

EXPLORING THE FIRST SCIENTIFIC OBSERVATIONS OF LUNAR ECLIPSES MADE IN SIAM

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Abstract: The first great ruler to encourage the adoption of Western culture and technology throughout Siam (present-day Thailand) was King Narai, who also had a passion for astronomy. He showed this by encouraging French and other Jesuit missionaries, some with astronomical interests and training, to settle in Siam from the early 1660s. One of these was Father Antoine Thomas, and he was the first European known to have carried out scientific astronomical observations from Siam when he determined the latitude of Ayutthaya in 1681 and the following year observed the total lunar eclipse of 22 February. A later lunar eclipse also has an important place in the history of Thai astronomy. In 1685 a delegation of French missionary-astronomers settled in Ayutthaya, and on 10–11 December 1685 they joined King Narai and his court astrologers and observed a lunar eclipse from the King's 'country retreat' near Lop Buri. This event so impressed the King that he approved the erection of a large modern well-equipped astronomical observatory at Lop Buri. Construction of Wat San Paulo Observatory—as it was known—began in 1686 and was completed in 1687. In this paper we examine these two lunar eclipses and their association with the development of scientific astronomy in Siam.

Keywords: Siam, King Narai, lunar eclipses, Ayutthaya, Jesuit astronomy, Lop Buri, Wat San Paulo Observatory

1 INTRODUCTION

The Jesuits are an order of the Roman Catholic religion with a long tradition in science, and especially astronomy (Udias, 2003). While the astronomical activities of European Jesuits in Beijing during the seventeenth century are well known (e.g. see Needham, 1959; Pigatto, 2004; Udias, 1994), few astronomers are aware that French Jesuits triggered the emergence of scientific astronomy in Siam (present-day Thailand) and India (see Kochhar, 1991; Rao et al., 1984) during this same century.

Jesuit astronomers were responsible for the first scientific astronomical observations made in Siam, in 1681–1682 and 1685, and in each instance a total lunar eclipse was involved. This paper examines these two events, and forms part of a larger research project that is described in Orchiston et al. (2016b).

But before we examine these eclipses we should meet King Narai who was largely responsible for the introduction of scientific astronomy in Siam.

2 KING NARAI: A BIOGRAPHICAL SKETCH

One of the most revered of Thailand's historic rulers, 'King Narai the Great' (Figure 1) was born in 1633 and died prematurely on 11 July 1688. He was the fourth king to rule during the

Prasat Dynasty, which was the fourth of the five Dynasties of the Ayutthaya Kingdom (see Table 1). Narai became the King of Ayutthaya in 1656, when just 23 years of age, and remained on the



Figure 1: A contemporary French sketch of King Narai dressed in Persian attire (en.wikipedia.org).

Table 1: Thai kingdoms and dynasties. King Narai ruled during the Prasat Dynasty.

Kingdom	Duration (years AD)	Dynasty
Sukhothai	1238–1438	
Ayutthaya	1350–1767	Uthong
		Suphannaphum
		Sukhothai
		Prasat
		Ban Phlu Luang
Thonburi	1767–1782	
Rattanakosin/ Thailand	1782–	

throne until his death. Upon his succession King Narai

... inherited a large and powerful kingdom in the centre of mainland South-East Asia. His realm reached south to the kingdoms of Pattani, Ligor, Phattalung and Songkhla; in the east Cambodia had acknowledged Ayutthaya's suzerainty, and in the west the port of Tenasserim on the Bay of Bengal was under Thai control. (Hodges, 1999: 36; for Thai localities mentioned in this paper see Figure 2).

Despite his comparative youth, from the start King Narai was an astute politician and a skilled military strategist. To stabilize the political environment in northern Siam he occupied Chiang Mai in 1662 and later that year and in 1663 he occupied parts of present-day Myanmar in order to pre-empt a Burmese invasion of Siam. However, his troops subsequently abandoned both



Figure 2: A map showing Thailand localities mentioned in the text (map: Wayne Orchiston).

regions and concentrated on consolidating their military presence in the Ayutthaya-Lop Buri-Bangkok area. Towards this end, forts designed by French engineers were erected in these cities and other cities in Siam.

King Narai also was very active in international affairs, and he saw exposure to Eastern and Western civilizations as a way of developing Siam. Thus, he signed treaties with England, France, Holland and Persia and expanded trade between Siam and India, Indonesia, China and Japan. These initiatives led to a proliferation of international trade, and cemented "... Ayutthaya's reputation as an 'emporium of the East' ..." at this time, which rested largely "... upon her role as a focus for the trans-shipment of goods between Europe/India and China/Japan ..." (Sternstein, 1965: 108). Because of his enlightened policies we could regard King Narai as

... a strange but also positive anachronism—or precursor—for the Siam of the time. Not only [because of] his wide spirit of religious tolerance but also his positive interest in faraway lands, their customs, religions and peoples ... (Sioris, 1992: 60).

In 1675 a Greek adventurer named Constantine Phaulkon (1647–1688; Figure 3; Sioris, 1988) came to Siam. He quickly learnt Thai, and being fluent already in English, French, Portuguese and Malay joined King Narai's court as a translator. Thanks to his prior experience with England's East India Company he quickly emerged as one of the King's favourites and gained increasing power until he became the King's principal advisor. As Sioris (1992: 60) remarks,

The adventurer, the old seaman, the man of profit, changed into the mature and experienced courtier and politician, the intriguer—and the trusted Counselor. Mere survival in the exotic land had been secured. Now, the investment in work and effort had to bring in dividends of influence and power. At this juncture there emerges the new Phaulkon, who projects himself onto the great diplomatic chessboard of the times, corresponding with popes, monarchs, bishops, generals, politicians, intriguing with Jesuits, missionaries and diplomats, planning or destroying great alliances, undercutting or supporting old and new religions. The small shipboy of remote Cephallonia was now wearing exotic golden uniforms and receiving ambassadors and envoys ...

Through Phaulkon's influence, Siam forged close diplomatic relations with the court of Louis XIV of France (1638–1715) as part of a carefully-planned strategy to use the French as a counter to the growing economic dominance of the Dutch in Siam (see Cruyssen, 2002; Hutchinson, 1933). King Narai also had heard of King Louis XIV's military success over the Dutch during the war of 1672–1679 (Love, 1994a). Meanwhile, for their part, the French

... had been seeking ways to establish France as a great commercial, political and military

power in the Far East, in direct challenge to Dutch hegemony. (Love, 1994b: 156).

Consequently, they were eager to establish a major trading centre in Siam, and also to convert the local population to Catholicism, so increasing numbers of French missionaries and lay persons made their way to Siam, and particularly Ayutthaya, Lop Buri and Bangkok. Among their number were architects, engineers and craftsmen who became involved in the construction of forts, and when King Narai decided to develop Lop Buri as an alternative capital (Thavornthanasan, 1986) they helped design and build a new palace, drains, fountains and a water reservoir.

In January 1684 two Thai ambassadors, Pichai Warit and Pichit Maitri, accompanied by a French missionary, Father Bénigne Vachet (1641–1720) from la Société des Missions Étrangères de Paris who had been in Siam since 1671, went to France and had an audience with King Louis. They presented the King with a letter from King Narai inviting him to send astronomers to Siam. The following year the French obliged, and on 3 March 1685 a mission led by Chevalier de Chaumont (1640–1710) sailed from Brest on the *l'Oiseau* and *la Maligne* bound for Siam. Accompanying de Chaumont were Father Vachet, François-Timoléone Choisy (1644–1724) and a number of Jesuit astronomers. They arrived in Siam on 24 September 1685 and were greeted by two mandarins and an impressive retinue of forty men, sent by King Narai. Meanwhile, the King's astrologers had been assembled to determine "... the luckiest day of the Year to be pitched upon for his [de Chaumont's official] Reception ..." at court (Love, 1994a: 60). This turned out to be 18 October, when the French delegation had an audience with King Narai (Figure 4) in Ayutthaya.

According to de Chaumont (1686), at this time

His Majesty the King Narai is about 55 years old, handsome, lovely, dark, has good behavior, and is brave. He is also intelligent, a good ruler ... [and is] kindhearted ...

Regrettably, there are no other descriptions of King Narai, so we cannot ascertain whether the likeness shown in Figure 1 is realistic or not. What we do know, however, is that King Narai's clothing shown in this representation is distinctly non-Siamese: apparently, prior to meeting the French he had entertained a Persian delegation, and he liked their attire so much that he decided to adopt it for his own court appearances (Smithies and Bressen, 2001).

Soon afterwards the delegation proceeded to Lop Buri (or Louvo as it was usually referred to by the French).¹ The city they encountered upon their arrival was impressive, and was described by Gervaise (1689) as "... a town which is, so to speak, in the Kingdom of Siam what Versailles is in France." Because King Narai favoured Lop



Figure 3: A contemporary drawing of Constantine Phaulkon (en.wikipedia.org).



