

## European astronomers at the court of Savai Jai Singh II

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### *The Indian context*

Sawai Jai Singh II, born in 1688 AD, ruler of Amber since 1700 AD, and founder of Jaipur, was attracted by astronomy since his teens. Already in 1706 AD, while he was in Malwa as Deputy Governor of the Mughal Emperor Aurangzeb, he had 13 manuscripts of traditional siddhantic astronomy copied for him.<sup>2</sup> Jai Singh's early interest in astronomy was possibly kindled by his *guru* to be (in 1714), Jagannātha Samrāt, a Brahmin from the Deccan.<sup>3</sup> However, the presence of Jagannātha at Jai Singh's court is not attested before 1709 AD, when he officiated as *adhvaryu (unneta)* in a *vajapeya* sacrifice.<sup>4</sup> Before 1720 AD, Jai Singh composed his first astronomical work, the *Sūryasiddhāntasāravicāra*,<sup>5</sup> or was it already Jagannātha ?<sup>6</sup>

Before 1720 AD again, Jai Singh became also interested in Muslim astronomy and in astronomical instruments, in order to improve the agreement between computed and observed positions of the planets. A *Yantrarājaracanā*, a treatise on the astrolabe, was composed by or for Mahārājādhirāja Jayasimha around 1720 AD.<sup>7</sup> Later, several Muslim astronomical works were translated for him into Sanskrit, as well as the Naṣīr ad-dīn at-Ṭūsī (Arabic) versions of Euclid's *Elements* and Ptolemy's *Megalè Syntaxis* (or *Almagest* in Arabic) under the names of *Rekhagaṇita* and *Siddhāntasamrāt*.<sup>8</sup> The translator was Jagannātha Samrāt, who himself composed an original *Siddhāntakaustubha*.

In 1720 AD<sup>9</sup>, Jai Singh had a meeting in Delhi with the newly enthroned Mughal Emperor Muhammad Shāh (1719-48), who proposed that the Rāja-astronomer composed for him an imperial Zīj, a *Zīj-i-Muḥammad Shāhī*, a set of astronomical tables following the traditional pattern initiated by the Sasanid emperors of Iran and already imitated by the Indian *Zīj-i-Shāh*

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<sup>2</sup> According to D.Pingree, « *An Astronomer's Progress* », *Proceedings of the American Philosophical Society*, vol.143 (1999), pp.73-85, who gives (p.74, n.7) the names of two scribes, Tulārāma and Nātha. The manuscripts are now conserved in the Library of the Maharaja Man Singh II Museum of Jaipur. They are all dated and one of them specifies that it has been copied at Ahmadabad.

<sup>3</sup> D.Pingree, Introduction to the *Siddhāntakaustubha*, Indian National Science Academy, 2004, for more details. About the Hindu astronomers of Jai Singh and their works, see V.N.Sharma, « *Sawai Jai Singh's Hindu Astronomers* », *Indian Journal of History of Science*, 28 (1993), pp.131-155.

<sup>4</sup> Following the *Rāmavilāsa*, ed. G.N.Bahura, Jaipur, 1978, quoted by D.Pingree, in his Introduction, p.S1. For G.Tillotson, *Building Jaipur*, Oxford University Press, 2002, p.37, this *vajapeya yajña* occurred in 1708.

<sup>5</sup> Described in D.Pingree et al., *A Descriptive Catalogue of the Sanskrit Astronomical Manuscripts Preserved at the Maharaja Man Singh II Museum in Jaipur, India*, Philadelphia, 2003, p.19.

<sup>6</sup> In his Introduction, *op.cit.*, D.Pingree attributed it to Jaisingh, but in the *Descriptive Catalogue*, he writes « (...) composed, it is alleged, by Samrāt Jayasimha, presumably at Amber in ca.1715-1720. This is attributed hesitatingly to Jagannātha Samrāt, in *Census of the Exact Sciences in Sanskrit* A5, 114a ». I would like to thank here Dr Tillotson, Dr Chandramani Singh and Dr Pankaj Sharma, for their help during my visit at the Jaipur Museum Library, in December 2011. Thanks to them, I could check many informations about Jai Singh's astronomical work.

<sup>7</sup> Description in the *Descriptive Catalogue*, p.124.

<sup>8</sup> For other translation from Arabic into Sanskrit, see D.Pingree, « *Sanskrit Translations of Arabic and Persian Astronomical Texts at the Court of Jayasimha of Jayapura* », *Suhayl*, vol.1 (2000), pp.101-106. For the methods of translation, see S.R.Sarma, « *Translation of Scientific Texts into Sanskrit under Sawai Jai Singh* », *Sri Venkateswara University Oriental Journal*, vol.XLI (1998), pp.67-87.

<sup>9</sup> In November, according to D.Pingree, « *An Astronomer's Progress* », p.76, without source.

*Jahānī*. But Jai Singh wanted his *Zīj* to give correct positions as determined by observations and this is the reason why he began to design his first observatory in Delhi a few years after the meeting. Before that, perhaps already in 1718 AD, another much larger observatory was planned in a plain 10 kilometres south-west of Amber, where Jai Singh had a hunting lodge, *Jai Niwas*, since 1713 AD.<sup>10</sup> This observatory was completed in 1734 AD, one year after Muhammad Shah acknowledged as State capital the newly built city of Jaipur,<sup>11</sup> a city that Jai Singh designed according to the celestial directions, with its Dhruv (Skt. dhruva ‘polar star’) Pol to the North, its Suraj (Skt. Sūrya ‘sun’) Pol to the East, its Chand (Skt. Candra ‘moon’) Pol to the West, and its lanes heading towards the cardinal points.

*Manuel de Figueiredo, s.j., from Portugal*

While still building his own observatory, Jai Singh met a remarkable man, with whom he would stay in very good relation until his death in 1743 AD. This man, called Manuel de Figueiredo, was the Rector of the Jesuit College in Agra. Born in Coimbra (Portugal) in 1689 AD, he entered the Jesuit order in 1704 AD and went to Goa before 1719 AD. After having taught Latin and Logic, and completed his theological studies, he took his vows in 1722 AD and travelled to Agra, where he became Rector in 1724 AD.<sup>12</sup> Though he was more a classical scholar than a scientific, Figueiredo seemed to have instilled into Jai Singh an interest for European astronomy so that the Rāja wanted to send him to Portugal in order to find astronomical books and instruments, with the status of an Ambassador from the Mughal :

« (...) Missus fuit in Collegio Agressi, ibique Rectorum egit : num Legatus Mogolensis ad Serenissimum Portugaliae Regem Ulyssippone immoratur. »<sup>13</sup>

The date of this text, December 1728 AD, shows that Figueiredo left India before the end of that year, and probably much earlier, for he arrived in Lisbon in January 1729 AD. Before leaving India, he had spent some time in Goa, where he offered the Vice-King a *Sirpào*, a long robe as a token of honour, on behalf of the Mughal Emperor<sup>14</sup>.

At the end of February 1729 AD, the Embassy, made up of Manuel de Figueiredo, Pedro Ji, a Catholic born in India, and Cheikh Ji, a Muslim, was received by the King of Portugal, João V, in order to give him letters and presents from Jai Singh and from the Emperor Muhammad Shah, and to describe the mission with which Jai Singh entrusted them, that is to compare astronomical tables used in both Courts, in Lisbon and in Jaipur, to resolve the doubts they

<sup>10</sup> According to G.Tillotson, *op.cit.*, pp.39 and 56.

