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From Brera to Lisbon: Skyscapes, Astronomical Observatories and Meridians

Architecture, Astronomy, Observatories, Heritage, Lisbon

/Abstract

It may seem like a pretext – and it is a pretext! – but the existence of the Brera Astronomical Observatory (1764) raises several questions of Italian-Portuguese scope: (1). the presence in Portugal of astronomers and mathematicians from the Society of Jesus, professors at one of the most qualified schools of European cosmography from the 17th-18th century – the *Aula da Esfera*, in Lisbon; (2). the leading role of Italian astronomers in the "golden" years of the reign of D. João V, in Portugal and in overseas territories, in the development of observation of the stars, in topography, terrestrial and cosmic geography and in the measurement of Time, be it, or not updated by the Copernican proposals; (3). and the memory of the oldest observatories in the kingdom of Portugal, contemporary with the notable Milanese scientific structure. The scope of marginalized architecture also arises here, serving as a reminder of multiple scientific achievements with repercussions on eighteenth-century architecture. Our aim is to reactivate these "places of memory", some of them humble testimonies (the "meridian" of the Mafra Convent), others just narrated memories (the observatories of the Colégio de Santo Antão – today Hospital de S. José – or the observatory of the Paço da Ribeira, the Arsenal *Cosmochronometro*), others still brought to us with rigorous documentary vigor, although demolished or never built and giving rise to a work of crypto-history of architecture (as with the project of the large observatory of the University of Coimbra; then the small observatory that was "de facto" built and later demolished in the middle of the 20th century), others that still exist (such as the Tower-Observatory of Paço da Bemposta; the site of the Escola Politécnica Observatory; and Tapada da Ajuda Observatory) as a fleeting but real presence of those past times that our century must preserve and revive. A heritage challenge for our time.

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Astronomical Knowledge between Italy and Portugal

The existence of the Brera Astronomical Observatory (1764)[1] raises several questions of Italian-Portuguese scope. One fact that puts us on the track of Portuguese-Italian relations is the contemporaneity of many of the advances in astronomical science, mathematics and natural physics – what we would today call astrophysics – on Italian soil, and the similar process, although not as full-bodied, carried out in Portugal during the 17th century and especially during the reign of D. João V or even later, throughout the 18th century until the end of the 19th century. In short, a moment of transition to modernity.

It is no coincidence that one of these protagonists, Giuseppe Ruggiero Boscovitch[2], the Italianized name of this Croatian (or Serbo-Italian) born in Dubrovnik (then Ragusa), joined the Society of Jesus, already in Milan, assuming a prominent role. The Society of Jesus would also be, in the kingdom of Portugal, the model institution for astronomical studies[3]. On the other hand, in terms of current affairs, that is, for our 21st century, an aspect that has interested us greatly stands out: the existence of an architectural astronomical heritage materialized in achievements of evident impact and monumentality and that urgently needs to be known, studied and preserved. The astronomical heritage is defined as "the material evidence relating to astronomy and to social uses and representations of astronomy"; and this heritage can assume various natures such as:

(1) tangible objects, monuments, places and landscapes connected to celestial bodies;

(2) movable objects, such as instruments and archives;

(3) intangible knowledge, such as primitive knowledge related to astronomy;

(4) natural environments that foster human interest in the celestial vault[4].

1 For the Brera Observatory, see Pasquale Tucci, ed., *Da Brera a Marte: storia dell'Osservatorio astronomico di Milano* (Novara: De Agostini, 1983); Mario Carpino, "Breve storia dell'Osservatorio astronomico di Brera attraverso i suoi strumenti," *INAF – Osservatorio astronomico di Brera*, http://www.brera.inaf.it/utenti/carpino/didattica/ Accessed July 2015; Giuseppe Schio, "Brera," in *Enciclopedia Italiana* (Rome: Istituto dell'Enciclopedia Italiana, 1930); Wayback Machine, Internet Archive, http://www.merate.mi.astro.it, Accessed 2024, https://web.archive.org/web/19971017000149/http://www.merate.mi.astro.it:8; Graziela Buccellati, Pasquale Tucci, and Arturo Balboni, *I cieli di Brera: astronomia da Tolomeo a Balla* (Milan: Università degli studi di Milano, 2000). See also the website of the Museo Astronomico di Brera, http://www.brera.unimi.it Accessed March 2026.

2 For Ruggiero Giuseppe Boscovich, see Ruggiero Giuseppe Boscovich, *De centro gravitatis* (1751); and *Philosophiae naturalis theoria redacta ad unicam legem virium in natura existentium* (1758). See also *"Boscovich," La storia dell'Osservatorio astronomico di Brera attraverso i suoi strumenti*, MUsAb – Museo Astronomico di Brera, http://museoastronomico.brera.inaf.it/, Accessed 2024; and Jonathan Wright, *Ruggiero Boscovich (1711–1787): Jesuit Science in an Enlightenment Context* (Notre Dame, IN: University of Notre Dame Press, 2014).

3 For recent studies on the subject or related matters, see especially Henrique Leitão, *Sphaera Mundi: a ciência na Aula da Esfera; manuscritos científicos do Colégio de Santo Antão nas colecções da BNP* (Lisbon: Biblioteca Nacional de Portugal, 2008); Henrique Leitão, *Os descobrimentos portugueses e a ciência europeia* (Lisbon: Alétheia and Fundação Champalimaud, 2009); and Henrique Leitão, Cândido Marciano da Silva, and Luís Tirapicos, eds., *Estrelas de papel: livros de astronomia dos séculos XIV a XVIII* (Lisbon: BNP, 2009). See also Rómulo de Carvalho, *A astronomia em Portugal no século XVIII* (Lisbon: ICLP, 1985); Angela Delaforce, *Art and Patronage in Eighteenth-Century Portugal* (Cambridge: Cambridge University Press, 2002); Carlos Fiolhais and José Eduardo Franco, *Jesuítas: construtores da globalização* (Lisbon: CTT, 2016); Manuel J. Gandra, *A astrologia em Portugal: dicionário histórico-filosófico* (Lisbon: Arcano Zero, 2010); and Miguel Soromenho, "Astronomia-Astrologia," in *A ciência do desenho: a ilustração na colecção de códices da Biblioteca Nacional*, ed. Joaquim Caetano and Miguel Soromenho (Lisbon: BNP, 2011).

4 Michel Cotte and Clive Ruggles, "Introduction," in *Heritage Sites of Astronomy and Archaeoastronomy in the Context of the UNESCO World Heritage Convention: A Thematic Study* (Paris: ICOMOS/IAU, 2010).