Figure 4: A painting showing Chevalier de Chaumont presenting a letter from King Louis XIV to King Narai in 1685. He is accompanied by the Jesuit missionaries, Fathers Tachard and Vachet. Constantine Phaulkon is crouching on the left, with his hand raised (en.wikipedia.com).

Buri over the official capital, Ayutthaya, he "... had caused to be carried out many works in his desire to improve and embellish the town." (Giblin, 1904: 9). Thus, he repaired the ruined Buddhist temples, built a new palace and other buildings, and surrounded them with attractive gardens, ornamental fountains and water features (e.g. see Chaumont, 1686; Gervaise, 1689; Smith, 1880). Is it any surprise, then, that King Narai liked to spend up to nine months of each year in Lop Buri, enjoying the more relaxed lifestyle, and

... pleasure trips to the forests abounding with every variety of trees and to the wild mountain scenery abounding in birds and beasts, and [he] was enchanted with the romantic scenery of the region. (Smith, 1880).

It was within this idyllic environment that the French attended to affairs of state, ceremonies and conferences (Giblin, 1904). Then on 10 December de Chaumont and Phaulkon signed an agreement that gave French missionaries special privileges in Siam, and as we shall see, through the Jesuits this would soon benefit Siamese astronomy. It is interesting that one of the five conditions in the agreement specifically reflected King Narai's personal interest in science, and especially in astronomy:

The King of Siam permits the Apostolic Missionaries to instruct any of his natural-born subjects in any of the sciences, and to receive them into any of their monasteries, schools, and dwellings with similar privileges to those enjoyed in the other monasteries of Siam, and without constraint from anyone. The said missionaries are allowed to teach *science, law, and any other subjects that are compatible with the Government and Laws of the realm.* (Hutchinson, 1935: 221; our italics).

To understand King Narai's interest in astronomy and the reason for the inclusion of astronomers in the 1685 mission we need to examine his education. In keeping with his royal pedigree, as a prince Narai received a sound Buddhist temple education from the monks, but he also was taught non-religious subjects such as astrology, astronomy, mathematics and medicine by lay teachers. The young prince showed a special interest in astronomy and astrology, and it is noteworthy that his lay teacher in these subjects later was appointed Siam's Chief Royal Astrologer. Hodges (1999: 36) also reminds us that

Narai's contact with foreigners also contributed to his education. His reign coincided with European advances in the sciences associated with navigation, astronomy and horology. He lived in an age when humans were first beginning to grasp the nature and extent of the cosmos ...

Once he was King, Narai was in an ideal position to indulge his astronomical interests, and he learnt about telescopes and other scientific instruments, the newly-constructed Paris Observatory and Jesuit astronomical activities in

Peking from Jesuits and others who were on their way to Peking or returning home to Europe and stopped off in Siam along the way. Moreover, he sometimes was able to influence the types of gifts he received from visiting dignitaries, which went far beyond the typical "... cloth, spices and jewellery of his predecessors ..." and—at his specific request—included telescopes, clocks and military equipment (*ibid.*). Thus, among the gifts brought out to Siam by the 1685 delegation were a celestial globe, a terrestrial globe, telescopes and other scientific instruments (Tachard, 1686).

3 SIAM'S FIRST EUROPEAN ASTRONOMERS

3.1 Father Antoine Thomas

Following King Narai's enlightened policy of promoting increasing contact with Eastern and Western nations, both Lop Buri and Ayutthaya quickly acquired a cosmopolitan flavour with Armenian, Chinese, Dutch, English, French, Indian, Japanese, Javanese, Malay, Persian, Portuguese and Turkish communities. Many of these people worked for the state or had their own businesses, but there was always a transient population of visiting Europeans, Arabs, Indians and Asians. Because of this, there is a wealth of published material on seventeenth century Siam, as book after book appeared describing—and often singing the praises of—Ayutthaya and Lop Buri. It must be remembered that by international standards both were large cosmopolitan cities.

Among the Europeans who settled in Ayutthaya at this time were French missionaries from the Société des Mission Étrangères de Paris. The Société was formed to

... bypass the old privileges of the Portuguese and Spanish missions that depended entirely on the kings of Portugal and Spain, and to launch a new missionary instrument at the Pope's beck and call. (Cruyssen, 1992: 64).

Their missionaries first arrived in Siam in 1662 (see Love, 1999), but they found that other Catholic missionaries were already living in the city, and thus began an intriguing and complicated power-play involving different factions of Catholics and different nationalities. To explain this situation we need to understand that there were different orders of the Roman Catholic faith (e.g. Jesuits, Dominicans, Franciscans, etc.) and at the time there was competition between the Pope (the international leader of the Catholic Church, and based in the Vatican) and the Kings of Spain and Portugal (working collectively) for control of Catholic missionaries world-wide. Until the second half of the seventeenth century

All the Catholic missions in the East [i.e. in Asia] were under Portuguese protection and the *personnel* were composed mainly of Portuguese and Spaniards. (Hutchinson, 1933: 6; his italics).

Then, from the 1660s,

... two rival Catholic missionary circuits shared the Asian scene ... They engaged in a fierce struggle where all kinds of dirty tricks were allowed. It will surprise nobody that the Siamese were sick and tired of the neverending quarrels, and that very few among them felt the urge to join the Church which preached peace and brotherly love, but whose representatives were at each other's throats. (Cruyssen, 1992: 64–65).

Of all the Catholic faiths, the Jesuits had a special passion for science, and especially mathematics and astronomy, and during the sixteenth century the Spaniard Jesuit, Francis Xavier, founded missions in Asia. Then during the early years of the seventeenth century

... his followers spread over the Indo-Chinese Peninsula, and, when P'ra Narai came to the throne of Siam [in 1656] there were Jesuits as well as Dominicans [already] established in the Portuguese colony at Ayūt'ia. (Hutchinson, 1933: 6).

It was against this politico-religious backdrop that Father Antoine Thomas (1644–1709), a Belgian Jesuit missionary, arrived in Ayutthaya in 1681, and as far as we have been able to determine he was the first European to carry out *serious* astronomical observations and therefore expose Siam to Western astronomy.

So who was this pioneer of scientific astronomy in Thailand? Antoine Thomas was born on 25 January 1644 in Namur, in what is now Belgium. He joined the Jesuit Order in 1660, and by 1678 had been ordained a priest. While training for the priesthood he led a peripatetic existence, between 1662 and 1675 studying in Namur, Douai, Lille, Namur (again), Huy and once again in Douai (in that order—see Collani, n.d.). He taught at schools in Armentières, Huy and Tournai,² and served as a Professor of Philosophy at the College de Marchiennes in Douai.

In the course of his training, Father Thomas developed a passion for mathematics and astronomy, and between March 1678 and January 1680 he studied mathematics in Coimbra, Portugal. Whilst there he observed a lunar eclipse, and he published a short account of this in the *Journal des Sçavans* (Thomas, 1679), the earliest European academic journal, which included obituaries of notable people, church history, legal notes and, of course, astronomy.

Thomas' goal was to carry out missionary work in Japan, which ultimately would prove to be impossible, but while trying to arrange this he was forced to spend nearly a year in Siam, arriving in Ayutthaya on 30 August 1681 (Collani, n.d.). He was living there when the February 1682 eclipse occurred.³

After finally realising that his dream of carrying out missionary work in Japan was not to be, Father Thomas determined to go to China instead, and on 4 July 1682 he arrived in Macau.

He would spend the rest of his life living in China, where he enjoyed a distinguished career in astronomy and mathematics (Han, 2003; Jami, 2007; Witek, 2003). He died in Peking on 28 July 1709 at the age of 65 (Collani, n.d.).

Soon after arriving in Ayutthaya Father Thomas carried out solar observations in order to determine the latitude of the city. This occurred on 14 October 1681 and he conducted further observations on 30 December 1681. When various corrections were applied, these gave values of 14° 18' 21" and 14° 20' 18" N respectively (Thomas, 1692).⁴ Father Thomas indicates that his observations were made from "... the House of the Society of Jesus in the suburbs, to the south of Juthia [i.e. Ayutthaya]." (ibid.; our English translation). This residence must have been close to the Jesuit church in the Portuguese residential sector of Ayutthaya, which in Figure 5 is marked by the 'I' at the centre bottom of the map, beside the western bank of the river. This location is confirmed by a second—albeit somewhat cruder—map of Ayutthaya, which was published in 1686, and is reproduced here in Figure 6. The datum point for these latitude observations was a wooden board that was mounted high on one of the walls of the church, and contained an indented metal plate that was aligned parallel to the horizon (ibid.).

There is no record of the *precise* location of the Jesuit residence near the church (where Father Thomas was based), but from Loubère's (1693) account we can anticipate that it was built of brick and was only one storey high:

The Europeans ... build with brick, every one according to his Genius ... At the side of their Houses, to keep off the Sun and not hinder the Air, some do add Penthouses, which are sometimes supported by Pillars ... The Chambers [in the main house] are large and full of windows, to be the more fresh and airy ... (cited in Sternstein, 1965: 100).