<sup>11</sup> G.Tillotson, *op.cit.*, p.47.

<sup>12</sup> *Catalogus Patrum & Fratrum Provinciae Goanae pro Anno Domini 1719* (ARSI Goa 26, p.099v), *pro Anno Domini 1719* (ARSI Goa 26, p.108v), *Confectus mense Decembris an. 1728* (ARSI Goa 26, p.158), *Catalogus t<sup>us</sup> Sociorum Provinciae Goanae Confectus mense Decembris 1741* (ARSI Goa 26, p.236), and *Report on the Missions written by Father Emmanuel Rebello in December 1724* (ARSI Goa 36 II, pp.313-334). Unless otherwise specified, all the informations about the Jesuit catalogues came from digital sources (ARSI) consulted at the Jesuit Mansion *Broteria*, Lisbonne, in July 2010. I would like to thank Padre Trigueiros, s.j., for his kind help as well as Prof. Henrique Leitão (Lisbon University).

<sup>13</sup> *Catalogus Patrum & Fratrum Provinciae Goanae Confectus mense Decembris an. 1728* (ARSI Goa 26, p.162v).

<sup>14</sup> *Gazeta de Lisboa occidental*, n°3, 20 janvier 1729, p.24, consulted on microfilm at the National Library, Lisbon : « Na nao, que ultimamente chegou da India Oriental vieraõ o Padre Manoel de Figueiredo da Companhia de Jesus, e dous *Umbrãos*, ou fidalgos da Corte do Graõ Mogor ambos Mahometanos, com hum presente para El Rey nosso Senhor ; havendo primeiro estado na Cidade de Goa, onde da parte do mesmo Graõ Mogor Visitaraõ e deraõ ao Vice-Rey da India, hum *Sirpào*, ou vestido ao modo do seu paiz, cum huma joya de rubis, e diamantes. »

have in these matters and to find information about new and ancient instruments of astronomy.<sup>15</sup> This shows that, contrary to many articles' claim<sup>16</sup>, Jai Singh didn't ask yet for a European astronomer, but sent one of his Muslim astronomers in order that he could compare his astronomy with the European. Unhappily, the name of this astronomer, Cheikh Ji, is not complete in the *Gazeta de Lisboa occidental*. The other man accompanying Figueiredo, Pedro Ji, a Catholic born in India, could be Pedro da Silva, who became later one of Jai Singh's physicians. He died in Jaipur at a great age, as his grave in Agra shows : « (...) Pedro de Silva morto em Giapor aos 13 de 9bro 1791 »<sup>17</sup>. In a manuscript transcription of the *Tabulae Astronomicae* by Philippe de la Hire (1640-1718), brought by Figueiredo from Lisbonne, Joseph du Bois, probably a French priest living in Jaipur, writes in 1732 AD : « A certain young man, educated by the Father [Figueiredo] in India, and born with great abilities, named Petrus da Silva, also Portuguese, who studied astronomy with the very bright and Royal [astronomer] Father Giovanni Battista Carbone, came to the Raja (Jai Singh) »<sup>18</sup>. It thus seems that, instead of asking for a European expert astronomer, Jai Singh intended to have the astronomical knowledge of his own people completed in Europe, with the help of books and training by expert astronomers as Carbone was. We will see below that Carbone was far from sparing with his efforts in that matter. Perhaps Carbone was also present at the audience the King of Portugal gave to the Embassy.

With the exception of da Silva's training in astronomy, we have no idea of the activities of the members of the Embassy in Portugal. They certainly didn't stay long, for they were back in India before November 1730 AD, as attested by a letter dated 14/11/1730, giving instructions from the Vice King to Figueiredo : *Instrução que se deo ao Padre Manoel de Figueiredo da Companhia de Jesus, que hora vay para a Corte del Rey Mogor*

« If in Bassein they should meet any emissaries of the Marathas, it would be very useful if the doctor [i.e. Silva] and the cleric [i.e. Figueiredo], who entered this boat as servants of the Raja, should speak with them, and say to them that they had been sent to Lisbon on behalf of the said Raja to the King, and that they brought a reply and a gift, and that the said Raja has made an alliance with the King of Portugal (...) »<sup>19</sup>

Figueiredo was back in Agra before October 1731 AD :

« (...) Rediens reversus est ad Missionem Mogolensis. »<sup>20</sup>

<sup>15</sup> *Gazeta de Lisboa occidental*, n°10, 10 mars 1729, p.80 : « Nos fins do mez passado deu Sua Mag. audiencia particular ao P. Manoel de Figueiredo da Companhia de Jesus, Missionario na Corte de Agra, o qual lhe entregou as cartas, e o presente d'El Rey de Amber *Savay Jasseng*, e poz na sua Real presença os negocios que veyo cōmunicar por mandado do mesmo Rey de Amber, e pelo Graõ Mogor *Mahamad Xèa* Emperador do Indostan ; e trouxe em sua companhia *Pedro Gy*, Catholico, e Mogor de naçaõ, *Xequè Gy* Mahometano, que da parte del Rey *Sevay Janssenseng* traz a incumbencia de conferir as taboas Astronomicas de que se usa nesta Corte com as do seu Paiz, resolver as duvidas que nelle ha sobre esta materia, e toman conhecimento dos instrumentos modernos, e antigos pertencentes a Astronomia, em que he muy perito, e com as conferencias que tem tido com os Mathematicos da Corte, rem comprehendido os erros em que estavaõ os da sua Naçaõ. »

<sup>16</sup> So, Pingree, in « *An Astronomer's Progress* », p.79.

<sup>17</sup> More about him in G.A.Bailey, « *A Portuguese Doctor at the Maharaja of Jaipur's Court* », *South Asian Studies*, 11 (1995).

<sup>18</sup> Following R.Mercier, « *Account by Joseph Dubois of astronomical work under Jai Singh Sawā'ī* », *IJHS*, 28 (1993), pp.157-166.

<sup>19</sup> Quoted and translated by G.A.Bailey, *op.cit.*, p.54, from a letter in the State Archives of Goa, Panjim, *Regimento e instruções* 12, 1727-37, fol. 70b, that I couldn't see in Panjim. Here again, I want to thank Dr Blossom Medeira for her help at the Archives of Panjim, where I consulted many Portuguese letters in August 2011.

<sup>20</sup> *Catalogus Sociorum Provinciae Goanae per loca ex officio confectus mense Octobris 1731* (ARSI Goa 26, p.189v). There were then only three Jesuit Fathers in Agra : « In isto Collegio et Missione Agrensi ac Dilensi 3 modo versantur et aluntur enostris Sacerdotes. » (ARSI Goa 26, p.199).

After which, he moved up through the hierarchy of the Jesuit order<sup>21</sup>, while continuing to play a diplomatic and religious role at Jai Singh's court. By instance, fulfilling his promise to Anna Maria, Queen of Portugal, to tell her the history of the mission in Agra, he wrote a letter in 1735 to explain<sup>22</sup> how Jai Singh took under his protection all the Christians of his kingdom, allowed his 600 Christian employees to follow the ways and customs of their faith, and even himself attended a Mass and was so enthusiastic as to leave twelve gold coins upon the altar after the ceremony. We will see below how Figueiredo fulfilled some more diplomatic missions.