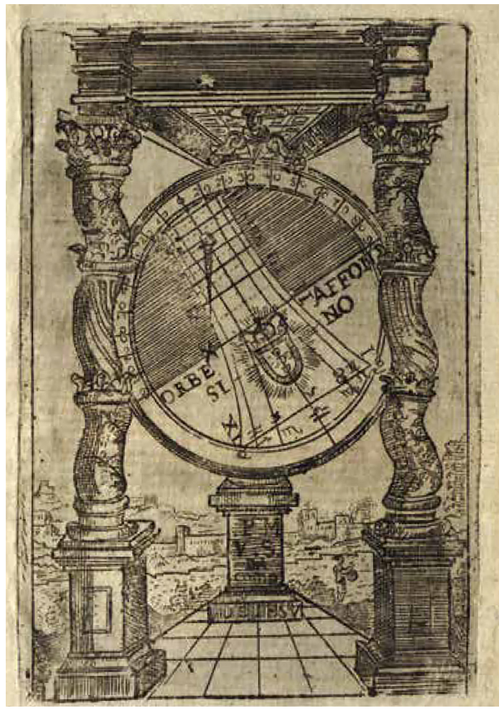
In Portugal we must highlight the pioneering role played by the *Aula da Esfera,* the classes held in the Jesuit College of Santo Antão[5]. Benefiting from the international – we would even say internationalist and proselytizing – character of the Company and the systematization of a universal – or unique, for the Company's schools – teaching, the famous Ratio Studiorum, numerous high-status teachers from Spain, France, Italy, Holland, Germany and Great Britain flocked to Lisbon, Coimbra and Évora. The circulation of knowledge and the experience of teachers thus came closer to true science, although it was still a teaching process that admitted acquired truths and promoted a bookish teaching style, guaranteed, however, by highly qualified teachers, of which we highlight Valentim Estancel for his proposal with architectural, albeit "mobile" consequences. Estancel's procedures were also dedicated to nautical science and problem-solving, which he intended to resolve by proposing new instruments, as can be seen in several of his works, starting with *Orbe Afonsino* (1658)[6] and the treatise *Typhis Lusitano* (1663)[7]. The *Typhis* would be an instrument that combined a compass and a concave sundial, along with instrumental inventions such as the "magnetic bosseta", illustrated with drawings. The most interesting of all is a page dedicated to the "monumentalization", if you can call it that, of the *Typhis*. It is presented to us framed by a triangular canopy, supported by three Solomonic columns – a noteworthy solution with no typological precedents. This new device is inserted there on a large scale, with the most distant pedestal bearing the initials F. V. S. as the inventor's signature. **[Fig.1]**

Among the Italians of this first phase, the famous Father Lembo (or Giovanni Paolo Lembo) (1570–1618) stands out. Lembo accepted the observations of Galileo and Tycho Brahe, proposing a mixed system, which he developed, everything leads us to believe, during his stay in Portugal, in Santo Antão, between 1615 and 1617. According to his cosmological model, Venus and Mercury gravitated around the Sun, but the Sun gravitated around the Earth. And the fascination of these times of great discoveries is not far removed from the present day, in which the most radical theses are tested and sometimes even adapted in the face of a consecrated teaching body, which is difficult to remove – and less due to reactionary resistance (which there was also, obviously) but rather due to explanatory difficulties – these two manuscripts kept in the Torre do Tombo, in

5 The College of Santo Antão was to be a major undertaking. The church, now demolished, followed the model of the Gesù in Rome and even had a dome over the transept. Today, all that remains of this complex is the immense sacristy, luxurious in materials and a good indicator of the richness of the building, in an architecture from a period of transition between plain architecture and the first baroque, before its radical transformation to house what is now the Hospital de São José. The complex maintains, in addition to the old sacristy, a cloistered court, the Porta do Carro and the old gatehouse, all internally decorated with historic tile panels from the mid-18th century. The original design was by Baltasar Álvares (1579–1613), with later interventions by Diogo Marques Lucas (1614) and João Antunes (1689–1702), to whom we certainly owe the large and primitive sacristy. In this context of Portuguese architectural production, which encompasses the Philippine cycle, as mentioned above, but also post-Restoration architectural achievements (post-1640). Today it is an immense mass that dominates the Sant'Ana hill, imposing its massive silhouette on the city, synonymous with the importance it held as a central teaching institution for the Jesuits and home to the famous Aula da Esfera.

6 Valentin Estancel, *Orbe Afonsino ou horoscopio universal* (Évora: Impressão da Universidade, 1658), Lisbon, BNP, BPNM I 2-40-1-91; and the Latin manuscript *Orbis Alfonsinus sive Horoscopium sciothericum universale* (1658), Lisbon, BNP, Cod. 21361.

7 Valentin Estancel, *Tiphys Lvsitano ou regimento navtico, novo o qual ensina tomar as alturas, descubrir os meridianos, demarcar as variaçoens da agulha a qualquer hora do dia e noite, com hum discvrso practico sobre a navegação de leste a oeste*, after 1661, Lisbon, BNP, Cod. 22641.



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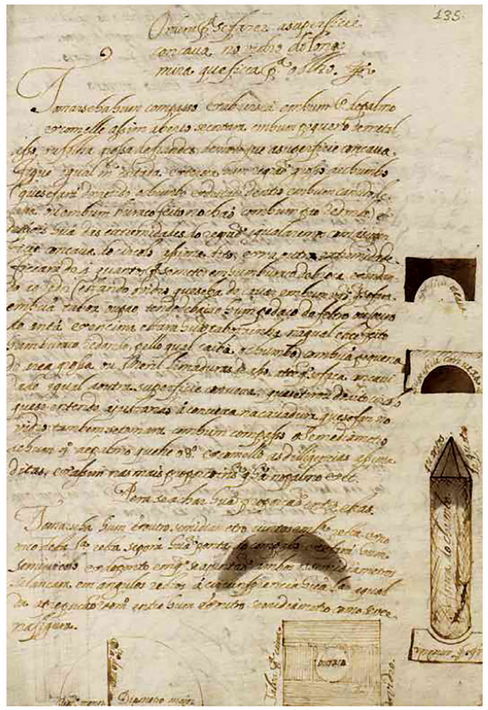


2

Lisbon, although very simply illustrated[8], are the only ones of his authorship that have been preserved, attesting to their importance for the history of science[9]. In them, remember, he explains, nothing less, how to build. **[Fig.2]**

Another prominent Italian active here was Cristóforo Borri (1583-1632), known to be a practitioner of telescopic observation, which he applied during his stay in Portugal, in Coimbra, around 1627, moving on to Lisbon, where he mainly dealt with nautical science, which implied a refined astronomical knowledge[10]. Among several works – most of them handwritten, according to copies by students[11] – his *Collecta astronomica* [12] published in Lisbon stands out, featuring an illustrative set of engravings by an unknown author but certainly prepared by Bruno (another first name by which Borri is known in Portugal), in what is one of the treatises most richly provided with scientific iconography among those printed in Portugal, this one in the workshop of Matias Rodrigues. **[Fig.3]**

8 Giovanni Paolo Lembo, "[Matérias de matemática]," 1615–1617, Manuscritos da Livraria, ms. 1770, Arquivo Nacional da Torre do Tombo, Lisbon.

9 Leitão, *Sphaera Mundi*, 121–24.

10 Leitão, *Sphaera Mundi*, 131.

11 For Cristoforo Borri, see *Tratado da arte de navegar pello Reverendo P. Christovão Brono da Companhia de Jesus*, 1628, Évora, Biblioteca Pública de Évora (BPE), Cod. CXXVI; *Compendium problematum, meteororum, et parvorum naturalium, copied by Ignatius Nunes*, 1627–28, Lisbon, BNP, Cod. 2378; Arte de navegar, 1628, Coimbra, Biblioteca Geral da Universidade de Coimbra (BGUC), Ms. 44; and *Regimento que o P. Christovam Bruno da Companhia de Jesus, por ordem de S. M., da aos pilotos das naos da India para fazerem as experiências sobre a arte de navegar de leste a oeste*, 1628, Rio de Janeiro, Fundação Biblioteca Nacional (FBN), Ms. 1-12.

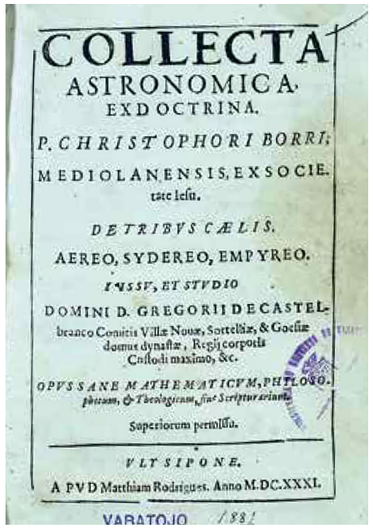
12 Cristoforo Borri, *Collecta astronomica, ex doctrina P. Christophori Borri, Mediolanensis, ex Societate Jesu: De tribus caelis, aereo, sydereo, empyreo [...] opus sane mathematicum, philosophicum, & theologicum* (Lisbon: Matias Rodrigues, 1629), Lisbon, BNP, Var. 1881.