While he was Belgian by birth, it is natural that Father Thomas ended up living in the Portuguese sector of Ayutthaya given that there was no suburb reserved for Belgians. During his religious training he spent some time in Portugal; he came to Siam via Goa, the Portuguese colony on the west coast of India; and when trying to arrange to conduct missionary work in Japan it was Portuguese supporters who lobbied (unsuccessfully in the end) on his behalf (see Collani, n.d.). All of his associations were with the Portuguese, and it is noteworthy that

... Portuguese was the *lingua franca* for communication with Europeans in Ayutthaya in the seventeenth century ... (Smithies, 1989: 60).

3.2 The First Contingent of Astronomers

With Father Thomas' departure for China in July 1682, Siam lost its sole active European astronomer, but he was soon to be replaced, for the 1685 French delegation included

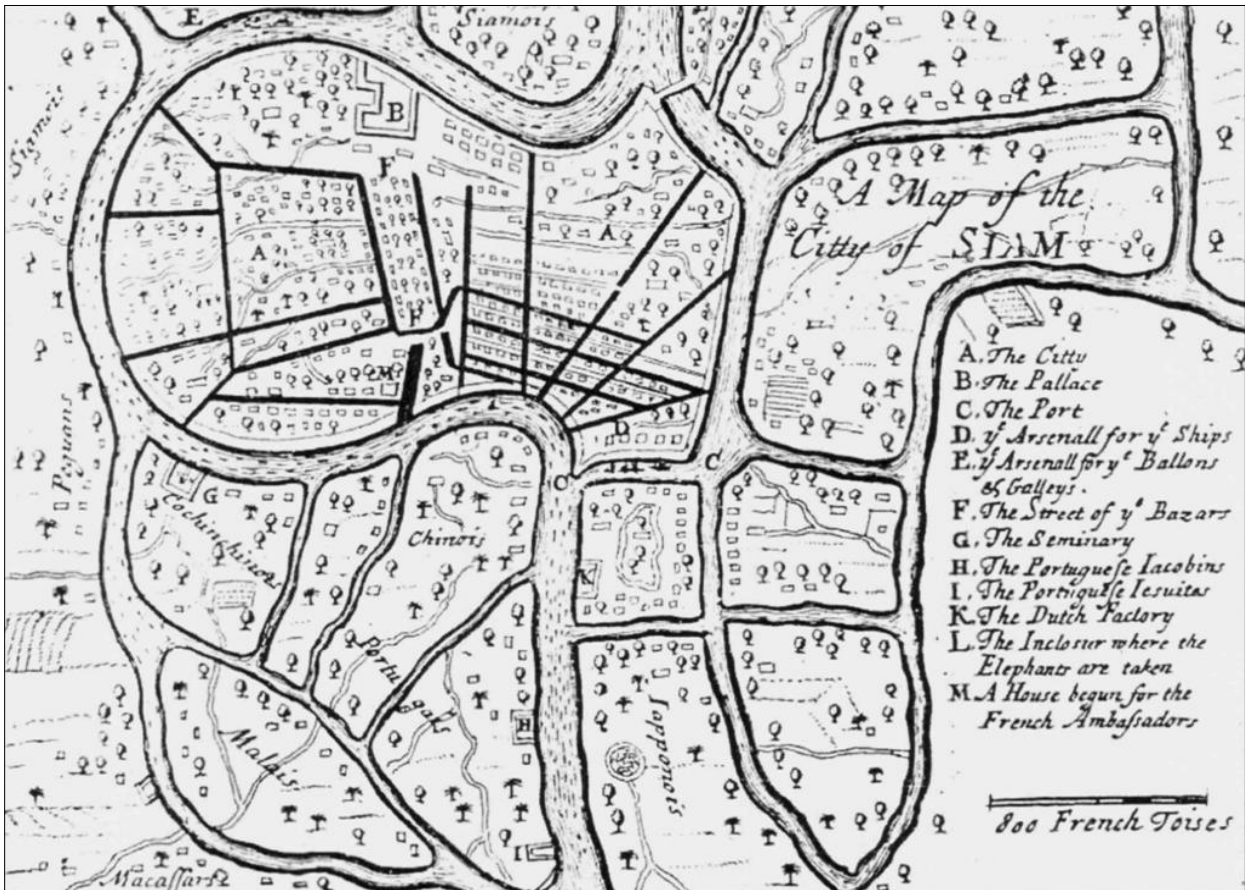


Figure 5: A map of Ayutthaya in the 1680s showing the location of the Portugese residential precinct (marked 'Portugals' to the south of the river on the left, and above the Malayan precinct (after Loubère, 1693).

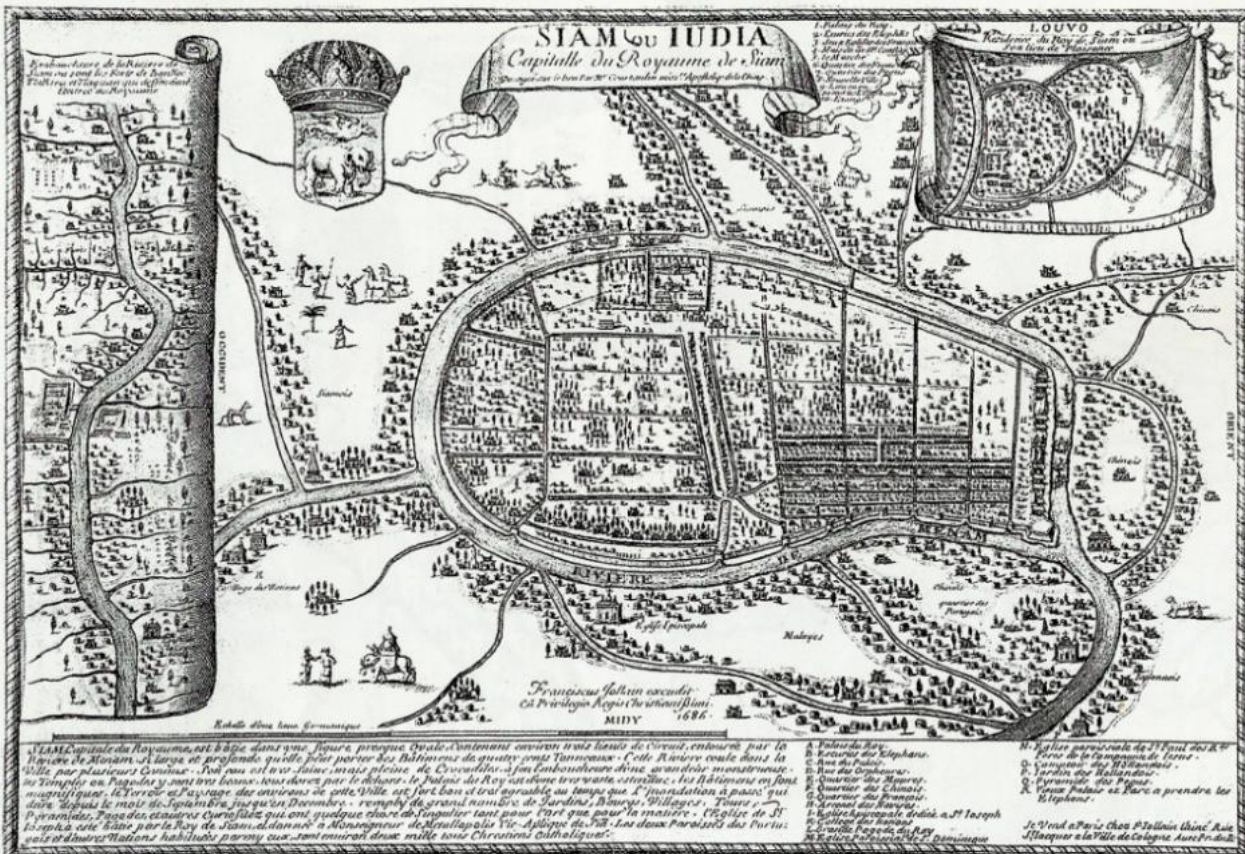


Figure 6: A map of Ayutthaya by Jean de Courtaulin de Maguillon (1686) confirms the location of the Jesuit church in the Portugese residential precinct. The inset map at top right shows Lop Buri (<http://www.esnips.com/web/NDMI-Oldmap>).

Table 2: Jesuit missionary-astronomers who came to Siam in 1685 with the French delegation.⁵

Name	Birth/Death Dates	Immediate Destination after Siam
Jean de Fontenay	1643–1710	China (1688–1702)
Joachim Bouvet	1656–1730	China (1688–1697; 1699–1730)
Louis le Comte	1655–1728	China (1688–691)
Jean-François Gerbillon	1654–1707	China (1688–1707)
Guy Tachard	1648–1712	Remained in Siam
Claude de Visdelou	1656–1737	China (1688–1709); India (1709–1737)

... six Jesuit mathematicians [*cum* astronomers] sent out by Louis XIV., under a royal patent, to carry out scientific work in the Indies and in China, in order, as the patent puts it, “to establish Security in Navigation and to improve Sciences and Arts.” (Giblin, 1909: 1).