### *Joseph du Bois*

We have seen above that Figueiredo's embassy to Portugal brought de la Hire's *Tabulae Astronomicae* (2<sup>nd</sup> edition, 1727) to Jaipur, where a manuscript copy was made and completed on 10 Septembre 1732 AD. The scribe was Joseph du Bois, who wrote a long introduction in Latin, presenting himself and specifying some interesting points about astronomy.

After 15 years of peregrinations, du Bois went to India, and to Delhi-Shahjahanabad, where he met a French family. The father, Jacques Martin, was the Emperor's physician until his death in 1728. He had two sons, Louis and Alexandre, who was the Emperor's principal surgeon, and also a math passionate spending most of the time solving astronomical problems with a friend, Théodore Forest, engineer to the Emperor. With them and with the help of astronomical books and Euclid's *Elements*, allegedly in Arab and in French, du Bois explored these subjects before being employed by Jai Singh, probably for his linguistic skills. This is all we know about Joseph du Bois' biography.

About astronomy, du Bois states in his introduction that Jai Singh has noted discrepancies, almost to the degree, between Father Riccioli's *Almagest* and the *Zīj-i-Shāh Jahānī*. This interesting remark shows that Jai Singh also knew other European books, in this case the *Almagestum novum* written in 1651 AD by the Italian astronomer Giovanni Battista Riccioli (1598-1671), in which he rejected Copernic's heliocentric system. Du Bois also said that he translated the *Zīj-i-Shāh Jahānī* from Persian into Indian language, for the huge price of 100000 rupees :

« (...) Regulus inveniens almagestum P P Riccioli vidit et antea cognoverat multam differentiam esse in suis Tabulis gentilium unde Persicus SciaYahan olim totus Indiae Orientalis Imperatoris iussu tabulas in indorum lingua converti feci cum expensis 100000 rupiarum in quibus etiam aliqua differentia ferme ad gradum usque »<sup>23</sup>

But this is in contradiction with the fact that the *Zīj-i-Shāh Jahānī* had already been translated into a Sanskrit *Siddhāntasindhu* in 1630 AD by Nityānanda, and that four copies of this work

<sup>21</sup> In 1733, he was Visitor in Agra (ARSI Goa 26, p.205v) : « (...) Rediens reversus est ad Missionem Mogolensem ubi Visitatorem egit. ». In 1741, it is said (ARSI Goa 26, p.236) that he was Minister for some months in the College of Goa, then Operarius in the Professe House, and in Salsete Parish : « (...) Fuit Minister Collegii Goani per aliquot menses. Operarius in Domo Professorum. Modo Patrochus Salsetanus. » He was the Procurator of the all Province in 1752 (ARSI Goa 27, p.168).

<sup>22</sup> Stöcklein, J., Probst, P. (ed.), *Neue Welt-Bott, mit allerhand Nachrichten dern Missionarium Soc. Jesu*, Augspurg und Grätz : in Verlag Philips, Martins, und Joh. Weith seel. Erben, Buchhändlern, 1726-58, letter 595.

<sup>23</sup> R. Mercier, *op.cit.*, p.159, confirmed by my reading in Jaipur.

are conserved in Jaipur, the last one having been copied in 1727 AD.<sup>24</sup> In order to solve this contradiction, we propose, instead of *feci*, to read *fecit*,<sup>25</sup> referring to Jai Singh.

Following a more recent source<sup>26</sup>, the Figueiredo Embassy also brought the *Historia Caelestis Britannica* of John Flamsteed (1712-1725), the *Mirifici Logarithmorum Canonis Constructio* of John Napier (1619) and a Latin translation of Euclid's *Elements*. While Flamsteed's book appears in Bahura's Catalogue<sup>27</sup>, nor Napier, nor Euclide (in Latin version) seemed to exist in Jaipur's archives. But this does not imply that such texts had not been acquired by Jai Singh,<sup>28</sup> for it is true that logarithms could be useful, especially when one knows that de la Hire used them to tabulate the distances, from the sun to the earth and to other planets, in his Tables 14, 31, 37, 47 and 52, and that these Tables have been translated in a Sanskrit text named by Pingree *Sanskrit prose version*. This text is preserved in two manuscripts<sup>29</sup>, « most probably written in early 1734 », according to Pingree<sup>30</sup>, together with another Sanskrit version of de la Hire called *Phiraṅgicandrachedyopayogikam*,<sup>31</sup> 'Aid to the Representations of the European Lunar Theory', in which one can see transcriptions of some diagrams on the theory of the moon taken from de la Hire.<sup>32</sup>

We also happen to know, thanks to du Bois' introduction, that Jai Singh had already completed a high sundial, a large astrolabe and one planisphere, the other being in progress in his Jaipur observatory :

« Machinae istae sunt tam maximae exempli gratia turris in trianguli anguli recti forma, cum linea aequinoctia in medio divise usque ad minuta tertia et ad sensum divisibilis usque ad dena facta fuit ipse vero ex cera molle suis minibus prototypum feci et artificibus tradidit omnes enim ab eo sunt edocti turris vero erit alta 73 pedum romanorum et modo astrolabum 12 ulnarum seu 36 pedum romanorum modo sphaera planae fecit dum ista scribo et modo incipitur aliud 108 pedum ei simile et multe alia (...) »<sup>33</sup>

<sup>24</sup> According to D.Pingree, « *An Astronomer's Progress* », p.77.

<sup>25</sup> In another part of the text (see below), a *feci* should be read *fecit*, according to Mercier (*op.cit.*, p.160), who notes that the « emendation is not certain ».

<sup>26</sup> Bailey, *op.cit.*, p.55.

<sup>27</sup> *Catalogue of Manuscripts in the Maharaja of Jaipur Museum*, Compiled and Edited by G.N.Bahura, Jaipur, 1971, p.55.

<sup>28</sup> Concerning Napier, W.Hunter (« *Some Account of the Astronomical Labours of Jayasinha, Rajah of Ambhere, or Jayanagar* », *Asiatick Researches*, vol.V, 1797, pp.177-211) testifies that he had seen in the hands of Jagannātha's grandson, whom he met in Ujjain, « the translation into *Sanscrit* of several European works, executed under the orders of *Jayasinha*, particularly Euclid's *Elements*, with the treatises of plain and *spherical trigonometry*, and on the construction and use of logarithms, which are annexed to CUNN'S or COMMANDINE'S edition. In this translation, the inventor is called *Don JUAN NAPIER* (...) ». The book here described is most probably J.Keill (1671-1721) *Euclidis elementorum libri priori sex*, published in Oxford in 1715, in which he « studies trigonometry and logarithms » (according to <http://www-history.mcs.st-and.ac.uk/Biographies/Keill.html>) or its second edition which was prefaced by S.Cunn. It is a translation into English of the Commandino's Latin version (1572) of Euclid's *Elements*' first six books and books 11-12, followed by two works by Keill himself, the first dealing with plane and spherical trigonometry and the second a brief tract on logarithms (according to <http://babel.hathitrust.org/cgi/pt?id=mdp.39015063888914>).