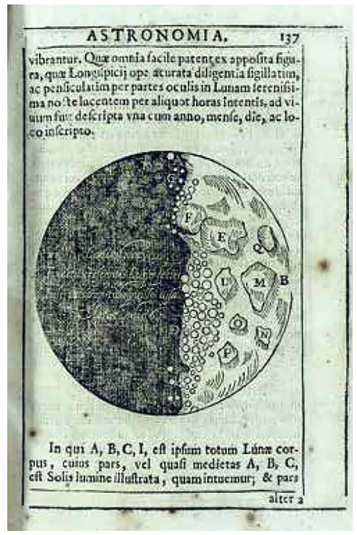
Fig. 1

Typhis lusitano, in *Orbe Afonsino ou Horoscopio Universal* (Évora, 1658). Valentin Estancel. Biblioteca do Palácio Nacional de Mafra (I 2-40-1-91)

Fig. 2

"Ordem para se fazer a superfície concava no vidro de longa mira que ficca para o olho", de *Tratado da Esfera e Outros Tratados Matemáticos, de Giovanni Paolo Lembo* (1615-1617). Arquivo Nacional Torre do Tombo, Lisboa (Manuscritos da Livraria, n.º 1770, f. 135; PT/TT/MSLIV/1770)


COLLECTA
ASTRONOMICA.
EX DOCTRINA.
P. CHRISTOPHORI BORRI;
MEDIOLANENSIS, EX SOCIE.
tate Iesu.
DE TRIBVS CÆLIS.
AEREO, SYDEREO, EMPYREO.
IVSSV, ET STVDIO
DOMINI D. GREGORII DE CASTEL-
branco Comitis Villæ Nouæ, Sortelliæ, & Goesiæ
domus dynastæ, Regij corporis
Custodi maximo, &c.
OPVS SANE MATHEMATICVM, PHILOSO-
phicum, & Theologicum, sine Scripturarium.
Superiorum permissu.
VLT SIPONE.
A PVD Matthiam Rodriguez. Anno M.DC.XXXI.
VABATOJO /88/


ASTRONOMIA. 137
vibrantur. Quæ omnia facile patent ex apposita figura, quæ Longispicij ope accurata diligentia sigillatim, ac pensiculatim per partes oculis in Lunam serenissima nocte lucentem per aliquot horas intentis, ad vium fuit descripta vna cum anno, mense, die, ac loco inscripto.
In qui A, B, C, I, est ipsum totum Lunæ corpus, cuius pars, vel quasi medietas A, B, C, est Solis lumine illustrata, quam intuemur; & pars alter a

3

Italian Influences in the Scientific Circles of the Reign of D. João V

During the time of D. João V, not only did the interest in astronomical and cartographic matters continue, but it is known that among the cultural matters that interested the monarch was the establishment of libraries equipped with the most recent (and also the most striking, although old) books, prints, letters and maps existing in Europe, to the point of organizing with his ministers and ambassadors systematic purchasing campaigns without (or with few) financial limits. In the field of astronomy, the reign of D. João V, in line with the rest of his achievements, went through one of its most fertile periods. It is known from documents that the royal family and the king himself delved into these matters, sometimes out of curiosity, other times out of sincere involvement, in response to the king's immense curiosity. Following the example of the Academies of the time, the monarch is present at conferences and discussions on scientific matters, among which those of a cosmographic nature stand out[13], in one of which the highly erudite 4th Count of Ericeira, D. Francisco Xavier de Meneses, was involved:

> The Count of Ericeira, wanting to make his universality communicable in all literature, and to direct hearts and discourses to moral virtues, and to science, removing useless speculation from them, instituted in his palace a congress of erudite people, with the title of Portuguese Academy, whose laws are comprised of twenty-two precepts. The assemblies will begin on May 26th, and will continue every Wednesday afternoon.[14]"The most illustrious and learned people of the Court"[15] were present.

13 On Carbone's observations and astronomical activity at the Johannine court, see the summary in Carvalho, *A astronomia em Portugal no século XVIII*, 41–44.

14 *Gazeta de Lisboa*, no. 23, June 10, 1717, cited in Carvalho, *A astronomia em Portugal no século XVIII*, 38.

15 Carvalho, *A astronomia em Portugal no século XVIII*, 38.

Fig. 3

The Moon as represented in *Collecta astronómica*, Cristóforo Borri (1631). Biblioteca Nacional de Portugal, Lisboa (Var. 1881, p. 137)

At this time, two astronomical observatories were also installed, one at the Colégio de Santo Antão, led by Giovanni Battista Carbone (1694–1750), a Jesuit based in Portugal, who would assume a prominent role as an advisor to the king in all matters, including the commissions for the Royal Building of Mafra, and obviously in what was his speciality, astronomy –, but also in the Royal Palace of Lisbon, or Paço da Ribeira. With Domenico Capassi and Francesco Mussara, who accompanied him on his arrival in Lisbon in 1722, the king's intention was to commission him to carry out astronomical observations in South America – certainly as a result of cosmological and astronomical agreements but also to resolve the already long-standing problem of correctly calculating longitudes for the purposes of improving maritime navigation, but Carbone would remain on the continent and would be invested with the status of "royal mathematician". Correspondent of the Royal Society of London, where he published several observations in the famous Philosophical Transactions, it was also through him that Portugal became largely integrated into the European scientific circles of the time. The Paço da Ribeira observatory would have had two telescopes of reasonable range, around three meters long, in line with those used in other countries at the time, the result of very special orders placed in Italy and France[16].

4

Angela Delaforce assures that

> meanwhile, D. Luís da Cunha was tasked with ordering the plans for the Observatory of the Royal Academy of Sciences in Paris, as well as the designs for all the respective instruments. In 1725, the Portuguese court commissioned the works of Philippe de la Hire, astronomer to Louis XIV, for the new observatory, together with the French translation of the works of Isaac Newton.[17]

The Paço da Ribeira Library would become one of the most important (if not the most important) in Portugal, unfortunately lost in the 1755 earthquake with all its contents. It was designed, in fact, to contain scientific instruments, such as a large armillary sphere, manufactured precisely under the technical direction of Father Carbone. Further, Angela Delaforce writes:

> The documents suggest that the library was organized so that scientific instruments could be used alongside consultation of the latest theoretical treatises, and, indeed, the ordering of instrumentation ran parallel to that of the relevant technical texts. A didactic initiative of this type was already evident in 1721, when a series of texts dedicated to science, mathematics and navigation were commissioned from Jean Mariette in Paris by D. Luís da Cunha. Around the same date, two pendulums designed for calculating longitudes were ordered from a certain Monsieur Sully, an

16 Delaforce, *Art and Patronage in Eighteenth-Century Portugal*.

17 Delaforce, *Art and Patronage in Eighteenth-Century Portugal*, 86.

Fig. 4

D. João V as patron of the arts. Engraving by Gaspare Sennarij (c. 1740). Biblioteca Nacional de Portugal, Lisboa (E 42 V)

instrument maker from Bordeaux who had workshops in Versailles. In The Hague, in April 1723, the Count of Tarouca purchased a pair of rare celestial and terrestrial globes made by the famous Venetian cosmographer Vicenzo Coronelli. They would have been five palms in diameter and must have been similar to those that Coronelli made for Louis XIV in 1683, remarkable for their dimensions. From 1725 onwards, and even later, after D. Luís left Paris, Jean-Baptiste Bourguignon (1697-1782), a young cartographer at the French court, was tasked with supervising orders for the royal library in Lisbon.[18] [Fig.4]

All these facts end up coinciding with the publication of an influential treatise by the astronomer and mathematician Francesco Bianchini (1662-1729), an up-to-date man of science informed by Newton's discoveries, which contains observations of the planet Venus, entitled *Hesperi et Phosphori nova phaenomena*[19], from 1728, naturally dedicated to his benefactor (and prestigious patron in Rome), D. João V, something that resulted from the scientific exchanges between Carbone and the illustrious Roman scientist, which is immediately acknowledged on the front cover, which features an engraving of the monarch's effigy held by the goddess Minerva, accompanied by Atlas holding the celestial globe with the constellations, the work of the artists Stephanus Pozzi and Rocchus Pozzi, the first as a draftsman, the second as an engraver[20]. The astronomer will decide on the honorary names of some of the spots on Venus (*machie*) such as *Mare Regis Emmanuelis* (Emmanuel's Sea King) or those of Portuguese discoverers. It was also during the reign of the Magnanimous that the Oratorians began their teaching as innovators in the field of education. In the context of the so-called "Catholic Enlightenment" and following the proposals of Luís António Verney, a critic of Jesuit teaching, the support of D. João V and later of D. José to the priests of the Oratory would lead to a renewal in the field of pedagogy and, for what concerns us now, in the field of astronomy. Even so, within the Society of Jesus there was a desire to follow the progress of science and to welcome the proposals of the Copernican model and Kepler.