They were led by Father Jean de Fontenay (see Table 2), and although they were supposed to continue on to China, all but one of their number would remain in Siam until the end of 1687 and then move to Peking. The exception was Guy Tachard (1651–1712; Figure 7), who would stay behind and play a key political role in the development of scientific astronomy in Siam (see Orchiston et al., 2016b).

Before they left France, Tachard and the other five Jesuit astronomers were admitted to the Académie Royale des Sciences, and supplied with astronomical instruments on the understanding that these would be used—among other things—to determine the latitude and longitude of different geographical features and population centres. Such data would later prove invaluable when creating maps of the Asian region. As well as scientific instruments, the astronomers were supplied with tables of Jovian satellite phenomena, courtesy of Paris Observatory, and various reference books and charts. And in addition to astronomy, they also were required to collect information on natural history, geography, culture, etc.

Once in Siam the French Jesuit astronomers unwittingly became involved in a power struggle with non-Jesuit Catholic missionaries from the Société des Mission Étrangères de Paris (Cruyse, 2002, Hutchinson, 1933). When the Jesuit astronomers arrived, missionaries from the Société were already well established in Siam, and their goal was simply to capture the minds, hearts and souls of the Siamese by gathering as many Catholic converts as possible. Whilst this was an aim of the Jesuits, they also had scientific objectives in mind. To access King Narai both parties had to use Constantine Phaulkon as an intermediary, and most of those from the Société despised him, whereas the Jesuits found him helpful and supportive, partly because he was a Jesuit convert himself and partly because of the King’s personal interest in astronomy. The Jesuits openly exploited this situation, and upon arriving in Ayutthaya Tachard

... set himself to cultivate an intimacy with Phaulkon acting as his secretary and confidant ... [and soon] was working on behalf of the

Jesuits to supplant Bishop Laneau [from the Société des Mission Étrangères de Paris] as intermediary between the French and Siamese Courts. (Hutchinson, 1933: 25).

This tactic worked admirably, and Father Tachard soon became King Narai’s personal astronomical consultant and eventually his scientific ambassador, first to Paris and later to the Vatican (Smithies and Bressen, 2001).

While Tachard could be viewed as an astro-politician *par excellence*, others have painted a less than charitable picture of him in a non-astronomical context. For example, when back in France with Chaumont and Choisy in 1686, he usurped the rightful role of the three official Siamese ambassadors and carried out secret negotiations with the French court, and

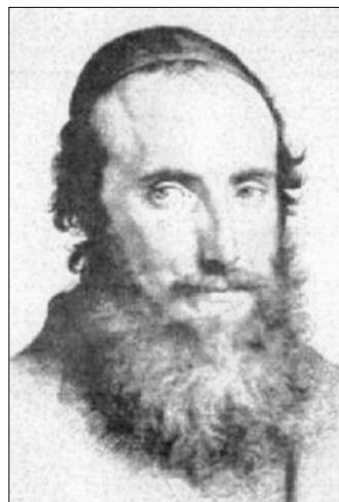


Figure 7: A drawing of Father Guy Tachard by Carlo Maratta (en.wikipedia.org).

During the second French embassy in 1687 of La Loubere and Ceberet, Tachard behaved outrageously towards the accredited French envoys ... Power had simply gone to his head. He was as arrogant towards them as he was subservient to Phaulkon. (Smithies, 1994: 176).

Smithies (ibid.) also states that Tachard “... was universally loathed by all who came into contact with ...” (ibid.) him except for François Martin, and he then assembles first-hand or second-hand opinions of Capuchin Fathers from the Coromandel Coast, the Cardinale de Tournon, Chaille, Choisy, employees of the French East India Company, Forbin, the Papal Legate in the Indies, the Patriarch of Antioch and Vachet, to the effect that Tachard was “... imbued with foolhardiness

Table 3: Details of the 22 February 1682 lunar eclipse.

Totality	Local Time	Moon Altitude Azimuth	Sun Altitude Azimuth
Start	05h 25m	+17° 267°	-19° 96°
Middle	06h 13m	+06° 279°	-07° 99°
End	07h 01m	-05° 282°	+05° 102°

to a degree beyond which it would not be possible to proceed ..."; was "... a swindler and an impostor ..."; and was "... the most despicable and pernicious of all men." (Smithies, 1994: 177). Fellow professor, Dirk van der Cruysse (1992: 67), also has little time for Tachard:

[He] ... was about to play a pernicious part in Siamese-French relations, [and] is the leading "bad character" in our story.

But are all of these criticisms justified? As we have seen, there was no love lost between the Jesuits and other factions within the Roman Catholic Church or between the French Jesuits in Siam and their confrères from the Société des Mission Étrangères de Paris, and it is noteworthy that all—or almost all—of Tachard's critics were non-Jesuits. Undoubtedly Tachard had some faults, but he was not all bad. Yet Vongsuravata (1992) goes too far in trying to rehabilitate Tachard, and claim that he was "... an extraordinary diplomat who deserves a place of choice in French maritime history ... [and] also deserves to be considered a great diplomat by the Siamese ..." (Vongsuravata, 1994: 98).

4 LUNAR ECLIPSE OBSERVATIONS

Although there was interest during the seventeenth century in explaining the visibility of the Moon prior to totality, astronomers mainly wanted to time lunar eclipses in order to determine the longitudes of their observing sites. Link (1959: 10) notes that

In the 17th and partly also in the 18th century Hipparchos's old method for the determination of longitudes was renovated using the transits of craters on the edge of the shadow ... Though the accuracy of this method could not exceed more than some tenth of a minute of time, its utility was great in those times. For instance the eclipse of 1634 observed in Cairo, Aleppo and the western part of Europe, enabled the astronomers to shorten the Mediterranean Sea by 1000 km in respect to its assumed length before that time ...

In seventeenth Siam, lunar eclipses therefore held special appeal. In the years immediately following Father Thomas' arrival in Ayutthaya, lunar eclipses were successfully observed on 22

Table 4: Details of the 11 December 1685 lunar eclipse.

Totality	Local Time	Moon Altitude Azimuth	Sun Altitude Azimuth
Start	04h 37m	+26° 288°	-27° 109°
Middle	05h 29m	+15° 290°	-15° 110°
End	06h 21m	+03° 293°	-04° 113°

February 1682, 11 December 1685, 30 November 1686 and 15–16 April 1688 (Bhumadon, 2000). The first two eclipses were associated with the birth and early development of scientific astronomy in Siam, and are discussed below.

4.1 The Eclipse of 22 February 1682

There is embarrassingly little information available, other than that Father Thomas (1692) successfully observed this eclipse from Ayutthaya,⁶ and derived a longitude of 121° E of El Hierro for the city (Tachard, 1686). The currently-accepted value is 100° 33' 54" east of Greenwich, but note that at this time the French measured longitude from the island of El Hierro, which was 20° 23' 09" west of Paris, and Paris is 2° 20' 14" east of Greenwich.

Father Thomas probably observed the eclipse from the Jesuit church, in the Portuguese district, or just possibly from the veranda or courtyard of the Jesuit residence near the church. From our knowledge of the Moon's position at the time we can ascertain that the eclipse would have been visible from throughout this residential area of Ayutthaya, as adjacent buildings would not have impeded visual access to the western sky.

Listed in Table 3 are start, middle and end times of the total phase of the lunar eclipse in local time,⁷ along with the positions of the Moon and Sun, as observed from Ayutthaya. We can see that this eclipse was visible in the morning shortly before the beginning of astronomical twilight, with the Moon located low in the western sky. The Sun rose at 06h 39m local time, before the completion of the eclipse, so only the very early parts of totality would have been viewed in a completely dark sky. Mid-totality took place just before the beginning of civil twilight, so by this time the sky would have had an obvious blue hue, and only the brighter stars would still have been visible.

The eclipse was readily visible to the naked eye, and there is no mention that Father Thomas used a telescope to record it, but in order to record the times of the contacts and derive a longitude for Ayutthaya from the observations he used a pendulum clock (Thomas, 1692).

4.2 The Eclipse of 11 December 1685

After arriving in Ayutthaya with Chevalier de Chaumont's diplomatic mission, Father Fontenoy and his fellow Jesuits discovered that they could not immediately continue on to China and would have to remain in Siam for some time. At first they were frustrated because they could not use their astronomical instruments:

... because all the time we were at Ayutia the City and the Camping places were so inundated that we had no place to set them up. The very house where we were lodged, being of wood, the least movement shook it so much

that our Clocks and our Quadrants were disturbed. (Tachard, 1686).⁸

This situation changed when they moved to Lop Buri in order to prepare for a total lunar eclipse that conveniently would occur on the night of 10–11 December 1685, during their stay in Siam. Table 4 lists the start, middle and end times of the total phase of this lunar eclipse in local time based upon modern calculations, along with the positions of the Moon and Sun, as observed from Lop Buri. This eclipse was visible in the morning on 11 December 1685, with the start of totality occurring well before the beginning of astronomical twilight. At this time, the Moon was low in the sky about 20° north of due west. At mid-totality, astronomical twilight had just begun, and in the east there would have been a minor twilight glow on the horizon 20° south of east.