<sup>29</sup> That I had the opportunity to consult in Jaipur : Khasmohor 5292 and 5609. For a short description, see Pingree et al., *Descriptive Catalogue*, p.150.

<sup>30</sup> « *An Astronomer's Progress* », p.81.

<sup>31</sup> Called *Phiraṅgicandravedhopayoginīsāraṇī* by S.R.Sarma, « *Translation of Scientific Texts (...)* », p.77.

<sup>32</sup> D. Pingree, « *Philippe de La Hire's Planetary Theories in Sanskrit* », in Y.Dold-Samplonius, J.W.Dauben, M.Folkerts and B.Van Dalen (ed.), *From China to Paris : 200 Years Transmission of Mathematical Ideas*, Stuttgart, 2002, pp.429-53.

<sup>33</sup> R. Mercier, *op.cit.*, p.159, for a translation : « Such great structures are, for example, a tower in the form of a right-angle triangle, with the equinoctial line in the middle, divided up to the third minute, and divisible by the senses to tenths. Moreover, he made the prototype by his own hands from soft wax, and then gave it over to

Finally, du Bois recounts that Jai Singh is now hoping to find somebody ready to go to Paris or London in order to draw astronomy from its source :

« modo vero exoptat ut aliquis Parisios vel Londinum pergut et ex fonte Astronomiam hauriat unde ergo. »<sup>34</sup>

### *The French connection*

At about the same time he sent Figueiredo with his embassy to Portugal, Jai Singh tried to find other sources of knowledge about European astronomy. This is attested by a letter, dated 22 May 1730 AD, from the French Council of Pondichery to the Council of Chandernagor :

« Nous n'avons point d'astronome à pouvoir envoyer au Mogol, ce serait sans doute un bien pour nous d'avoir une personne libre à la Cour de ce Prince, qui fût sage et capable. Nous pourrions en tirer de grands avantages, mais il faudrait le faire venir de France. Cela serait encore difficile à trouver. »<sup>35</sup>

Jai Singh's request was thus originally addressed to Chandernagor, and it is from that place that two French Jesuit priests, Fathers Claude Boudier and Jean-François Pons, set off for Jaipur on 6 January 1734 AD.

In the meantime, Jai Singh had addressed to Chandernagor five precise astronomical questions, inspired by de la Hire's work, of which we find a copy in a letter, dated 24 January 1733, from the Jesuit Father Calmette to Monsieur de Cartigny.<sup>36</sup> We won't analyse these questions here<sup>37</sup>, but rather focus on Boudier and Pons' journey to Jaipur.<sup>38</sup> Actually, they took the opportunity to calculate latitudes and longitudes of many places they visited, using for that purpose :

« une bonne montre », a good watch and « une boussole », a compass, in order to estimate the distances in longitude, and  
« des observations des hauteurs méridiennes apparentes des astres (...) avec un quart de cercle de deux pieds de rayon », observations of the apparent meridian heights of stars (...) with the help of a two foot quadrant.

This way they observed the Sun in Cassimbazar (17, 21 and 22 January), in Patna where they reside with the Capuchin friars (25, 27 February, 1, 2 and 5 March), in Banaras (23 March) where Father Pons, who knew Sanskrit, visited some Brahmines well versed in the traditional sciences, in Allahabad (28 March), in Fatehpur (2 April), in Agra in the Jesuit house (14, 15, 17 and 18 April), and in Jaipur (8 and 9 September). They also observed a solar eclipse in Delhi (3 May) and other stars or constellations, by instance, the Lyra (7 August) and the Swan (Cygnus, 10 September) in Jaipur.

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artisans; for he instructed them all. The tower will be 73 Roman feet in height. Next an astrolabe of 12 cubits (ulna) or 36 Roman feet. As I write this, he has made a planisphere and another is begun of 108 feet similar to it, and many others. »

<sup>34</sup> R. Mercier, *ibidem*, confirmed by my reading in Jaipur.

<sup>35</sup> Martineau, Alfred, *Archives de l'Inde française : Correspondance du Conseil supérieur de Pondichéry avec le Conseil de Chandernagor*, tome 1 (1728-1757), Société de l'histoire de l'Inde, Pondichéry, 1915, p.71.

<sup>36</sup> *Lettres Edifiantes et Curieuses*, Vol. II (of the 4 vol. published by M.L.Aimé-Martin, Paris, 1838-43), pp.610-611.

<sup>37</sup> More about this subject in D. Pingree, « *Philippe de La Hire's Planetary Theories in Sanskrit* » and in R. Mercier, « *The Astronomical Tables of Rajah Jai Singh Sawā'i* », *Indian Journal of History of Science*, 19 (1984), pp.143-171.

<sup>38</sup> *Lettres Edifiantes et Curieuses*, Vol. II, pp.772-8 : « *Observations géographiques faites en 1734 par des pères jésuites pendant leur voyage de Chandernagor à Dely et à Jaëpour* ».

« Les observations des satellites de Jupiter ont été faites (...) par les pères jésuites qui étaient en voyage avec une (lunette) de 17 pieds »,

which means that, in order to verify the longitudes, they used the Jupiter satellites method, for which they needed a 17-foot telescope. By instance, at Cassimbasar, they observed the immersion of the first satellite on 30 January, at Fatehpur, the same phenomenon on 2 April. At Jaipur, they observed the emersion of the first satellite on 13 August and, at Agra, the same phenomenon on 7 October.

At that time, they were already on their way back, after a little more than a month spent in Jaipur. But, as short as this sojourn was, it could have brought a better insight into de la Hire's *Tabulae Astronomicae* by Jai Singh astronomers. This insight is manifest, by instance in the *Phiraṅgicandrachedyopayogikam*, in their understanding that it is based on a heliocentric theory :

*Tatra bhūmir bhramatīti kalpitam // raviḥ sthira kalpito 'sti'*<sup>39</sup>

Here, it is assumed that the Earth revolve, the Sun is supposed motionless

Of the five questions asked by Jai Singh and recounted by the French Jesuit Calmette, the last one was :

« D'où vient la différence qu'il trouve entre la longitude de la lune observée et le calcul fait sur les tables de M. de La Hire qu'il s'est fait traduire ? Cette différence est de près d'un degré ; cependant, les instruments avec lesquels il a fait ses observations sont grands et exacts, et les observations ont été faites avec tous les soins requis. Cette différence se trouve-t-elle aussi pour le méridien de Paris ? »<sup>40</sup>

For Pingree, this question has been partially answered by Jai Singh himself :

« According to the manuscript recording the discrepancies<sup>41</sup>, they were reduced to less than 40 minutes of arc by 1733/34, and seldom exceeded 30 minutes thereafter.<sup>42</sup> This improvement seems to have resulted from a better understanding of de la Hire's mathematics, due either to further efforts to comprehend it on the part of Jayasimha's colleagues or to a helpful response from the French Jesuits at Candranagara. »<sup>43</sup>

### *Portugal, again*

Strangely enough, the affair of the European astronomer required by Jai Singh took a new turn when, on 20 December 1735, the Royal Astronomer Carbone sent a letter to Cardinal Retz, the General Superior of the Jesuits in Rome.<sup>44</sup> Carbone had recently received from the Vice King in Goa letters informing him that Jai Singh asked, six years ago<sup>45</sup>, for a Jesuit missionary and mathematician to be sent to his court.