One of the most prominent renovators of compendial teachings of a cosmographic-astronomical nature would be Inácio Monteiro, who was a professor of Mathematics at the College of Arts, in Coimbra. Inácio Monteiro (1724-812) would write, without shame, that

> Many applied themselves to observing, others to calculating and adjusting the system of the world with various and ingenious hypotheses. In one of these the earth was seen (to which almost everyone had granted complete rest until then) thrown by a German, the excellent Nicolaus Copernicus, from the center of the firmament to the Ecliptic, where he made it revolve around the Sun, from which he took away all movement and brought it to the center. Tycho Brahe, the famous Danish astronomer, wanted to return the land to its former possession for a second time. Astronomers have been divided between these two parties; but the majority declare themselves in favor of the first[21],

thus opening the field to doctrines that until then were «heretical» in their *Compendium of Elements of Mathematics*, giving particular importance to the physical sciences in their exposition, as Rómulo de Carvalho points out. And the historian of sciences says more, giving an account of the frankness of this Jesuit priest:

> It should be noted that it was only in 1758, after the publication of this Compendium, that Copernicus' De Revolutionibus Orbium Coelestium was ordered to be removed from the Index of forbidden books by Pope Benedict XIV, a date from which it became possible to speak of the heliocentric doctrine a little more freely.[22]

The work came after all in the wake of a work by Noel Regnault, *Origem Antiga da Fysica Moderna*, which was translated into Portuguese by an unknown person, João Carlos da Silva (obviously, a possible pseudonym), published under the date of 1753, five years before the ban on Copernican ideals was lifted. With the congregation of St. Phillip of Nery Oratorians, an almost complete openness to the New Astronomy was finally achieved. Cherished by the king, he ordered the construction of the Royal Palace of Necessidades as a royal residence and religious college, reaching the end of the 18th century with a work in which the assumptions of old science were questioned and the new ones were irrefutably accepted, a task that was undertaken, in terms of dissemination, by the wise priest Teodoro de Almeida, with his monumental work *Recreação Filosófica* (1751-1800), in ten volumes, with an updated survey of all branches of knowledge of what would then be called natural philosophy.

From Italy to Portugal and the Memory of Astronomical Heritage.

It is now up to us to remember the achievements that some have perished, but others have persisted in memory, in writings and plans of great value. Interestingly, some of them along with the long and fascinating life and constant updating of one of the central European observatories – and of the Italian Peninsula, if not of Central Europe. Observatories, major pieces of architectural astronomical heritage. This is where the magnificent Milanese observatory of Brera, born from Boscovicci's initiative, takes on special importance. However,

18 *Art and Patronage in Eighteenth-Century Portugal*, 86.

19 Francesco Bianchini, *Hesperi et Phosphori nova phaenomena sive observationes circa planetam Veneris [...] nunc primum editae sub auspiciis Sacrae Regiae Majestatis Joannis V* (Rome: Giovanni Maria Salvioni, 1728), Lisbon, Biblioteca da Ajuda (BA), 35-XV-21.

20 Leitão, *A ciência na "Aula da Esfera"*, 182.

21 Inácio Monteiro, *Compêndio dos elementos de matemática*, 2 vols. (Coimbra, 1754–56), cited in Carvalho, *A astronomia em Portugal no século XVIII*, 25.

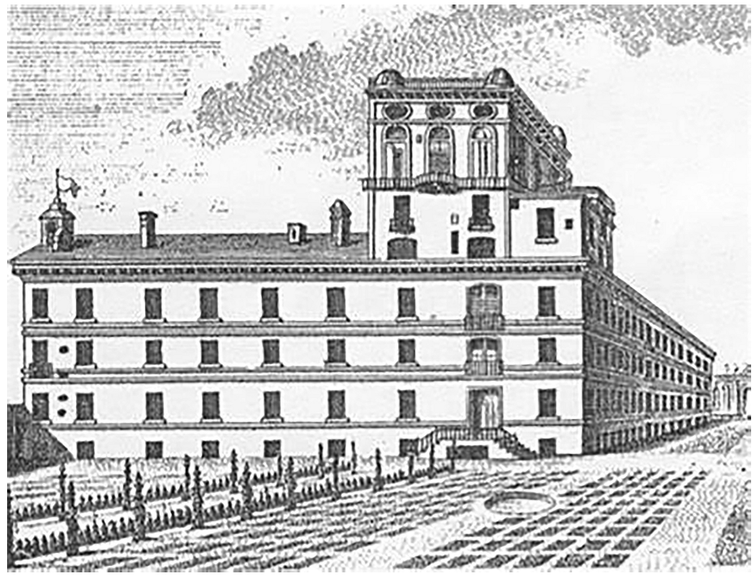
22 Carvalho, *A astronomia em Portugal no século XVIII*, 25.

the Observatory's built history would be long and rich[23]. The Observatory would undergo numerous changes in response to various scientific directions and the political context that conditioned and determined such changes, with the increase in the observatory's various functionalities, to the point that in the mid-19th century the structure was (as it still is today) completely modified. Boscovitch's founding observatory has been assimilated and absorbed by the various changes and additions, in such a way that it is difficult to recognize the original building. This is the one that interests us here, created within the framework of the first Milanese Enlightenment. The oldest engravings show its positioning as an addition to one of the corners of the Palace, inspired by the Roman project by Martino Bassi of the Collegio Borromeo in Pavia from c. 1573 continued until 1590. The so-called "Palazzo" would therefore be built as a College of the Society of Jesus under Francesco Maria Richinni, with work beginning in 1615 and being completed by his son Gian Domenico Richinni in 1658. It has a Baroque containment in the Milanese tradition with additions in height and two observation towers. That was the possible limit. **[Fig.5]**

A precious model – or wood model – survives from its first iteration. Quoting from the Museum's file:

> This is almost certainly the original wooden model built by Ruggero Giuseppe Boscovich (1711-1787) to illustrate his project for the Astronomical Observatory to the rector of the Jesuit College of Brera. The model reproduces the two floors of the Observatory with the terrace and the two towers. The long quadrant hall, which faced east, is incomplete: the outer walls and ceiling are missing, while the wall that separated it from the small entrance hall is present. Downstairs, there are four rooms. The two to the north have no floors. The floor of the two rooms facing south, however, can be raised and under one of them you can read the inscription "della Compagnia di Ges". The four rooms have one window each, so there are two windows facing south and two facing north. Inside you can see the column that supports the roof, as well as the balcony that gives access to the entrances of the two towers. To the north, the external walls follow the square plan of the lower floor, while inside the room has an octagonal plan created with internal walls. The large windows in the hall have wrought iron grilles. To the southeast and southwest the balconies are triangular. The two towers cross the roof and are closed by conical covers with longitudinal openings covered by a hatch. Some external stairs connect the various floors of the building. The joints between the various parts are made in such a way that you can easily disassemble the model to observe its interior. Representation of the functional model of the first architectural project of the Brera Astronomical Observatory, in Milan.[24] **[Figg. 6a-6b]**