On 22 November 1685 the French astronomers had a meeting with King Narai in Lop Buri, and he honoured them by inviting them to join him in observing the eclipse from his 'country retreat', "... a very roomy Palace ... surrounded by brick walls fairly high." (Giblin, 1904: 11), located at the water reservoir called 'Tale Chup-sawn' about 4 km east of Lop Buri (Giblin, 1904: 22). This small artificial lake is described by Father Tachard in his 1686 book:

There is a large stretch of water which makes of it a peninsula [where King Narai's 'country retreat' was located], and on this water the King of Siam has built two frigates with six small pieces of cannon, on which this Prince takes pleasure in going about. Beyond this canal [lake] is a forest, 15–20 leagues in extent and full of Elephants, Rhinoceros, Tigers, Deer and Gazelles. (Giblin, 1904: 12).

The reservoir had been completed not long before in order to provide a continuing supply of fresh water to the palace in Lop Buri. Armed with three Galilean telescopes (these included a 12-ft and a 5-ft) and a clock, Phaulkon and the astronomers visited the observing site on 9 December, and the French were suitably impressed:

A more convenient spot could not be selected. We saw the Heavens on all sides and we had all the space necessary for setting up our instruments. Having settled everything we returned to Louvo. (Tachard, 1686).

Subsequently,

... we had cause to be transported to the Tale-Poussonne our telescopes and a spring clock very trustworthy and regulated by the Sun ... [so that we could] observe there the Eclipse, according to the orders of the King. (ibid.).

Upon arrival, they immediately set up their instruments on the waterside terrace adjacent to the reservoir, then they rested for 3–4 hours before rising and heading for the observing site. By this time "It was then nearly three hours after mid-night." (ibid.).

Fortunately the night of 10–11 December was

clear (it was the dry season), and

We prepared for the King a very long telescope of 5 feet [length] in a window of a saloon which opened on the corridor [terrace] in which we were.⁹ The Penumbra being well advanced the King was informed and came at once to the window. We were seated on Persian mats, some with telescopes, others with the clock, others ready to write the time of the observation. We saluted His Majesty with a profound bow, after which the observations were begun. (ibid.).

It is interesting that during the eclipse King Narai

... wished to look through a telescope 12 feet long, which Father de Fontenay was using, and we immediately carried it to him. He allowed us to rise and stand up in his presence, and he was quite willing to look through the Telescope after we had done so, for it was necessary to put it in position to show it to him.

Those who know the respectful attitude which Siamese Kings expect from those who may be in their presence have spoken to us of this favour as of something very unique. (ibid.).

Figure 8 shows the Jesuit astronomers and King Narai observing the eclipse, in the presence of the prostrated court astrologers.¹⁰ From all accounts, the King thoroughly enjoyed the experience, and

... expressed a special satisfaction seeing all the spots [craters, etc.] of the Moon in the Telescope, and in seeing that the plan [map] which had been drawn of it at the Paris Observatory agreed with it so well. He put several questions to us during the Eclipse. For example: Why the Moon appeared upside down in the Telescope? Why one could still see the part of the Moon which was eclipsed? What time was it at Paris? What could be the utility of such observations made at the same time at two places at such a distance apart? &c. (ibid.).

The map of the Moon referred to in this quotation was one that Jean Dominique Cassini, the Director of Paris Observatory, first presented to the Academy of Sciences in Paris on 18 February 1679 (see Launay, 2003). It is reproduced here as Figure 9,¹¹ and clearly shows the maria, highland regions and various distinctive craters that would have attracted King Narai's attention.

It is interesting that Tachard (ibid.) also includes the times of the start and end of totality that were recorded by the Jesuit astronomers. These were 04h 23m and 06h 10m, both of which are earlier than the times listed in Table 4 by 14 minutes and 11 minutes respectively. Using their recorded times of totality the French computed the longitude of Lop Buri to be 121° 02' E of the island of El Hierro. Meanwhile, the latitude of Lop Buri later was reported to be 14° 48' 17" N (Tachard, 1689). The currently-accepted value is 14° 48' 00" N, while Lop Buri is now known to be 118° 42' E of the island of El Hierro.

The various quotations reproduced above demonstrate that Father Tachard provided a detailed account of this eclipse in his 1686 book



Figure 8: A drawing showing King Narai and the Jesuit astronomers observing the 11 December 1685 total lunar eclipse from the King's country retreat which was on an island in the water reservoir that was located to the northeast of his palace in Lop Buri (en.wikipedia.com).

Voyage de Siam des Pères Jésuites Envoyés par Roi aux Indes & à la Chine. Choisy (1687) also mentions the eclipse in his book, but he supplies no details, and does not even identify the water reservoir—as opposed to King Narai's palace in Lop Buri—as the site where the observations took place.

As we have seen, in addition to Tachard's detailed description of the eclipse observations there is the drawing shown here in Figure 8, which was included in Tachard's 1686 book. But how reliable is this drawing as a realistic depiction of the country retreat, King Narai and the astronomers and their instruments, and their observations of the eclipse?

All six Jesuit astronomers are shown in the drawing, along with King Narai, his advisor, Constantine Phaulkon (in the pavilion with the King), and six court astrologers (who, incidentally, are never mentioned in the contemporary European accounts of this eclipse). Three different telescopes are shown in the drawing if we assume that the Jesuit astronomer closest to the King's pavilion is holding a telescope support and not a fourth telescope, and this tallies with the account that during the eclipse some of the astronomers

used telescopes, others attended the clock and yet others recorded the observations. Two of the telescopes were stated to be 5-ft and 12-ft in length and the size of the third telescope is not mentioned, yet in Figure 8 the telescope used by King Narai is only ~20% longer than the lengths of the two telescopes used by the Jesuit astronomers—which are similar in length—not ~240% longer (and this takes no account of perspective). From this observation alone we can conclude that the drawing contains an element of artistic licence.

Nor does the drawing in Figure 8 realistically depict the lunar eclipse itself. Knowing the altitude and azimuth of the Moon at the time of totality and the fact that King Narai observed through a window in his country retreat, we can establish that the King and the Jesuit astronomers had to be located on the western side of the country retreat. The azimuth of the Moon ($\sim 22^\circ$) is realistically depicted in the drawing (cf. Table 4), but the Moon should not have been included in the diagram at all for at the time it was located in the northwestern sky whereas only part of the sky extending from the northeast to the southeast is shown. The Moon therefore



Figure 9: A copy of the 1679 map of the Moon produced at Paris Observatory that was consulted by King Narai and the French astronomers during the 11 December 1685 eclipse (© Observatoire de Paris).

would have been located in the sky *behind* the 'artist's position', as depicted in the drawing. So, allowing for perspective, we can see that King Narai has his telescope pointing in approximately the correct direction, but the two telescopes of the Jesuit astronomers are pointing in quite the wrong direction.

The afore-mentioned comments reinforce the view that the Figure 8 drawing cannot be accepted as a realistic depiction of the eclipse observations. Is this confirmed by architectural and other details that are shown in this drawing? Fortunately, some of the walls of the water reservoir country retreat have survived, and these show clearly that the design of most of the windows there mirrored those found in King Narai's palace in Lop Buri and in stately houses that were

constructed in Lop Buri at the time. As illustrated in Figure 10, most of the windows were rectangular and with 'portrait' orientations (as opposed to the 'landscape' orientation depicted in Figure 8). Moreover, most of the windows at the water reservoir country retreat had lintels immediately above and below them, and therefore lacked the arched top shown in Figure 8. Yet there are some exceptions (for example, the building shown in Figure 11), but we can see that although the general shape of each window is identical, their proportions differ markedly from King Narai's 'viewing window' depicted in Figure 8.

In Figure 8, the rather pagoda-like form of the roof above the pavilion in which King Narai is located also is an artistic aberration. Contempor-



Figure 10: A view, looking north, of the ruins of King Narai's country retreat at the water reservoir site in Lop Buri. This photograph was taken in October 2014 (photograph: Wayne Orchiston).



Figure 11: A close-up view of the building in the left foreground in Figure 10, which has windows with vaulted tops (photograph: Wayne Orchiston).

rary accounts of the palaces and other royal buildings erected during King Narai's reign indicate that they contained one or a succession of gable roofs, none of which stylistically reflected seventeenth century Siamese Buddhist temple architecture (e.g. see Sternstein, 1965).

Finally, we should note that the pennant shown at top left in Figure 8 erroneously sug-

gests that the eclipse observations took place at King Narai's palace in Lop Buri, and not at his water reservoir country retreat near Lop Buri.