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<sup>39</sup> Quoted by D. Pingree, « *An Astronomer's Progress* », as well as diagrams showing the motion of the moon, perfectly comparable to de la Hire's, appearing in the *Phiraṅgicandrachedyopayogikam*. Confirmed by my reading in Jaipur.

<sup>40</sup> Translation of Pingree (who doesn't quote it entirely and presents it as the first question, but differs as to the LEC reference) : « Whence comes the difference that he (Jayasimha) finds between the observed longitude of the Moon and the calculation made with the tables of M. De la Hire, which he had caused to be translated ? This difference is close to one degree. »

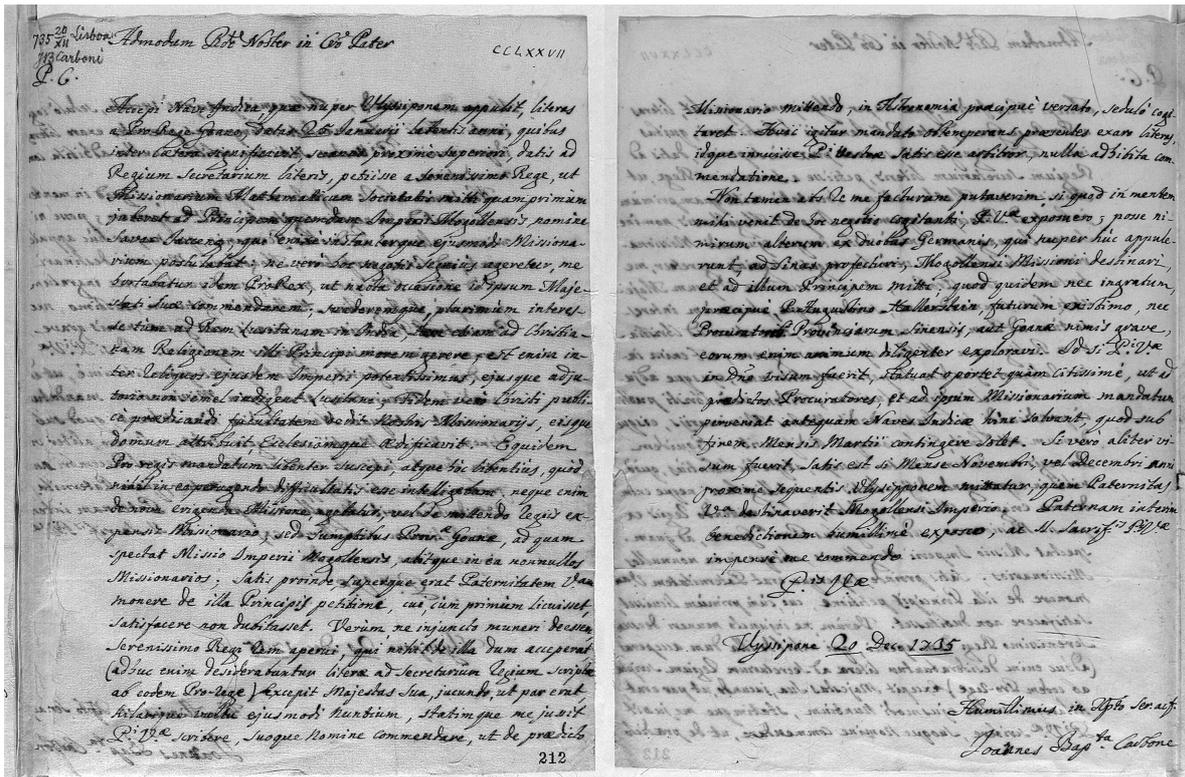
<sup>41</sup> Khasmohor 5183, called *Laiyaravedhapatrāṇi* by S.R.Sarma, « *Translation of Scientific Texts (...)* », p.77.

<sup>42</sup> This was observed by Jai Singh II himself, in the preface of his *Zīj-i-Muḥammad Shāhī*: « On examining and comparing the calculations of these tables (de la Hire) with actual observations, it appeared there was an error in the former, in assigning the moon's place, of half a degree (...) », translated by W.Hunter, *op.cit.*, p.188.

<sup>43</sup> « *An Astronomer's Progress* », pp.80-1.

<sup>44</sup> ARSI, Lus.76 , pp.212-212v.

<sup>45</sup> « sex anni proxime superiori », but the text is rather difficult to read here.



Letter, dated 20 December 1735, from the Royal Astronomer Carbone to Cardinal Retz, General Superior of the Jesuits in Rome

This reminds a letter sent on 6 February 1733 by the Vice King in Goa, Conde de Sandomil, to the Secretary of State Diogo da Mendonça, Corte Real (Lisbon). This letter was accompanied by the copies of two letters from Manuel de Figueiredo and one letter from Jai Singh :

« (...) From the said copies, your Lordship will see the desperation with which the same Ma Raja seeks a good mathematician, which he indeed requests from his Majesty and since this correspondence has the potential to open a path of no small utility for the state, as the same Father de Figueiredo believes, I am resolved to send for some Father from China who has taught that science there in order to entertain the taste of the same Raja (...) »<sup>46</sup>

The advantages put forward, according to Carbone, by the Vice King for such a mission remind what the French Council of Pondichery already wrote in 1730, that Jai Singh is the more powerful of the Emperor's vassals, that the Portuguese very often needed his help, and that he gave to the missionaries a house, a church and the permission to preach in Jaipur state. After which, Carbone proposes that one of the two German priests, Father Hallerstein and Father Laimbeckhoffen, who are waiting in Lisbon their departure to China, could be sent to the Mogol mission instead. Carbone thinks that Father Augustin Hallerstein would not be opposed to the change of destination, but insists on an urgent decision before March, which is the period when the boats to India generally cast off.<sup>47</sup> The two priests, actually Austrian, Fa-

<sup>46</sup> Quoted and translated by Bailey, *op.cit.*, p.55, from A.B. de Bragança Pereira, *Arquivo Português Oriental*, tome I, vol.III, parte IV, pp.297-9 (Bailey gives Part I, n°25, p.35).

<sup>47</sup> « (...) posse mirum alterum ex duobis Germanis, qui nuper huc appulerunt, ad Sinas profecturi, Mogollensi Missioni destinari et ad illum Principem mitti ; quod quidem nec ingratum praecipue P. Augustino Hallerstein, futurum existimo, nec Procuratoribus Provinciarum Sinensis, aut Goana nimis grave, eorum enim animum diligenter exploravi. Id si Pi Vo in ? visum fuerit, statuatur oportet quam citissime, ut ad praedictos Procuratores, et ad

ther Hallerstein and Father Laimbeckhoffen had actually arrived on 20 November 1735 from Genoa. On 7 December 1735, Father Hallerstein explained, in a very detailed letter<sup>48</sup>, how Carbone presented him the Jai Singh problem, with the help of Father Campos, teacher of mathematics in Lisbon.<sup>49</sup> The letter gives us information on Carbone, born in Naples (Neapoli), who came from Rome to Lisbon in order to be sent to Brazil, but was so appreciated by the King João V that he persuaded him to stay in Lisbon as his Royal astronomer and adviser. Hallerstein accepted to be sent to India, if the General of the Jesuits would change his destination, but asked for a further year of preparation, in order to get ready to tackle with astronomical problems. Concerning Carbone's help in that matter and the mathematical level of Portuguese universities, let's quote Hallerstein :