23 Aldo Kranjc, Guido Tagliaferri, Pasquale Tucci, and Renato Valota, *Da Brera a Marte: storia dell'Osservatorio astronomico di Milano* (Milan: Nuovo Banco Ambrosiano, 1983); Mario Carpino, "Materiale didattico," *Osservatorio astronomico di Brera*, http://www.brera.mi.astro.it/~mario.carpino/didattica/ , Accessed March 2026; Giovanni Virginio Schiaparelli, *Le opere di G. V. Schiaparelli*, vol. 2 (Milan: Ulrico Hoepli, 1930); *Museo Nazionale della Scienza e della Tecnica Leonardo da Vinci: sezione di astronomia* (Milan: Museo Nazionale della Scienza e della Tecnica, 1956); Edoardo Miotto, Guido Tagliaferri, and Pasquale Tucci, *La strumentazione nella storia dell'Osservatorio astronomico di Brera* (Milan: Unicopli, 1989); Graziela Buccellati, Pasquale Tucci, and Arturo Balboni, *I cieli di Brera: astronomia da Tolomeo a Balla* (Milan: Università degli Studi di Milano, 2000); and "Polvere di Stelle: The Cultural Heritage of Italian Astronomy," INAF, https://www.beniculturali.inaf.it/musei/milano/, Accessed March 2026.



5

Fig. 5

South facade of Brera Palace (Collegio) with the new observatory. Engraving, 1778

6a

6b

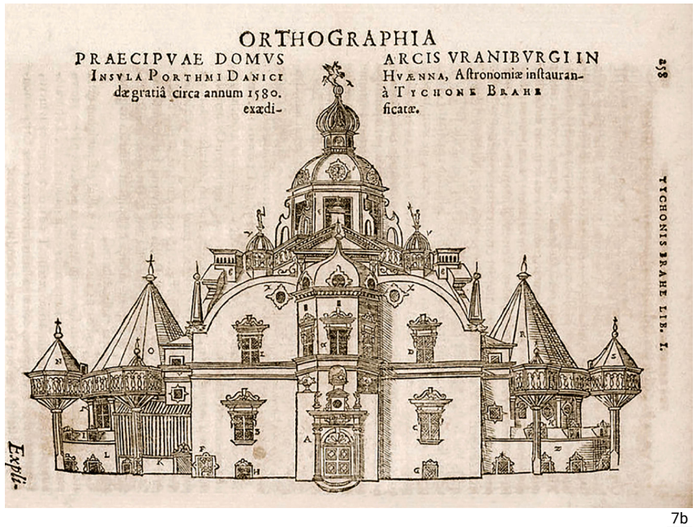
Figg. 6a-6b

Model of the first architectural project of the Brera Astronomical Observatory, in Milan (*Museo nazionale della scienza e della tecnologia Leonardo da Vinci*, Milano (catalogue)

For a parallel, let us refer to the architectural fairytale of Urianiborg (1546-1601) invented by Tycho Brah (to the point that it could be said to be an "utopia" from a Wes Anderson film), the most extraordinary structure ever built for astronomical observation, unfortunately lost but of which drawings, engravings and

24 Museo Nazionale della Scienza e della Tecnologia Leonardo da Vinci, https://www.museoscienza.org/ Accessed March 2026

7a



7b

reconstructions resulting from it remain. It does not have the richness of the Danish structure, since it started from more advanced assumptions than those of Tycho, and with a substantial investment in the scientific component of the new times, the eighteenth century. [Figg.7a-7b, 8]

What survives today of the Brera Observatory after successive alterations makes it, however, one of the most surprising structures of its kind in the world. Boscovitch was also responsible for supervising the establishment of the great meridian line in Milan Cathedral (Milan, coincidentally or not, was the Roman Mediolanum), installed by Giovanni Angelo Cesaris and Francesco Reggio. It

8

Figg. 7a-7b

Left: Engraving of Uriniborg observatory in *Historia coelestis* (1666) by Albert Curtz [Lucius Barrettus] (1600-1671) (old.maa.org/, Accessed March 2026); Right: Engraving of Uranibirg observatory in *Atlas maior, sive cosmomographia blaviana* (c. 1662) (sciencephotogallery.com/, Accessed March 2026)

Fig. 8

Brera Observatory. Milan, today (adapted from Google Earth)

10

9a

9b

was intended, like many others installed in churches, to calculate the Easter days and the precise time since the Austro-Hungarian Empire adopted, on the initiative of Count Di Wilczek, governor of Lombardy, the "transalpine central time". [Figg.9a-9b]

This is another relevant example that should be noted, the "meridiana" (or the meridian line) in Milan Duomo – what we might call a "solar observatory". At noon, the sun enters through a hole located 24m high in the south wall, illuminating the brass line that continues up the north wall of the Duomo. The moment was signaled to a tower of the Palazzo dei Giureconsulti and from there to the Sforzesco Castle: a cannon shot marked the time for the adjustment of the clocks in the city[25]. Interestingly, in the gigantic Palace-Convent of Mafra, ordered to be built by D. João V (founded 1717-1744/1775), a meridian line also exists in the so-called Casa da Meridiana[26], embedded in the floor, and it is certain that in addition to this detail, other astronomical observation activities were carried out in the Royal Building (or "Real Edifício" as it was then named), during the 18th century. [Fig.10]

However, in Portugal, no such older observatories survives. We have seen that observatories existed, such as those of Aula da Esfera in the Jesuit Colégio de Santo Antão – today Hospital de S. José – or the observatory of the Paço da Ribeira. Others were also quite curious, if not mainly determined for astronomy

25 John L. Heilbron, *The Sun in the Church: Cathedrals as Solar Observatories* (Cambridge, MA: Harvard University Press, 1999), 266–71.

26 Cândido Marciano da Silva, "Note on the Mafra Meridian," *Bulletin of the Scientific Instrument Society*, no. 110 (2011): 32–34.

Figg. 9a-9b

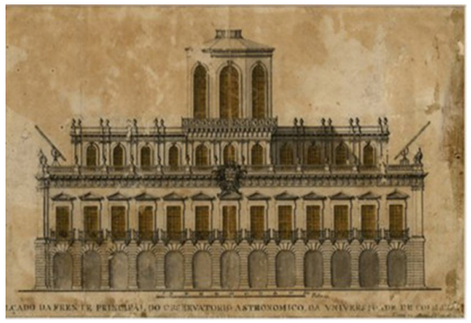
The "meridiana" in Milan Duomo, 1786 (Photos by the authors)

Fig. 10

Mafra. "Real Edifício" Meridiana (photo by J. Marciano da Silva, in *SIS: Bulletin of the Scientific Instrument Society*, (2011): 110).

but towards the intimately connected problem of the correction of Time/legal hour/chronometry in relation with longitude calculations – such as the Arsenal *Cosmochronometro* in Lisbon with his high balloon to determine the setting of the hours[27]. From the time of the creation of Brera Observatory, there are others, still brought to us with rigorous documentary vigor, although demolished or never built and suggesting a work of crypto-history of architecture (as with the project of the large observatory of the University of Coimbra; then the small observatory that was "de facto" built and later demolished in the middle of the 20th century), others that still exist (such as the Tower-Observatory of Paço da Bemposta; the Escola Politécnica Observatory; and Tapada da Ajuda Observatory) as a fleeting but real presence of those past times that our century must preserve and revive.