All of this additional evidence confirms that we cannot accept the drawing in Figure 8 as a realistic 'photographic' depiction of the eclipse observations, and this tallies with Michel Jacq-Hergoualc'h's evaluation. In 1986 he prepared an



Figure 12: The edge of the waterwide terrace along the western margin of the country retreat is indicated by the extended foundations on the left side of this image (photograph: Wayne Orchiston).

exhibition at the Musée de l'Orangerie in Paris which included this drawing. In his exhibition catalogue Jacq-Hergoualc'h (1986) noted that this figure and others in Tachard's 1686 tome were drawn by Pierre-Paul Sevin and engraved in Paris by Cornelius-Martin Vermeulen, even though neither was a member of the 1685 delegation to Ayutthaya and Lop Buri, or had ever visited Siam! Smithies (2003: 191–192) concludes that

The drawings and engravings were probably made in great haste after a few casual descriptions gleaned from the manuscript [of Tachard's 1686 book] or possibly Tachard in person, and perhaps sketches which he may or may not have seen.

Notwithstanding these comments, and despite the somewhat dilapidated state of the western side of the country retreat (when compared to the southern walls), we were able to correlate existing foundations with the covered walkway shown in Figure 8, and these are shown in Figure 10 starting at the main building and leading diagonally across the photograph towards the bottom right margin. This marks one wall of the walkway and the other runs near the right-hand wall of the ruined room on the left foreground in this photograph. This covered walkway led from the main building, and would have provided safe and ready access to those rooms along the western side of the country retreat both day and night, and in all kinds of weather.

We also were able to identify foundations that marked the margin of the terrace that fringed the western side of the country retreat and directly abutted the water reservoir (as illustrated in Figure 8). These foundations are shown in Figure 12, and run continuously along the full length of the country retreat.

In Figure 8 it is apparent that there is no indication of the country retreat main building *behind* the small single-storey room where King Narai is conducting his observations, and if this was intentional it would suggest that this room was located either to the north or the south of the main building and access to it was afforded via the covered walkway.

If this is a valid interpretation and our identification of the foundations of the covered walkway and margin of the waterside terrace are correct, then we can tentatively identify King Narai's location when he observed the 11 December 1685 lunar eclipse. He was in the room, now in ruins, shown in the left foreground in Figure 10, in close-up in Figure 11 and on the extreme right (and partly obscured) in Figure 12. Figure 13 is a scale drawing showing the location of this 'pavilion' relative to the main buildings of the country retreat, the covered walkway and the edge of the terrace beside the water reservoir.

More than one hundred years ago, the Australian-born Director of the Thai Royal Survey

Department, Ronald Worthy Giblin, examined sites associated with King Narai and had no trouble finding the water reservoir:

Making now a short excursion into the country, less than a league [from King Narai's palace in Lop Buri] will take us to the Tale Chupsawn, the reservoir built by King Narai. Reference to a map made up by sheets of the cadastral survey will show just how this small artificial lake is situated with regard to the town. It must be remembered that to the east the ground slopes upwards to form a low range of hills running north and south. These hills, with the somewhat striking and jagged peaks of the hills near Prabat, may be seen from the northern railway line. *The reservoir is enclosed by a heavy earth embankment, nearly 4½ miles long. This bank is about 12 to 13 feet high, and the area avail-*

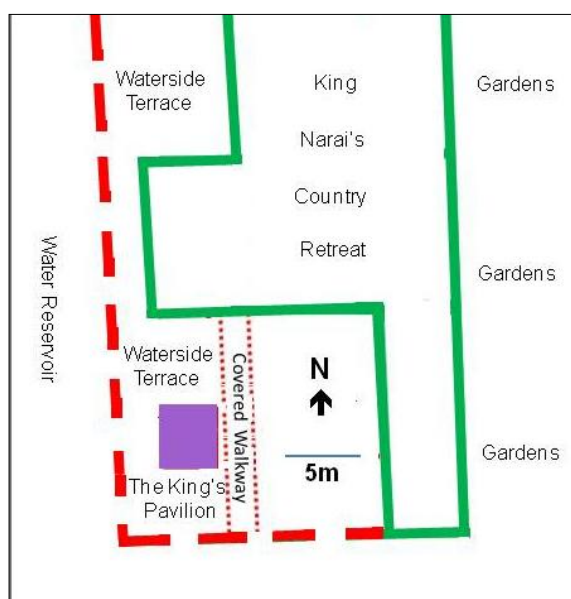


Figure 13: A plan showing the location of the pavilion from which King Narai observed the eclipse (purple rectangle), the edge of the waterside terrace (red dashed line), the covered walkway (red dotted lines) and the main and other adjacent country retreat buildings (green outline) (plan: Wayne Orchiston).

able for the storage of water is roughly one square mile. Mr. Irwin^[12] ... is of opinion that the probable depth of water, when the tank was full, came to not less than nine feet and a half, deeper in some places and less in others ...

Within the reservoir and near the western embankment on a small elevated piece of ground stand the ruins of the King's country residence. *It was here he took part in the observation of an eclipse of the moon, recorded by Father Tachard.* (Giblin, 1904: 22; our italics).

This would have written not long before Giblin's paper was published in 1904 in the *Journal of the Siam Society*, and at that time the water reservoir and King Narai's country retreat were easily recognisable.

The cadastral maps that Giblin refers to in the above quotation were prepared sometime

between 1895 and 1903, but enquiries in Bangkok revealed that unfortunately they are no longer extant (Visanu Euarchukiati, pers. comm, November 2015), and moreover, copies of them could not be located in Bangkok (ibid.) or in Lop Buri. So they can no longer be used to identify the water reservoir and artificial island where the country retreat was located "... with regard to the town [of Lop Buri]." However, aerial photographs of the region (e.g. see Goggle maps) clearly show the country retreat and the artificial island. The latter is elliptical in shape, and measures ~55m N-S by ~45m E-W. A field reconnaissance in November 2015 by the first two authors of this paper revealed that despite the passage of time, the boundaries of this island were obvious, with the land sloping down steeply, especially to the north, east and south. Aerial photographs also revealed that the country retreat was not centrally-located on the island, but was close to its western edge. To the east of the main building there is now an area of lawn, which back in 1685 would have contained attractive gardens, and perhaps fountains, if the beautification of King Narai's palace in Lop Buri is any indication.

Despite the absence of Mr Irwin's cadastral maps, aerial photographs and a field reconnaissance (also made in November 2015) easily allowed us to identify the almost 4.5-mile long 12–13 foot high heavy earth and stone embankment that was built in the early 1680s to create the reservoir. As Figure 14 indicates, modern roads now run along the top of embankment, and where recent construction work is absent it is easy to see the land sloping down steeply from these two roads to what originally was the floor of the water reservoir. Meanwhile, it also is telling that although this historic water reservoir no longer exists *per se*, there are still extensive expanses of emponded water in this area (see Figure 14), indicating the low-lying nature of the land where the water reservoir once was and the continuing effectiveness of the southern embankment.

5 DISCUSSION

5.1 The 1682 and 1685 Eclipses: The Nature of the Evidence

It is regrettable that so little information has been published about the Jesuit observations that were made in Siam of the February 1682 and December 1685 total lunar eclipses, and it remains to be seen whether relevant archival records have survived. However, in the paper where he provides English translations of selected contents of Tachard's *Voyage de Siam des Pères Jésuites Envoyés par le Roi aux Indes & à la Chine* (1686), Giblin (1909: 14) has these sobering comments:

The foregoing pages contain all that is to be extracted from the two volumes of travels published by Father Tachard. It must be admitted that the results in quantity do not amount to