« He (Carbone) proposed all his books on mathematics and instruments, with which he is royally endowed, as well as his skill and effort, in order to give me and my companion some practice in the astronomical observations. This art has been well considered and practised in Portugal. In our superior schools, in Coimbra, stay some [members] of the [Jesuit] Society, named Destinatos, who dedicate themselves to that task and have been educated in that field by their demanding teacher Father Campos, who is perfectly at ease in that science. »

Carbone is well determined to send a Jesuit astronomer to Jai Singh, but Hallerstein, after a long journey to Goa (25 April 1736 to 18 September 1737), was not able to travel further because of the Indian troubles of the time :

« It was said that, in the Great Mughal Empire, everything was upside down, in a complete disorder : some powerful Hindu kings, named Rajas, bound together on oath, wanted to expel from his throne the Muslim Emperor (...); they were about to succeed when the King of Persia (...) violently insulted him (...) and approached in order to besiege the capital, Agra, at a distance of three days only, with a powerful army. »<sup>50</sup>

*Andreas Strobl and Anton Gablsperger, s.j., from Germany*

But Carbone didn't give up and another Jesuit mathematician, Father Andreas Strobl, born in Schwandorf (Bavaria) in 1703, was already in Lisbon in January 1737, waiting for a boat to Goa. Meanwhile, he learned the Portuguese language, met the Queen « herself well informed and fond of mathematics » in Bellem, where they observed together a solar eclipse.<sup>51</sup> Con-

ipsum Missionarium mandatum perveniat antequam Naves Indica hinc solvant, quod sub finem Mensis Martii contingere solet. »

<sup>48</sup> Stocklein, *Weltbott*, n.584 : Erster Brief R.P. Augustini Hallerstein, Missionarii der Gesellschaft Jesu, aus der Oesterreichischen Provinz an R.P. Franciscum Molindes, Selber Provinz voregesezten Provincial, Geschrieben zu Lisabon, dem 7. Christmonat (= December), 1735.

<sup>49</sup> More precisely, at the College San Antão. According to U. Baldini (« *The Teaching of Mathematics in the Jesuit Colleges of Portugal, from 1640 to Pombal* », *The Practice of Mathematics in Portugal* (ed. L. Saraiva and H. Leitão), 2004, p.419), Manuel de Campos (1681-1758) was probably the best mathematician of the Portuguese Jesuit Province between 1710 and 1740. He is also the author of several books on the subject, as *Elementos de geometria* (Lisbon, 1735).

<sup>50</sup> Stocklein, *Weltbott*, n.586 : Dritter Brief R.P. Augustini Hallerstein, Missionarii der Gesellschaft Jesu aus der Oesterreichischen Provinz an P. Weichardum Hallerstein, Derselben Gesellschaft und Provinz, dermalen Ihre königlichen Hoheit, Prinzens Carls von Lothringen, Gubernanten in Niederland, Beicht: Vatter, seinen Bruder. Geschrieben zu Goa, dem 13 Jenner. 1738.

<sup>51</sup> Stocklein, *Weltbott*, n.641, *Ester Brief R.P. Andreae Strobl, (...) an seinen Herz n Bruder A.R.D. Josephum Strobl, (...) Geschrieben zu Lisabon, dem 17. April, 1737*. The solar eclipse was probably the one of 1 march 1737, that Cassini observed in Versailles, in the presence of the King (*Mémoires de l'Académie Royale*, 1737, p.136).

cerning his mission, Strobl gives the same motivations as the French and the Portuguese before him :

« I heard from afar that I would be sent by my superiors to the Mughal mission or to the Japanese province. In the Mughal kingdom, we have already two houses, in Agra and in Delhi, and a third one has been promised by an under-King, vassal of the Emperor, actually a Muslim, but rather than one of these preachers, he is a well-disposed Prince, well-versed in mathematics. »<sup>52</sup>

Finally, on 5 May 1737, Strobl boarded with seven other German speaking Jesuits and two Portuguese and, having left Lisbon the next morning, they disembarked at Goa on 30 September.<sup>53</sup> A very short journey, when compared to Hallerstein's :

« (...) we didn't meet the third of the dangers, illnesses and miseries encountered during a year, on this same route, by our two Austrian priests chosen for China. They arrived in Goa, not more than 13 days before us, while they had left Lisbon more than a year before us. They had to hibernate 10 months in Mozambique, where not far from a half of their militia had been carried to the cemetery (...) »<sup>54</sup>

Before Strobl's arrival in Goa, the Vice King already informed Jai Singh and Pedro da Silva that Strobl was on his way to India :

« Para Pedro da Silva assistente ao Raja Savae Iae Singa.  
(...) boa nova de me haver ja chegado o Padre Mathematico que elle me encomendou, o qual tem todas as boas partes para inteira mente o poder satisfazer, e logo que acabar o inverno, pois antes d'elle já não há tempo para a viagem o despedirey daqui, e poderá hir com elle o P.<sup>e</sup> Manoel de Figueredo, (...) Goa 20 de Mayo de 1737.  
Conde de Sandomil<sup>55</sup> »

Unfortunately, Strobl and his companion, Anton Gablsperger, had still before them a very long journey to Jaipur. Firstly, they had to wait one more year to have the permission to leave Goa. Secondly, when arrived in Surat on 2 February 1739,<sup>56</sup> they were lucky enough as to find a letter and an envoy sent by Jai Singh, in order to guide them on the way to Jaipur. But, no sooner began their journey than another letter of Jai Singh enjoined them to turn back. After waiting two months, they decided to join the Jesuit College of Damão.

A letter from the Vice King, to Pedro da Silva again,<sup>57</sup> sent in August 1738, attests to the delay :

Para Pedro da Silva Leitão em Jaepor corte do Raja Savae Iaeceng.  
(...) Tenho visto a reposta de Raja ; e quanto a ter elle mandado hum bramane seu a conduzir os Padres Matematicos, parece me que se apressou nesta diligencia, por que elles não podem daqui partir se não na primeira ocazião de embarçoens para o Norte,

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<sup>52</sup> *Ibidem.*

<sup>53</sup> According to Stocklein, *Weltbott*, n.642, *Zweiter Brief R.P.Andreae Strobl, (...) an oben benannten seinen Geistlichen Herzn Bruder, (...) Geschrieben zu Goa, dem 21ten Jenner, 1738.*

<sup>54</sup> *Ibidem.*

<sup>55</sup> Historical Archives, Panjim, Vol.977, Fol.12 verso. Edited by A.B. de Bragança Pereira, *Arquivo Português Oriental*, tome I, vol.III, parte V, pp.38-9 : « (...) good new has arrived to me that we found the Father Mathematician you have asked for, one who has all the natural abilities to satisfy [you] entirely, and as soon as the winter ends, and after his trip to Goa, he will quit here and would go with Father Manuel de Figueiredo (...) »

<sup>56</sup> Where Strobl wrote another letter, ARSI, Goa 36, pp.572-572v, dated 11 April 1739 and recounting these tribulations.