The expulsion of the Society of Jesus from Portugal in 1758–1759[28], launched an identical movement in other European kingdoms, however, without Boscovitch having felt any immediate or even long-term consequences. Following the reforms of the General Studies – which also extinguished, in 1762, the teaching of the priests of the Oratory – and the publication of the new Statutes of the University of Coimbra, which extended over a long period, becoming effective in 1772, the Enlightenment rose as the dominant teaching, especially in the physical sciences and mathematics, with evident consequences regarding experimental science and the setting up of Laboratories, among which the Chemistry and Physics Laboratory and the Astronomical Observatory of the University of Coimbra. Both new buildings and the renovation of older ones date from that period, when neoclassicism was first introduced in Portugal under the direction of the British William Elsden (act. 1756-1777)[29]. One of the most conspicuous projects was the new astronomical observatory. The plan was ambitious, and it is worth admitting that it was excessive, requiring large sums of money to be carried out Elsden's plans give us a good idea of the building dimensions integrating the features of a modern European observatory[30]. **[Figg.11a-11b, 12]**



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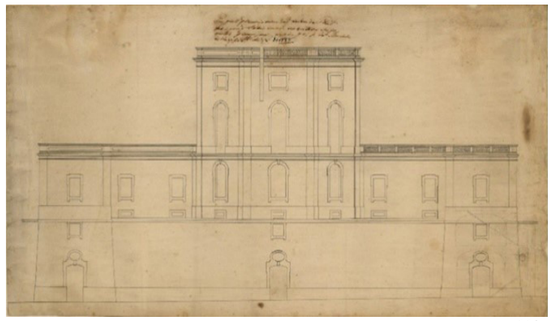


11b

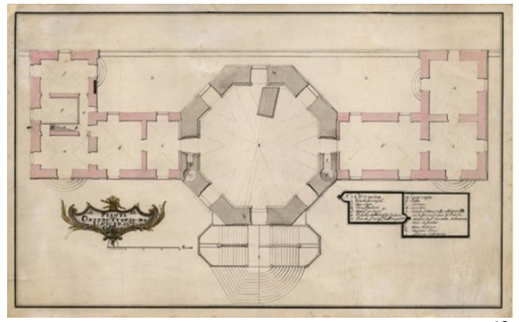
Figg. 11a-11b

Astronomical Observatory of the University of Coimbra. First project by William Elsden (1773). MNMC, Museu Nacional Machado de Castro, Coimbra; Inv. 2945/DA 23 (https://www.uc.pt/ org/historia_ciencia_na_uc/Textos/observa/obser, Accessed March 2026)

Maria de Lurdes Craveiro, who studied the process, tells us about the Provision of the Marquis of Pombal

> given on [...] the 16th of October (1772), which incorporated the Castle of Coimbra into the perpetual Domain of the same University; His doors, and all the lands, which belong to him and them, for the establishment of the Astronomy Observatory; of the Teachers' Quarters, and their Assistants; and the Custody of Optical Instruments.

The project would not see fruition and would be replaced by another, substantially more restrained, but still authored by Elsden. The building was already under construction in 1774 and reached the first floor in 1777, but the work was frozen and without continuity, as everything that had been built up to that point was demolished. Incomplete, a process of replacement with a substantially more modest observatory began, now designed by Manuel Alves de Macomboa[31]. **[Fig.13]**



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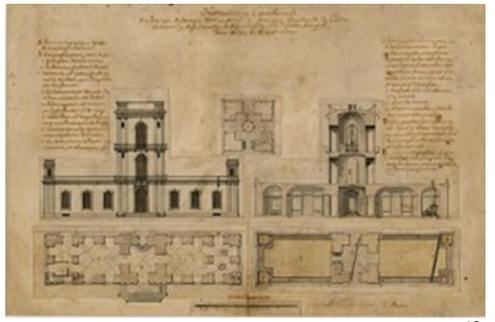

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Fig. 12

William Elsden, Second project of the Astronomical Observatory for the University of Coimbra 1774-1777 (unbuilt) https://www.uc.pt/org/historia_ciencia_na_uc/Textos/observa/obser, Accessed March 2026

Fig. 13

M. Alves Macomboa, Final project of the Astronomical Observatory for the University of Coimbra, 1788-1799 (Biblioteca Geral da Universidade de Coimbra. BGUC Ms. 3377) https://www.uc.pt/ org/historia_ciencia_na_uc/Textos/observa/obser, Accessed March 2026

In 1788, the work on the observatory designed by Manuel Alves de Macomboa was already progressing and would be installed in the southernmost part of the so-called Pátio das Escolas[32], although its official inauguration only took place in 1799, certainly due to delays in the arrival and installation of the optical equipment. With its central tower, it stood out prominently in the skyline of the city of Coimbra; and despite being a relatively simple project with a very discreet neoclassical language, it is essentially functional without any major adjectives[33].

27 António Estácio dos Reis, *O Observatório Real da Marinha* (Lisbon: CTT, 2009). See also Fernando Correia de Oliveira, Observatório (blog), http://observatoriorelogioshistoricos.blogspot.com/, Accessed March 2026.

28 See: Fiolhais and Franco, Jesuítas; see also Sheila J. Rabin, "Early Modern Jesuit Science: A Historiographical Essay," *Journal of Jesuit Studies* 1, no. 1 (2014): 88–104; Maria de Lurdes Craveiro, "A arquitectura da ciência," in *Laboratório do mundo: ideias e saberes do século XVIII* (São Paulo: Pinacoteca do Estado de São Paulo, 2004), 49–101; and Maria de Lurdes Craveiro, "A Companhia de Jesus entre Coimbra e Macau: espiritualidade e ciência," in *O Colégio de Jesus entre Portugal e o mundo* (Coimbra: Imprensa da Universidade de Coimbra, 2020), 193–226.

29 Maria de Lurdes Craveiro, "Guilherme Elsden e a introdução do neoclassicismo em Portugal," in *Portugal e Espanha entre a Europa e além-mar* (Coimbra: Universidade de Coimbra, 1988).

30 Maria de Lurdes Craveiro, "Reforma Pombalina da Universidade," in *Dicionário da arte barroca em Portugal* (Lisbon: Presença, 1989).

31 Maria de Lurdes Craveiro, *Manuel Alves Macomboa: arquitecto da Reforma Pombalina da Universidade de Coimbra* (Coimbra: Instituto de História da Arte da Faculdade de Letras da Universidade de Coimbra, 1990).

32 Craveiro, *Manuel Alves Macomboa*.

33 Craveiro, *Manuel Alves Macomboa*.

14

15

This more modest observatory remained standing for almost two centuries, but would also disappear in the 20th century, due to the requalification works of Coimbra's University, and what remains of it is only the project and engravings (and photographs) that give us an accurate portrait of it. [Figg.14-15]

Advances in science and a controversy regarding a topic of celestial mapping (the position of the star Argelander) led to the construction of the most important observatory in history in Portugal in Lisbon: the Royal Observatory of Tapada da Ajuda. Its origin and construction have been studied in detail and is one of the best documented cases. It was born from the desire to provide the kingdom with a center for sidereal astronomy studies on par with the most modern ones, and for this reason, the Lisbon observatory constitutes a perfect copy – although with a different arrangement according to its orientation – of the Pulkovo Observatory, in turn derived from the more modest Dorpat Observatory in Tartu (Estonia). The local project was due to the French architect Jean Colson (whose biography is little known) and José da Costa Sequeira (1800-1872), under the scientific direction of Frederico Augusto Oom (1830-1890) and the supervision by correspondence of the astronomer director of Pulkova, the famous Otto Friedrich Wilhelm (Vassily Yakovlevich) Struve (1793-1864) (with whom Oom spent five years, precisely, in Pulkova), under the auspices of King D. Pedro V, its effective founder-patron (1857). [Fig.16]

We will not dwell on this "central" observatory as it has been extensively studied, highlighting the recent – and excellent – study dedicated to it from a historical, architectural and phenomenological point of view by Pedro Abreu[34] in a work he co-coordinated. It does not, in itself, constitute a heritage problem, being well preserved and integrated into the University of Lisbon and, as such, protected and still active, especially on determining the "legal hour". Replica of Pulkova, like the latter, it has a medium-sized body with a central plan where