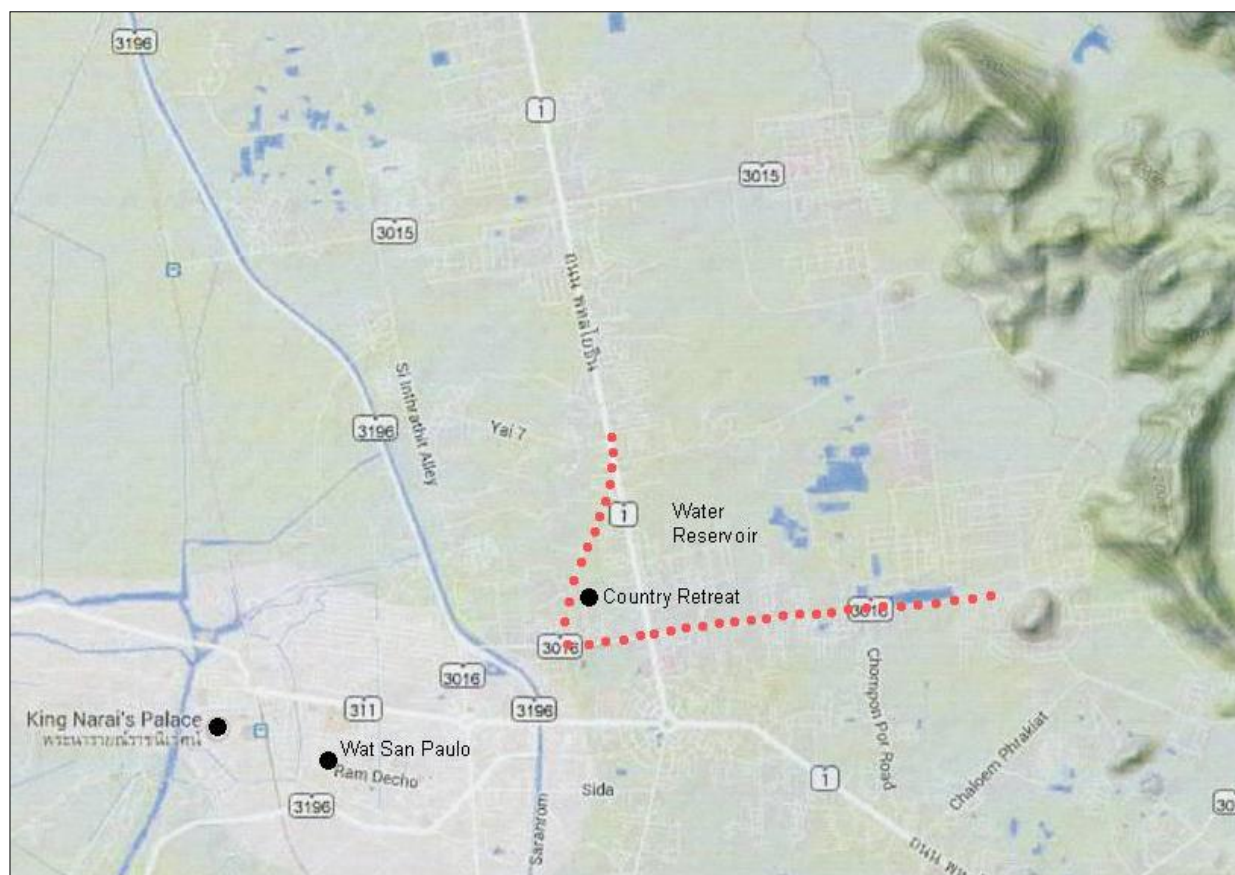


Figure 14: A map of part of Lop Buri showing the location of King Narai's water reservoir and 'country retreat' in relation to his palace. The red dots mark the position of the embankment that was erected to stop run-off from the mountains to the east and form the water reservoir. Terracotta pipes carried the water from the southwestern corner of the embankment to King Narai's palace (map modifications: Wayne Orchiston).

very much, but this would hardly be the right way in which to weigh them. At the time when the observations were made they furnished values which were, no doubt, acceptable and accepted as the best available for use for the construction of charts and for navigation purposes. From an historical point of view the fact that the observations were taken at all, and the circumstances surrounding them must always remain of interest, especially to those connected with Siam and concerned in any way in its past, whilst allied to this aspect of the case lies the possibility or power, which has its utility to a surveyor, to institute comparisons between the results obtained then and those of a later date.

5.2 Subsequent Seventeenth Century Astronomical Developments in Siam

The successful observations of the lunar eclipse of 11 December 1685 encouraged Phaulkon to propose the establishment of a major observatory at Lop Buri, and King Narai agreed to this. The result was Wat San Paulo, an impressive two-storey rectangular structure with a large internal courtyard, and a four-storey tower Observatory at one end (see Figure 15). The Observatory section of this large building, inspired in part by the Paris Observatory, was completed in 1687 and its design and inspiration are discussed in Orchiston et al. (2016b), along with an

account of the surviving remains of this historic observatory building.

King Narai was so impressed by the achievements of the first contingent of French astronomers that he invited King Louis XIV to send more astronomers to Siam, and at the end of September 1687 a second contingent, totalling fourteen Jesuit astronomers, arrived in Ayutthaya.¹³ For further details see Orchiston et al. (2016b).

Between 1686 and 1688 (inclusive) the French astronomers used state-of-the-art telescopes and other astronomical instruments to carry out observations of a comet; two further total lunar eclipses; Jovian satellite phenomena; conjunctions of Mars; an occultation of Jupiter by the Moon; and a new double star. The last serious astronomical observations they carried out at Lop Buri were of the partial solar eclipse of 30 April 1688 (see Orchiston et al., 2016a).

5.3 The Demise of Scientific Astronomy at Lop Buri

The success of the French Jesuit astronomers was in large part due to the patronage of King Narai and the role that Constantine Phaulkon played in fostering Siamese-French relations, but this combination ultimately would lead to their downfall (see Cruysse, 2002; Le Blanc, 1692; Smithies, 2002). Not unexpectedly, Phaulkon's

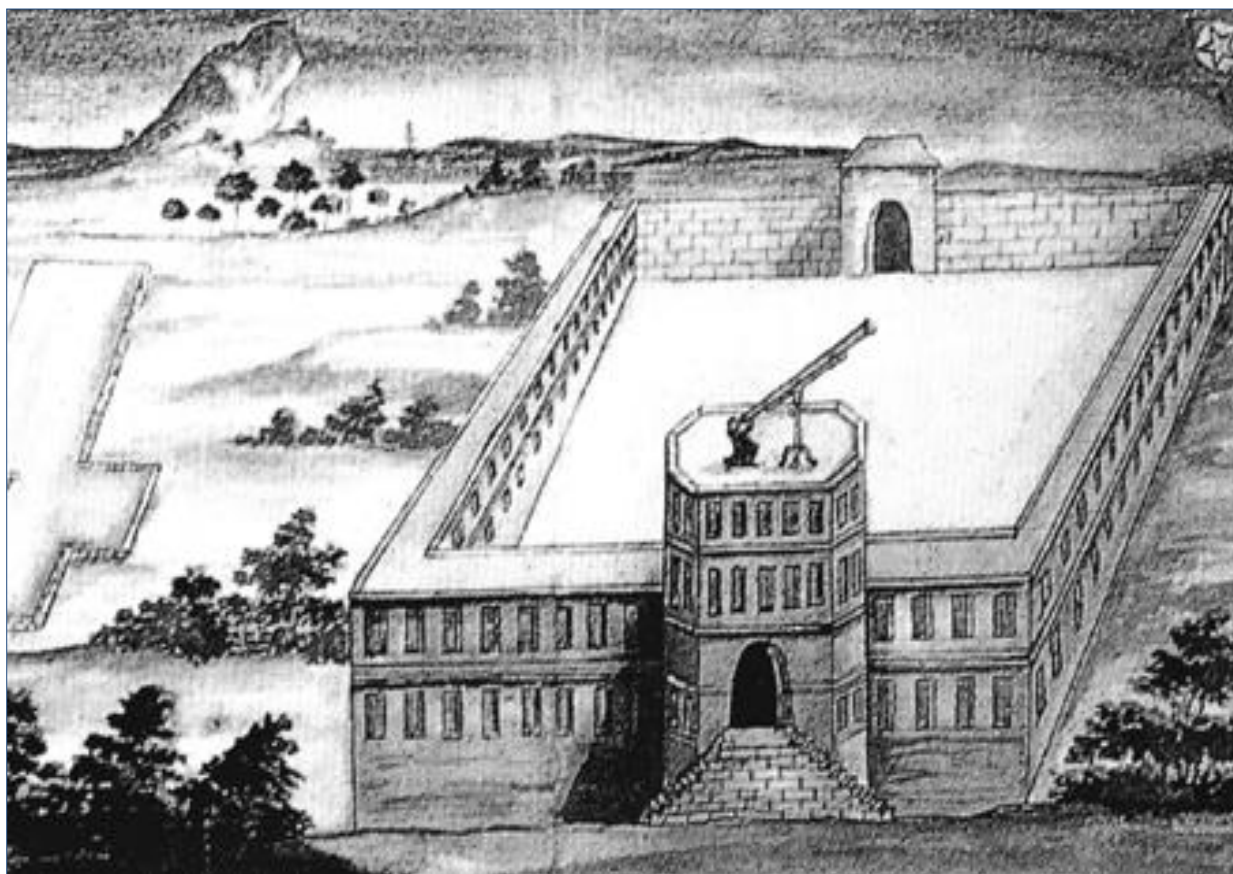


Figure 15: A contemporary drawing of Wat San Paulo, with its distinctive 4-storey observatory (en.wikipedia.org).

rise to power in Siam generated envy among some members of the Royal Family, including Pra Phetracha, King Narai's foster brother. By 1688 King Narai was terminally ill (it is thought by some that he was poisoned), and a malicious rumour spread that Phaulkon wished to become the next King of Siam and planned to install the designated heir, Phra Pui, as a puppet ruler. Pra Phetracha used this as an excuse to stage a *coup d'état*, and Phaulkon, Phra Pui and their supporters were arrested and on 5 June 1688 they were executed.¹⁴ King Narai was mortified when he learnt of this, but he was too weak to organize a counter-offensive and died soon afterwards, on 11 July 1688.