<sup>57</sup> Actually, every letter to Jai Singh was doubled by a letter to Pedro da Silva, who was, following Bailey's formula (personal communication), an agent of the Portuguese in Jaipur.

que não será antes do mes de outubro (...) 3 de Agosto de 1738.  
Conde de Sandomil.<sup>58</sup>

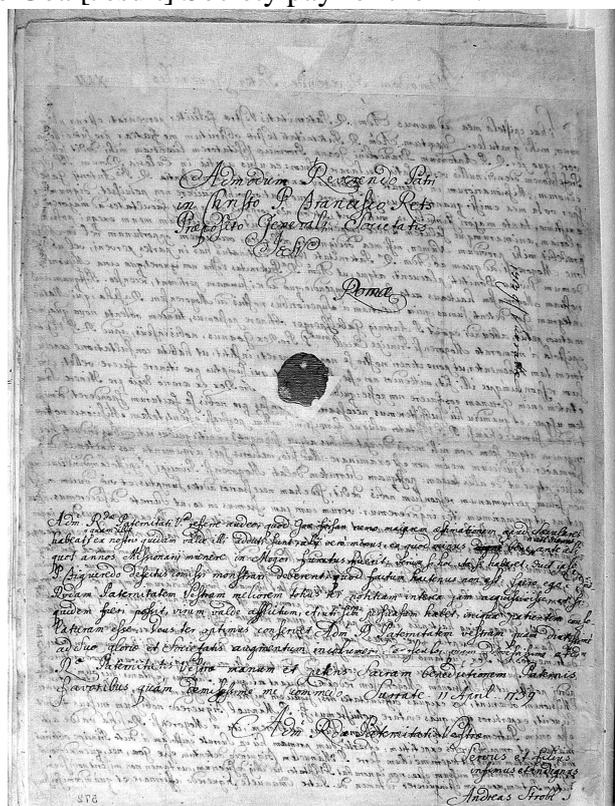
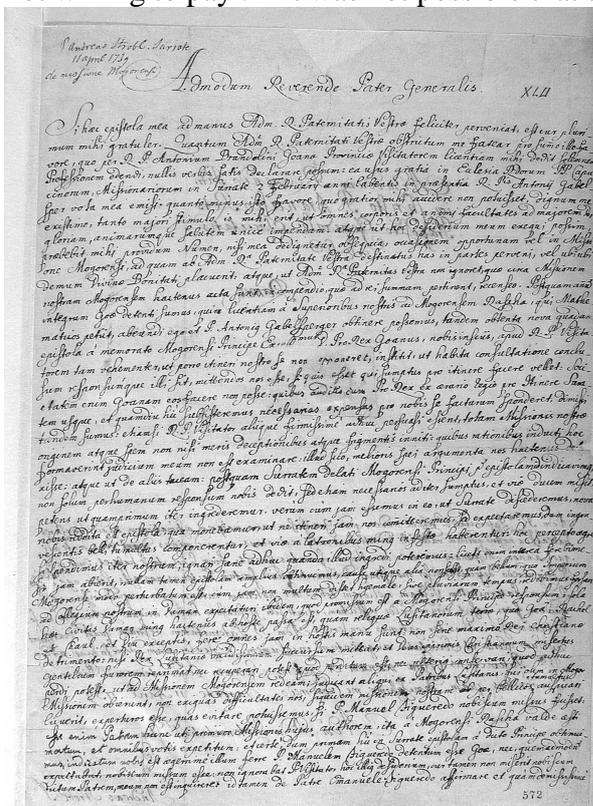
In another letter, dated 25 October 1738, from the Vice King to Jai Singh, we happen to know why Manuel de Figueiredo has not accompanied the two mathematicians :

Ao muito Illustre Raja poderoso e gr.<sup>de</sup> entre os Rajas do Industan, fiel<sup>59</sup> ao poderosissimo Rey Mogor Devs lhe assista e communique a sua graça.

(...) Desevaja eu que fosse tambem em sua companhia o P<sup>e</sup> Manoel de Figueredo e elle tambem desejava m.<sup>to</sup> chegar a prezença de V.A. mas a doenças que tem padecido impossibilitão por hora a fazer viagem, sendo esta a cauza de não poder acompanhar aos ditos P.<sup>es</sup> Mathematicos. (...)

Goa 25 de Outr.<sup>o</sup> de 1738. Conde de Sandomil.<sup>60</sup>

Strobl himself, in his letter dated 11 April 1739 quoted above, explained that there had been equivocations concerning the expenses of their journey. The Jesuit Visitor Brandolini was not willing to pay : « It was not possible that the Goa [Jesuit] Society pay for them ».



Letter, dated 11 April 1739, from Strobl to Cardinal Retz, General Superior of the Jesuits in Rome

<sup>58</sup> Historical Archives, Panjim, Vol.977, Foll.80-1. Edited by A.B. de Bragança Pereira, *op.cit.*, p.213 : « (...) I have seen the answer of the Raja. Concerning the Brahmin he has sent in order to guide the Fathers Mathematicians, it seems to me that he hastened a bit, for they won't be able to quit here before the first departure of ships to the North, which won't happen before the month of October (...) »

<sup>59</sup> This word, meaning 'faithful, loyal', shows that the letter is addressed to a vassal rather than to the Great Mughal himself, despite the grandiloquent formulas, unusual when Conde de Sandomil addressed to Jai Singh.

<sup>60</sup> Historical Archives, Panjim, Vol.977, Foll.87-8 illegible, but happily edited by Bragança, *op.cit.*, p.237 : « (...) I wished that Father Manuel de Figueiredo would also accompany them and himself also very much wished to be in the presence of your Highness but the illness he is enduring prevents [him] to travel, which is the cause why he could not accompany the said Fathers Mathematicians (...) »

Happily, the Vice King solved the problem by guaranteeing that he would pay « from the Royal Treasure the expenditure necessary for the journey to Surat and as long as we would stay in that place (...) After being sent to Surat, we informed the Mughal Prince, who not only offered us a very kind answer, but also the amount for the travel. »<sup>61</sup>

Finally, Strobl and Gablsperger arrived in Jaipur on 4 March 1740, and in his next letter to his brother, dated 6 October 1742,<sup>62</sup> Strobl reminds the conditions of their journey :

« After I had stayed 13 months in Goa, most of the obstacles had been removed, and I was asked finally to get ready for the journey. Together with Patris Antonii Gabelsperger who had been my constant companion on the journey, I was to board the ship that was to carry us to the Mughal Empire on the eve of All Saints' Day, in the year 1738. (...) We spent a few day at Chaul, (...) and some days at Bacaim, (...) and, having left all our ships and provisions there as succor for the beleaguered city, we hastened to Damon. (...) The next morning we disembarked swiftly for Surat which we finally reached safely on the 5th of December. (...) It is inhabited mostly by heathens, although the landholders, the Mughals, are Muslims. A few Europeans also live there — Englishmen, Dutchmen and Germans. As foreigners they are, however, not entitled to purchase houses or landed property; therefore they make do with rented living quarters. The only exception are the Capuchinian Patres, of French nationality, who own their cloister and their little church forever, since their generous endowment was accepted by the city authorities as payment of irrevocable purchase. (...) We stayed with these Patribus and were received by them with unheard of kindness. Immediately after we reached there, they told us the joyful news that quite some time ago a certain Brahmin had been sent by the King of Jaepor to Surat to wait for our arrival there and to act as our guide for the rest of the journey. However, just then that Brahmin had left Surat for a short while on some other business. In his absence we thought it was our duty to inform the King, our future master, in writing about our presence at Surat. He acknowledged our letter very graciously, and after almost a month he answered with a very polite letter of invitation which he sent through our messenger. He also sent, as travel allowance, a generous note of hand for one thousand rupees (which is almost as much as the same amount of Bavarian guilders). The day for our departure had already been settled when a second letter from Jaepor ordered us not to proceed, since there were disturbances in the entire Mughal Empire because of the unforeseen invasion by Tamas Koulikan (Nadir Shah). All passes and roads were made unsafe, either by the Persian army or by bands of robbers who were moving about everywhere. We were to wait at Surat for better times and particularly for the outcome of the war, to see which side would carry off the victory. »