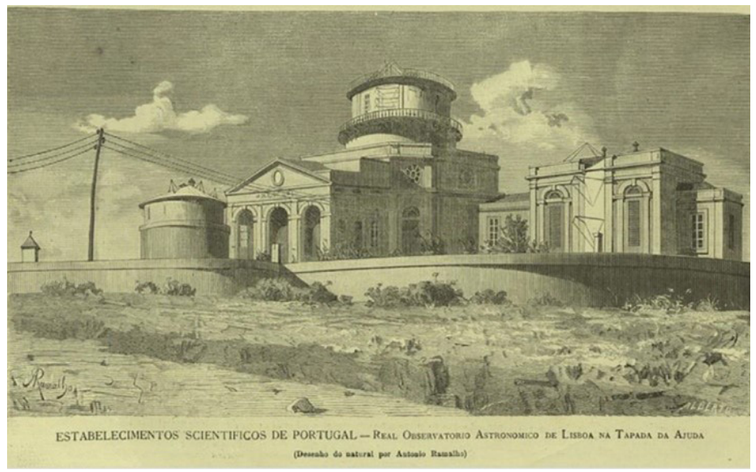
34 For Pedro Abreu, see "The Lisbon Astronomic Observatory: Elements for the History of Its Architecture," in *Proceedings, XV National Meeting of Astronomy and Astrophisics*, Lisbon, 27–29 July 2005, ed. J. Afonso, N. Santos, A. Moutinho, R. Agostinho (Editora: Scientific World, Inc, 2006); "Um templo para a ciência: O Observatório Astronómico de Lisboa (arquitectura e história)," in *Revistas de Arquitectura: Arquivos(s) da Modernidade*, ed. Marieta Dá Mesquita (Lisboa: Caleidóscópio, 2011): 194-217; José Duarte Gorjão Jorge and Pedro Marques de Abreu, *O Observatório Astronómico de Lisboa: arquitectura da obra* (Lisbon: Caleidoscópio, 2019).

Fig. 14

M. Alves Macomboa, Final project of the Astronomical Observatory for the University of Coimbra, 1788-1799. Engraving 19th century

Fig. 15

M. Alves Macomboa, Final project of the Astronomical Observatory for the University of Coimbra, 1788-1799. Photograph (c. 1930)



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the larger observation dome sits; two arms on each side, extend the internal dependencies according to the functional scheme of the Russian observatory and include at their ends two large observation rooms with an integral opening in their structure for the purposes of astronomical observation due to the instrumentation that was installed there35. It is completed by two domed batteries facing each side of an observation terrace with outdoor work tables. It marks, on the Ajuda highs attached to the wooded Monsanto hill crest, the city's skyline to the west. [Fig.17]

Another piece of astronomical heritage that survives is still virtually unknown. This is the Bemposta Observatory Tower, in Lisbon. It is located in front of the Palácio da Bemposta, known as Paço da Rainha, as it was established by D. Catarina de Bragança, widow of Charles II of England after his return to Portugal, becoming her residence. The works date back to 1694, but it would be completely modified and largely rebuilt according to a project by Manuel Caetano de Sousa (1738-1802), in a construction campaign that lasted until 1791. The Tower, which was both a bell tower and a clock tower, was separate from the main body of the Palace. With successive destinations, it would finally be assigned (by Decree of December 9, 1850) to the Army School, founded in 1837

35 "The parallax measurements of the star Argelander (number 1830 in the Groombridge catalogue) obtained by Hervé Faye, director of the Paris Observatory, did not coincide with those obtained by Peters and Otto Struve, from the Russian Pulkova observatory. Faye met Wilhelm Struve, Pulkova's director, in Paris in 1847 and again in 1848, and they discussed their differences vividly. To resolve the controversy (which had meanwhile extended to the parallax of other stars) Faye proposed, at a meeting at the Paris Academy of Sciences on February 11, measurements at a latitude further south, where these stars pass in a position close to the zenith, using for this purpose a zenith telescope – recently improved by Faye and more precise for these operations. The choice fell on Lisbon" (Abreu, "Um templo para a ciência," 3).

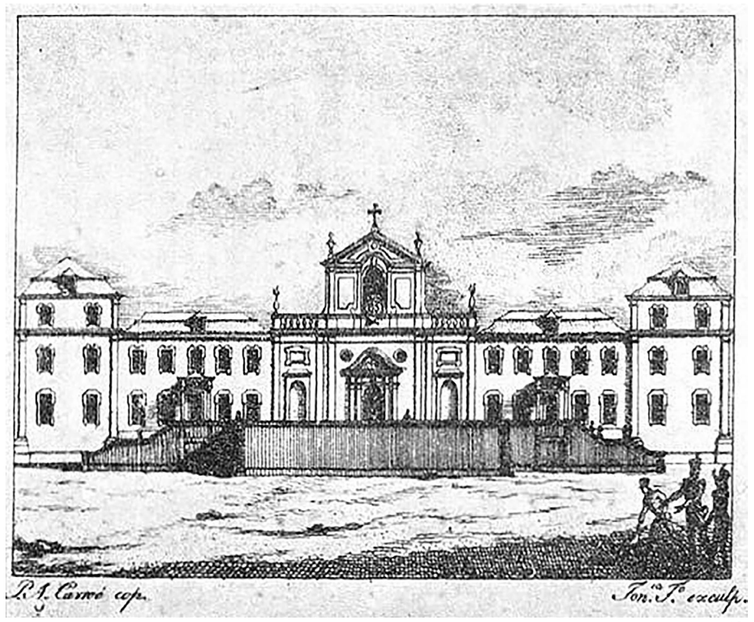
17

Fig. 16

Real Observatório da Tapada Ajuda, Engraving, magazine *O Occidente*, no. 96, dated August 1881, p.188

Fig. 17

Bemposta Observatory Tower, Lisbon. In front of Paço da Rainha or Paço da Bemposta



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(current Military Academy), and although little is known about its origin, the beginnings of the Observatory must date back to 1849 and would be installed with its rotating cylinder situated at the top of the Clock Tower. Scientific activities were carried out during the 19th and 20th centuries, compatible with the training of officers in matters of practical astronomy.

Another observatory in Lisbon deserves mention, and this one has some similarities when fully active and before its dismantling, with the optical dome systems of the last phase of the Brera Observatory, although it does not have the same importance and prominence in national terms and, much less internationally, despite the valuable work carried out there. This is the Astronomical Observatory of the Polytechnic School, located in the heart of the Lisbon Botanical Garden, now an integral part of the National Museum of Natural History and Science (MUHNAC36). It is late, since it was only completed in 1898, and its activity will continue for almost the entire 20th century, and this is where much of its technological and architectural interest lies, as it was designed in an integrated way, that is, comprising several valences, support rooms and a residential area. Its history, however, is linked to a much older institution, and here, once driven and created by the Society of Jesus. Its construction was completed in 1619, designed by the architect Baltazar Álvares (1560-1630), and consisted of a façade with a church with a nave and side altars in the center and two blocks, one to the south and the other to the north of the temple in a symmetrical composition. In plan, the dependencies were developed around this main nucleus, following a rectangular plan, with a late Renaissance language. **[Fig.18]**

36 Museu Nacional de História Natural e da Ciência, https://www.museus.ulisboa.pt, Accessed March 2026.

Fig. 18

The College of Cotovia main façade. Later "Colégios dos Nobres". Engraving. (as it was in the early 19th century)