Pra Phetracha then went and installed himself as the new King of Ayutthaya, and reversed King Narai's previous enlightened policies by closing Siam's 'doors' to the West and expelling most of the foreigners who were living there (Smithies, 2002).¹⁵ This led to the immediate close-down of Wat San Paulo. All but one of the Jesuit astronomers there quickly moved to the protection of the French fort in Bangkok and from there sailed for India, thus bringing to an abrupt end an all-too-short, yet extremely productive, period of scientific astronomical activity in Siam. However, adopting a very different viewpoint, Professor Dirk van der Cruysse (1992: 64) concludes that

Whether one likes it or not, the story of the commercial, religious and diplomatic contacts

between Louis XIV and Phra Narai is the story of a failure.

Meanwhile, in his encyclopaedic *A History of Southeast Asia*, the distinguished British historian, Professor D.G.E. Hall (1981: 397), points out that

... the reaction against the policy of King Narai and Constant Phaulkon had caused such a powerful upsurge of anti-foreign sentiment that, until the days of [King] Mongkut ... Siam was to be very chary of granting privileges to Europeans.

Thus, nearly two centuries passed before Western astronomers were able to re-instate—albeit temporarily—scientific astronomy in Siam, first in 1868 when French astronomers would observe a total solar eclipse from Wa Ko (see Figure 2) under the patronage of King Rama IV (Orchiston and Soonthornthum, 2016), and then in 1875 when British astronomers would observe another total solar eclipse, this time from near Phetchaburi (see Figure 2) and with the support of King Rama V (Hutawarakorn-Kramer and Kramer, 2006). This Royal patronage of scientific astronomy initiated by King Narai and demonstrated by Kings Rama IV and V has continued through to the present day, with strong support from His Majesty King Bhumibol Adulyadej (Rama IX) and Her Royal Highness Princess Maha Chakri Sirindhorn (see Soonthornthum, 2011), culminating in the establishment of the National Astronomical Research Institute of Thai-



Figure 16: The plaque at the water reservoir site; note the erroneous inclusion of the 1688 solar eclipse on the second and third lines in the English-language text (photograph: Wayne Orchiston).

land in Chiang Mai in 2009 and the opening of the Thai National Observatory and its 2.4-m Ritchey-Chrétien telescope on Doi Inthanon (see Figure 2) in 2013.

5.4 Promoting the Early History of Scientific Astronomy in Siam

Since we do not know *precisely* where Father Thomas was located within the Portuguese residential sector when he observed the 1682 lunar eclipse, it is understandable that no attempt has been made to commemorate the site with a plaque, and even attempts to pinpoint the exact location of the Jesuit church have been unsuccessful (see Vandenberg, 2010).

Fortunately, this is not so at Wat San Paulo¹⁶ or at the water reservoir, where commemorative plaques and interpretive display panels have been erected that alert visitors to the astronomical significance of both sites. However, it is to be regretted that both the plaque (Figure 16) and the panel at the water reservoir include a serious error: in addition to mentioning the 11 December 1685 total lunar eclipse, they state that the 30 April 1688 partial solar eclipse also was observed from this site. In fact, it was observed from King Narai's palace in Lop Buri, as documented elsewhere (see Orchiston et al., 2016a).

Finally, we should note that King Narai's liaison with the West in order to develop Siam has not been neglected by those responsible for promoting Thailand's history. Thus, within one

of the two large roundabouts on the highway that leads into the centre of Lop Buri from the east there is an imposing statue of this famous king who facilitated the birth of scientific astronomy in Siam (Figure 17).

6 CONCLUDING REMARKS

Largely because of King Narai's personal interest in astronomy, and the influence of his main councillor, Constantine Phaulkon, Siam (present-day Thailand) experienced the first blossoming of Western scientific astronomy in the seventeenth century. On 14 October 1681 the Belgian Jesuit mathematician and astronomer Father Antoine Thomas observed the Sun in order to determine the latitude of Ayutthaya, and this is the first scientific astronomical observation that is known to have been made from Siam. Then, on 22 February 1682, he observed a total lunar eclipse and determined the longitude of the city. Later, on 11 December 1685, a contingent of six French Jesuit astronomers joined King Narai and observed a total lunar eclipse from the King's country retreat near Lop Buri, using three Galilean telescopes and a pendulum clock. For reference purposes, they had access to the latest Moon map from Paris Observatory.

The success of the latter observations inspired the construction of a large well-equipped astronomical observatory at Lop Buri, and further astronomical observations were made, both there and at Ayutthaya, until 1688 when the European

astronomers were obliged to leave Siam following King Narai's untimely death.

Nonetheless, for seven short years—between 1681 and 1688 (inclusive)—scientific astronomy flourished in Siam, and the 1682 and 1685 lunar eclipses played a very important role in these developments.

7 NOTES

1. In the 1680s Lop Buri was variously referred to as Louvo (Tachard, 1686), Louveau (Gervaise, 1689), Luvu (see Giblin, 1904) and Lawo (ibid.) by the French.



Figure 17: The King Narai monument at the roundabout in Lop Buri (photograph: Wayne Orchiston).

2. In the mid- to late-seventeenth century the political geography of Europe was quite different to that found there today (e.g. see Wiesner, 2006). As already stated, Namur is in present-day Belgium, as are Lille and Tournai, while Armentières, Douai and Huy are in France.
3. Constantine Phaulkon played a key role in facilitating the development of scientific astronomy in Siam, and it may be that initially he acquired this sympathy for astronomy from Father Thomas, who on 2 May 1682 (Smithies, 1994: 176)—not long after the 22 February lunar eclipse—converted him from the Church of England faith to Roman Cath-

olicism (Hutchinson, 1933).

4. The currently-accepted value for the latitude of Ayutthaya is $14^{\circ} 21' 12''$ N.
5. Professor Michael Smithies (2003: 189) is a highly-respected authority on Siam of the 1680s, but he errs in stating that those listed in Table 2 "... as well as being mathematicians were also astrologers ..." Today the distinction between astrology and astronomy is very obvious to everyone, so perhaps he was misled by the English translation of Tachard's 1686 volume, which reads: *Relation of the Voyage to Siam Performed by Six Jesuits sent by the French King, to the Indies and China, in the Year 1685, with their Astrological Observations, and their Remarks on Natural Philosophy, Geography, Hydrography, and History* (Tachard, 1688). This is a clear mistranslation, as the original volume refers specifically to 'Astronomical Observations' and does not mention astrology.
6. Bhumadhon (2000) gives the impression that this eclipse was observed by Father Thomas and Father Gouye from Ayutthaya, but the original French account (Gouye, 1692: 693) clearly identifies Thomas as the sole observer. The confusion appears to have arisen because even though Gouye was tasked with publishing the astronomical observations of the Jesuit missionary-astronomers who were based in Siam, he also liked to add his own comments and corrections. However, Gouye's biography (see Thomas Gouye, n.d.) clearly indicates that he spent his whole life in France and never visited Siam.
7. All of the times listed in Tables 3 and 4 were calculated using Herald's OCCULT v3.6 and the NASA Catalog, which agreed to within one minute in all instances.
8. This quotation and subsequent ones listed as 'Tachard (1686)' are actually taken directly from Giblin (1909) and are Giblin's English translations of the astronomical excerpts contained in Tachard's 2-volume work *Voyage de Siam des Pères Jésuites Envoyés par le Roi aux Indes & à la Chine* (1686).
9. Even though the presents that King Louis XIV gave King Narai included telescopes, it is interesting that the Siamese king did not use one of these to observe the lunar eclipse, relying instead on a telescope supplied on the night by the Jesuit astronomers.
10. Soonthornthum (2011) erroneously states that this eclipse was observed from the yet-to-be constructed Jesuit observatory at Wat San Paulo, in Lop Buri itself, and not from King Narai's country retreat.
11. The original map is in the Paris Observatory Library and Archives and measures 550 × 563 mm. The diameter of the Moon is 530 mm (Launay, 2003). Subsequently, this map was engraved by Jean Patigny, and distributed to interested parties—including the Jesuit astronomers who went to Siam.

12. Giblin (1904: 23) identifies Mr A.J. Irwin as the individual who conducted the cadastral survey of the district and mapped the water reservoir. The Royal Thai Survey Department was founded by King Rama V in 1886, and the cadastral survey commenced ten years later (Giblin, 2008).
13. Smithies (2003: 192) also refers to these astronomers as astrologers.
14. This is sometimes referred to as the '1688 Siamese Revolution', even though it was not a popular uprising, or a 'revolution', in the strict sense of the word.
15. Thus ended France's brief but economically-successful escapade in Siam. The only concession Pra Phetracha made to foreigners was to allow the Dutch to maintain a single factory in Siam (Love, 1994a).
16. However, there is confusion over the correct spelling of Wat San Paulo, with both this (correct) version and 'Wat San Paolo' featuring at different times on different interpretive panels at the site itself! Soonthornthum (2011: 181) also uses Wat San Paolo.

8 ACKNOWLEDGEMENTS

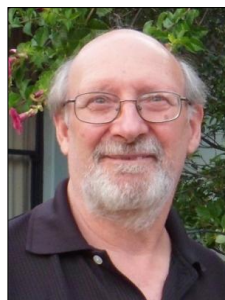
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