The evolution of these Persian troubles and of the Portuguese war against the Marathas, and their consequences for the two Fathers are recounted further in the letter :

« We two unfortunate missionaries were in a cleft stick: we could neither go back from where we had come, nor forward to where we wanted to go, and in the end we did not know what our final decision should be. We even considered going our separate ways —

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<sup>61</sup> ARSI, Goa 36, pp.572-572v, dated 11 April 1739 (see the copy of this letter, below).

<sup>62</sup> Stocklein, *Weltbott*, n°643, that Prof. S.R.Sarma has been kind enough to send me, as well as nn° 644, 645 et 646, in the English translation of his spouse, Dr Renate Sarma. May they be both thanked here for their most valuable help. For the copies of nn° 641, 642 and 647, I am indebted to Dr Grünendahl, whom I am pleased to thank here.

that is to say, I should go on a French ship to Pondicheri, while my companion who had some command over the Persian language should proceed to our missionaries in Persia to offer them our services. »

Then Strobl ended his noviciate and pronounced his vows to become a Jesuit Priest; finally they could leave Surat, but not without a further delay and difficulties caused by their Brahmin guide :

« To come back to our departure from Surat: for almost six months our departure was delayed because of obstacles created by those quarters from where we had least expected it. That very Brahmin who was to guide us to Jaepor pretended to have a different reason every day for putting off our departure, until finally it was made totally impossible by the onset of the rainy season. God knows what schemes were afoot to make that man detain us at Surat until the middle of November, thus considerably inconveniencing us and our most gracious hosts from whom we received all courtesies imaginable. On the 19th of November we finally set out, using for the mostly overland journey a certain type of cart with two wheels, not drawn by horses, but by oxen, as it is customary here. Four more of the same carts went with us, all filled with various types of goods, some of them for our king, some for the friends of our guide. However, these goods caused us great difficulties, particularly at the customs stations. Most of the customs officials took us for rich foreign traders, and at all places they demanded extremely high duties and even wanted some of the medicines which we were carrying with us. This gave continuously rise to quarrels and disputes. As far as the medicines were concerned, our Brahmin thought the matter could be solved if we were to wrap something or other, whatever we could put our hands on, into paper and present it to the simple toll collectors. When we expressed our distaste for such deceit, the Brahmin whispered into our ears: Padrigi! Reverend Patres! In this country, it is the custom to tell lies! If we want to tell the truth all the time, how shall we be able to go on? However, all the same we finally reached the end of our journey, though not without collisions (...) »

Arrived in Jaipur on 4 March 1740, they met Jai Singh :

« The King was very pleased and treated us from the first encounter with extreme politeness and benevolence. After the first welcome, we were given a very comfortably furnished house and a church which had been built completely new. In the living quarters there was nothing missing, except easy chairs, and His Majesty very kindly ordered some seats to be brought from the court to our house so that we would not miss armchairs. He said: These foreigners are not used to sit on the floor, give one of my seats to them, so that they do not suffer any inconvenience. (...) Since here it is improper for men of importance to be seen walking in the city, we found at our service a cart, drawn by two fat, well-built oxen who are maintained, together with their driver, by the Royal Treasury. Through his Majesty's generosity we receive daily 5 rupees, and the church 5 rupees every Sunday; and until now also daily (except on two days of each month which are days of fasting for the heathens) we received from the Royal kitchen goat's meat for our table. This must be understood as a special act of generosity, since it is strictly prohibited to kill a goat without first asking permission from the King himself. »

After some considerations about the people's beliefs and what Strobl named superstitions, even among Jai Singh's astronomers, he ends his letter by alluding very shortly to the astronomical subject :

« I am of service to him (Jai Singh) in matters concerning mathematics of which he is extremely fond, as I shall explain in detail in another letter. He seems to be pleased with my services, since he twice turned down a request by the Mughal Emperor who had invited me for the sake of mathematics to Dely, refusing to let me go away. Maybe even then the King had plans, as he told me later, to send me with gifts to Europe, to the Roman Emperor and to the Pope, in order to establish friendship with these world rulers and to show them his reverence. In fact, preparations were being made at court, to get appropriate gifts together when a war suddenly broke out and other obstacles arose, the most serious being the death of my companion and Superior, R.P. Antonii Gabelsperger whom God called to the better life hereafter. My departure was thus postponed for a longer period, if not completely given up. »

Actually, this was the case, for Jai Singh died on 2 October 1743.<sup>63</sup> And, of course, Strobl never went back to Europe, but stayed in India where he died, probably in 1770.<sup>64</sup> He seemed to have pursued for a while his mathematical activities, especially under Muhammad Shah,<sup>65</sup> with whom he had many interesting discussions about a treatise he was preparing on hydraulics, gnomonics and mechanics,<sup>66</sup> but confessed, in a letter dated 5 October 1748<sup>67</sup> from Delhi,<sup>68</sup> that he has completely given up his mathematical studies. Now, the astronomical and mathematical contribution of Strobl to Jai Singh's studies should still be investigated, especially when we read in another letter, dated 13 October 1744 from Jaipur, that Strobl deplors the loss of the four letters he wrote each of the last four years to the Queen of Portugal.<sup>69</sup> Perhaps would it be also possible to find some more traces of Strobl in Jaipur, Bikaner, Delhi or even in Portugal or Germany.

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<sup>63</sup> Recounted by Strobl, in Stocklein, *Weltbott*, n°644.

<sup>64</sup> Sommervogel, *Bibliothèque de la Compagnie de Jésus*, 12 vol., 1960, coll.1645-6.

<sup>65</sup> Stöcklein, n°647, dated 27 October 1746, from Delhi to the Queen of Portugal's Confessor.

<sup>66</sup> « By him (Jaipur Prime Minister), I was authorized to travel from Jaipur to Deli, where I arrived on December (Christmonat) 22, last year, and was very courteously welcomed by the Emperor. His Majesty let me visit Him at any moment I am coming at the Court, and receives with great pleasure my mathematical work on hydraulic, gnomonics and mechanics, that I prepare for him from time to time at His request, and discuss with me different treatises, some learned, some spiritual, of which He is a great enthusiast. »

<sup>67</sup> The very year Muhammad Shah died, as recounted by Strobl in Stöcklein, n°647.

<sup>68</sup> Stocklein, n°649, addressed from Delhi to R.P. Joseph Ritter, s.j., Confessor of the Portuguese queen Maria Anna.

<sup>69</sup> Stöcklein, n°646, addressed to the Portuguese queen Maria Anna, archduchess of Austria.