19a

19b

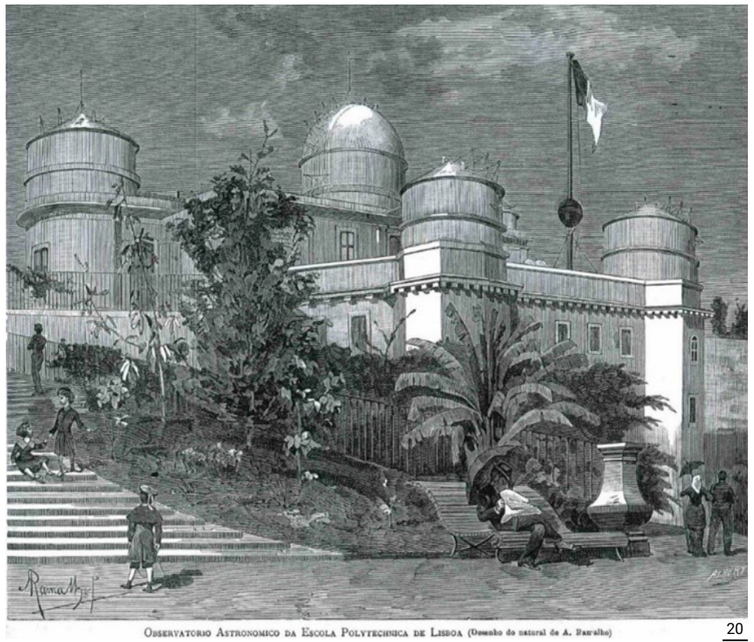
A fire destroyed it in 1694, followed by its reconstruction. But it would again be seriously damaged in the 1755 Earthquake and eventually rebuilt. This is also the time that will see, shortly afterwards, in 1757/1758, the extinction of the Company. The building would, however, serve to house the Royal College of Nobles – redesigned by Carlos Mardel (c. 1695 - 1763) –, an institution intended for pre-university education for aristocrats, on the initiative of Sebastião José de Carvalho e Melo (1699-1782), future Marquis of Pombal, in 1761 until its closure in 1837 as a result of educational reform, becoming the Polytechnic School. By then, a new fire had ravaged the facilities and a new building was designed under the intervention of a comité directed by José Feliciano da Silva Costa (1797-1866) and Filipe Folque (1800-1874), from 1845, and an earlier architectural project initially designed but which would later be taken up by Pierre-Joseph Pézarat (1801-1872), and in turn, completed under the direction of Joaquim Nunes de Aguiar (1812-1872), following neo-classical canons. In 1911 it was converted into a Faculty of Sciences, and today it is a school that is part of the University of Lisbon. **[Figg.19a-19b]**

The complex had (and has) a rectangular plan with a large interior courtyard or "cortile", and the Meteorological Conservatory with four corner turrets and an octagonal central drum was installed on the rear façade, that is, in the back of the complex, in a tower that topped the central body of this rear façade. An old design, sufficiently expressive, gives an account of the observation device. But an astronomical observatory required a place that the spaces and structures of the roof of the main building could not accommodate, so it was decided to build a new building, with considerable impact, at one end of the eastern platform, bordering the hill where the Botanical Garden was (and continues to be) developed, from there down. In fact, the complex was built in a suitable location on a hill – Monte Olivete or "Cotovia" – overlooking one of Lisbon's valleys and with unobstructed views and more rarefied in terms of competition with public lighting or interfering halos. **[Fig.20]**

Construction began in 1875, but the project was later rebuilt and relocated under the direction of Victor Gomes da Encarnação. The observatory was

Figg. 19a-19b

Astronomical Observatory of the Polytechnic School, Lisbon (Photo SIPA)



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inaugurated in 1889 following a plan that was advanced for its time, despite being intended primarily for teaching spherical astronomy. It has a centered plan; and the central, octagonal body is crowned by a bulbous dome. It is complemented by compartments in its "H" shaped floor plan angles. This is joined by a second construction that overcomes the unevenness of the elevations at the back. In a second phase, this body appears, in plan, connected to the central body, and later appears, certainly at the end of the 19th century, represented with a terrace in between, and it is certain that this was its final design and execution. The most precise description is given to us in the magazine O Occidente,

Fig. 20

Astronomical Observatory of the Polytechnic School, Lisbon. Engraving. In magazine *O Occidente*, no. 118, dated April 1, 1882

Fig. 21

Astronomical Observatory of the Polytechnic School, Lisbon. Cutaway drawing Project by the architect. J. P. Falcao de Campos and Appleton & Domingos Architects, Ltda

No. 118, dated April 1, 1882. So, in total, it has a hemispherical dome (the main one) and two conical observation domes at the north and south ends made of masonry lined with wood, in addition to two movable cylinders in the body located at the lower level. One of the outermost compartments is the Meridian Room, which has an enveloping slit indicating the precise direction of the meridian and is entirely covered (including the ceiling) with mahogany paneling from Guinea: it was "used for astronomical observations with the aim of determining longitude or local time, measuring the transit of stars with an instrument called a meridian circle". A balloon, visible in the picture[37], fulfilled the function of determining and signaling midday, with a cannon shot and the balloon falling, replacing what was previously part of the Navy Observatory that it came to replace. [Fig.21]

Today, part of these crops and the set remain, as well as around 200 of the instruments that equipped it, are part of the historical collection of the Museum of the Faculty of Sciences of the University of Lisbon (MUL/MUHNAC), although materials have been lost or dispersed. It is not currently a museum, but the complete restoration has already begun, with a project by the architect J. P. Falcao de Campos and Appleton & Domingos Architects, Ltda., being a fundamental pole of the history of science and astronomy in Portugal, with unique scope and efficiencies.

When comparing this device to Brera we are not exaggerating. In fact, the various phases of updating and modernization of the Brera Observatory, although not in distinct physical circumstances as it is not an isolated complex but rather an observatory framed and assimilated to a large "palazzo", cannot help but echo in the configuration of this Lisbon observatory. And the dates coincide, and in terms of installed technologies, Lisbon is more modest, Brera is richer.

A Final Remark… Just Look up at the Sky…

The Brera Astronomical Observatory presents itself as a starting point for a fascinating story. It is a starting point for a network of forgotten astronomical heritage in Portugal, a collection of marginalized architectures that bear witness to the collaboration between Italian and Portuguese astronomy since the 17th to the 19th century, as well as the perpetual link between scientific knowledge and architectural production. As such, let us realize that we are presenting here a set of examples that have helped humankind to shape its understanding of its place in the *cosmos*, its position in the vast and infinite Universe, its understanding of the firmament and the beams of light that move over our heads, as well as its understanding and measurement of time. And although many of the examples mentioned have disappeared, or simply fallen into oblivion, their

37 Pedro Abreu, "Um templo para a ciência: O Observatório Astronómico de Lisboa (arquitectura e história)," 3. Regarding the "time ball," see Fernando Correia de Oliveira, "The Arsenal Balloon," Observatory of Historical Clocks of Lisbon, http://observatoriorelogioshistoricos.blogspot.com , Accessed March 2026. See especially António Estácio dos Reis, *O Observatório Real da Marinha* (Lisbon: CTT, 2009).

legacy still remains in our collective memory. Our challenge today – in this century of uncertainty – is to ensure that this fabulous heritage is not lost to the terror of time. Preserving and studying these places of memory is a fundamental step towards understanding how science and architecture have intertwined throughout history. Portugal and Italy share a common scientific past, and it is up to today's generations to recognize and value this connection.

The past is not a burden – it is a foundation. The architectural astronomical heritage of Portugal and Italy, whether standing, vanished, or never realized, are more than relics; they are symbols of an enduring quest for knowledge. Their stories deserve to be told, their contributions recognized, and their legacies preserved. And as we navigate the complexities of scientific advancement in the 21st century, we would do well to remember the lessons of the past – the legacy of History –, because the architectural astronomical heritage, the legacy of science and architecture that once mapped the stars can still guide us – if we are only willing to look up at the sky and take notice of its magnificence…

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