undermine the contribution of Jesuits in Goa and beyond who gave rise to the beginning of modern science in India. These men of cloth were not just proclaimers of the ‘book of scripture’ but unraveled the ‘book of nature’ too so that God may be known and glorified. Church, which considers ‘evangelization as its identity’ does not shun away from this scientific culture but continues to make best use of it for evangelization. Science therefore is

not just for scientists but for all of us to make use of, to know more about God and to proclaim His wonders by studying the colossal cosmos.

Notes

- 1 Agustín Udías, “Jesuit Scientific Tradition and Ignatian Spirituality,” *Lo Sguardo - Rivista di Filosofia*, vol. 10 (2012): 212-213.
- 2 R. K. Kochhar, “Secondary Tools of Empire: Jesuit Men of Science” in *Discoveries, Missionary Expansion an Asian Culture*, eds. Teotonio Souza and Gregory Naik (New Delhi: Concept Publishing Company, 1994), 175.
- 3 Ramesh Kapoor, “The First Astronomical Use of the Telescope in India,” in *Growth and Development of Astronomy and Astrophysics in India and the Asia-Pacific Region*, eds. W. Orchiston, A. Sule and M.N. Vahia, Mumbai, Tata Institute of Fundamental Research, 2018): 34-39.
- 4 Ibid.
- 5 Ibid, 6.
- 6 Chander Mohan, *Story of Astronomy in India*, (Publisher author, 2016), 95.
- 7 R. K. Kochhar, “Historical Perspective” in *Astronomy in India: A Perspective*, eds. R. K. Kochhar and Jayant Narlikar (New Delhi: Indian National Science Academy, 1995), 1.
- 8 R. K. Kochhar, “Historical Perspective”, 1.
- 9 S.M. Razaullah Ansari, “Introduction of Modern Western Astronomy in India during 18-19 Centuries,” (New Delhi: Institute of History of Medicine and Medical Research, 1985), 369.
- 10 Ibid, 370.
- 11 Agustín Udías, “Jesuit Scientific Tradition and Ignatian Spirituality,” 207.
- 12 Jesuits and Science, 75.
- 13 Agustín Udías, “Jesuit Scientific Tradition and Ignatian Spirituality,” 209.
- 14 Ibid, 212.

- 15 Ramesh Kapoor, "The First Astronomical Use of the Telescope in India," 36.
- 16 Ibid, 36-37.
- 17 Ibid.
- 18 R.C. Kapoor, "Nur Ud-Din Jahangir and Father Kirwitzer: The Independent Discovery of the Great Comets of November 1618 and the First Astronomical Use of the Telescope in India" [paper on-line] (accessed on 5 November, 2018); available from <http://www.narit.or.th/en/files/2016JAHHvol19/2016JAHH...19.264K.pdf>; Internet.
- 19 Ramesh Kapoor, "The First Astronomical Use of the Telescope in India," 36.
- 20 Ibid, 35.
- 21 Ibid, 36.
- 22 Sarvesh Sinai Borkar, "The Astronomical Mysteries of Goan Churches," [article on-line] (accessed on 28 December, 2018); available from <http://goengaged.com/astronomical-mysteries-goan-churches/>; Internet.
- 23 Ibid.
- 24 S.M. Razaullah Ansari, "Introduction of Modern Western Astronomy in India," 371.
- 25 Dhruv Raina, "French Jesuit Scientists in India: Historical Astronomy in the Discourse on India, 1670-1770" *Economic and Political Weekly*, vol. 34, no. 5 (1999): 32.
- 26 Jose Kalapura, "India and East-West Interaction: The Jesuit Contribution, 16-18th Centuries," [paper on-line] (accessed on 28 December, 2018); available from <https://ceaa.colmex.mx/aladaa/imagesmemoria/josekalapura.pdf>; Internet.
- 27 Ibid, 2-3.
- 28 Ibid, 4.
- 29 Dhruv Raina, "French Jesuit Scientists in India," 31.
- 30 Jose Kalapura, "India and East-West Interaction: The Jesuit Contribution, 16-18th Centuries," 4.
- 31 R. K. Kochhar, "Science in British India," *Current Science*, vol.63, no.11, (10 December 1992): 691. See also Dhruv Raina, "French Jesuit Scientists in India," 31.
- 32 Ibid, 30.

- 33 Amitabha Ghosh, "Astronomy in Ancient, Medieval and Early Telescopic Era of India," [paper on-line] (accessed on 28 December, 2018); available from <http://textofvideo.nptel.ac.in/121104006/lec1.pdf>; Internet.
- 34 S.M. Razaullah Ansari, "Introduction of Modern Western Astronomy in India," 371.
- 35 Dhruv Raina, "French Jesuit Scientists in India," 33.
- 36 S.M. Razaullah Ansari, "Introduction of Modern Western Astronomy in India," 372.
- 37 R.K. Kochhar, "Secondary Tools of Empire: Jesuit Men of Science in India," 3.
- 38 S.M. Razaullah Ansari, "Introduction of Modern Western Astronomy in India," 373.
- 39 R. K. Kochhar, "Historical Perspective" in *Astronomy in India: A Perspective*, eds. R. K. Kochhar and Jayant Narlikar (New Delhi: Indian National Science Academy, 1995), 15
- 40 Daniel Špelda, "The Importance of the Church Fathers for Early Modern Astronomy," *Science & Christian Belief*, vol. 26, no. 1 (2014): 25.
- 41 Ibid, 33.
- 42 Ibid, 34.
- 43 Ibid, 38.
- 44 Dinesh D'Souza, *What's So Great About Christianity*, (Mumbai: Jaico Publishing House, 2011), 95-97.
- 45 Ibid, 99.