

The Instruments at the Astronomical Observatory of Lisbon - The Repsold Meridian Circle*

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**Research funded through SIS Grant*

Introduction

This article aims at assessing the historical potential of a large set of correspondence between Frederico Augusto Oom (1830–1890), the first director of the Lisbon Astronomical Observatory (OAL, see Fig. 1 and 2), and the instrument maker, Repsold,¹ responsible for the construction of the Observatory's main instruments. Some of this correspondence, located at the Observatory itself, was already well known and a large part of it was retrieved from the Hamburg State Archive thanks to a SIS Grant.

The Lisbon Astronomical Observatory

The Lisbon Astronomical Observatory (OAL) was founded in 1857, under the name Royal Observatory of Lisbon; it was installed in one of the hills of Lisbon, at the Tapada da Ajuda. It was equipped with state-of-the-art instruments, suited for sidereal astronomy but, even though the OAL never ceased its activity until the 1990s,² after a few successful contributions in international campaigns³ around the turn of the 20th century, it quickly became obsolete, lacking the financial support, staff and expertise to transition into the new field of astrophysics. Nevertheless, position astronomy practice carried on at this site, being able to overcome the obsolescence of the instruments mainly due to the instrument alterations, workflow and mathematical shortcuts devised by the second OAL Director, Campos Rodrigues (1936–1919). Part of the interest in the retrieved correspondence is the tracing of these alterations, through the analysis of the original instrument orders. This, obsolescence

process added to its hard-to-reach location, contributed to a gradual process of invisibility. The OAL became forgotten and unknown to the public, which contributed to its present remarkable conservation state, a true time capsule of science.⁴ Today, OAL's historical building, collections and archives are managed and made accessible by the Museum of Natural History and Science (MUHNAC), while the building compound also houses the members affiliated to the Faculty of Sciences of the University of Lisbon of the Institute of Astrophysics, an astrophysics and space sciences research unit associated with the University of Lisbon and the University of Porto. OAL's heritage is internationally relevant, not only for its scientific instrument collection and archives but also for its architectonic features.⁵ In historical terms, this institution represents an instance in which Portuguese science was, albeit briefly, on par with its international peers,⁶ gaining international recognition in the field of stellar astronomy. Portuguese historiography of science and technology has clearly demonstrated, in the last two decades or so, that science was an essential part of the country's development, from the maritime expansion, the exploitation and control of the Colonial Empire to the maintenance of the fascist regime.⁷ However, the role of science in Portugal across time and places, often does not fit within traditional narratives, strongly focused on main discoveries or on the luminaries responsible for those discoveries.

The scientific success of the OAL was possible due to a combination of factors. Firstly, its

very existence was sparked by an international dispute between Hervé Faye (1814–1902), from the Observatory of Paris and Wilhem Struve (1793–1864), from the Observatory of Pulkova, regarding specific measurements of stellar parallax.⁸ Lisbon was identified as the ideal locus where observations to resolve the issue could take place and, also, as a very suitable location for further endeavors regarding stellar astronomy. Since the required expertise and the technical apparatus were not locally available, an expedition to Lisbon was planned, in order to settle the dispute. This caught the attention of national elites, who became outraged at the prospect that such an important scientific event would be carried out in Portugal entirely by foreign astronomers – a national embarrassment! This situation made its way to the government, and discussions regarding the installation of a state-of-the-art observatory were initiated. The international influence of a scientific and diplomatic network, combined with the context of the Regeneração, a period of Portuguese history strongly marked by a logic of modernisation and technical improvements, found a champion under the figure of Filipe Folque (1800–1874), a Navy officer, mathematician and politician with significant influence on King Pedro V. Folque's interest had two main motivations: first, the main astronomical observatories in Lisbon (Navy and Lisbon Polytechnic School) were either outdated or had ceased to function properly due to urban growth, a hindrance to the effective training of students and officials, threatening cartographic and topographic efforts in the

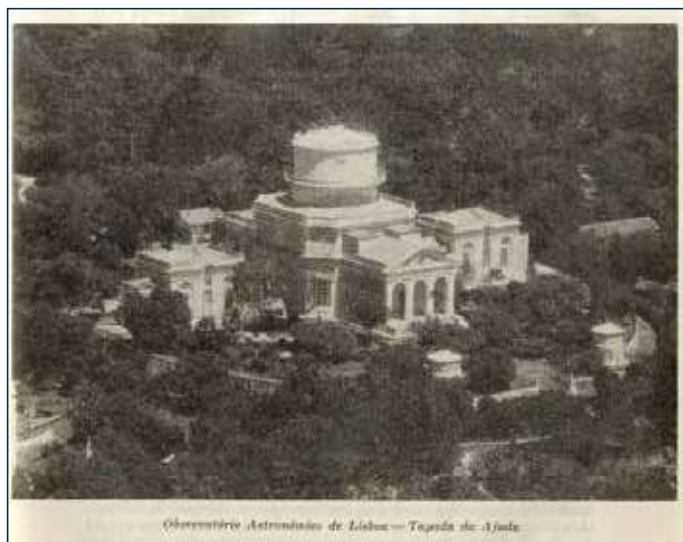


Fig. 1 *Astronomical Observatory of Lisbon (OAL). From Olisipo, No.94 (Lisbon: Amigos de Lisboa, 1961, p. 69).*



Fig. 2 *The OAL main building (Google Earth: 38,7104576° -9,1874775°).*

colonies; second, a new observatory would allow for a more precise Legal Time, a pressing matter with an empire reliant on long course maritime routes. A third reason can also be inferred, given the monumental architecture and noble construction materials used: the Observatory was also meant to serve as a statement of power and development.

It should be emphasised that the process described should not be seen, merely, as the influence of great European powers over a peripheric country, eager to comply to the center commandments. We must keep in mind that Folque actively used this external and internal pressure to enhance his own influence and that this sort of instrumentalisation of international pressure by a local actor is a mechanism typical of situations where agency is seemingly absent.

The project gained the favour of the King and was approved, but it required more than money and politics. The expertise to set up, operate and manage such a modern Observatory did not exist in Portugal. In order to overcome this, a scientific journey⁹ was planned. Frederico Augusto Oom, a promising Navy officer (and former Folque's student), was sent to the Pulkova Observatory, in Russia, with the aim of preparing for his role as OAL's first director.¹⁰

The OAL Archive

The Observatory's archive holds a large number of documents, dating from its foundation to 1992, when a series of institutional reforms at the government level took place, curtailing the autonomy of many scientific institutions and altering OAL's status, affiliation, staff and financing.¹¹

Documentation is considerably diverse, ranging from administrative documents from the foundation of the observatory and instruments' manuals to observational data. This article focuses on the documentation related to the foundation of the OAL, in particular, the correspondence between Folque, Oom and the Repsold Workshop regarding a particular instrument, the Repsold Meridian Circle. A significant number of letters describe, with variable detail and frequency, episodes of Oom's journey to Russia, including his visit to the Repsold workshop in Hamburg, where he selected the instruments that were to integrate his future observatory.

Thanks to a SIS Grant, it was possible to retrieve an additional trove of letters, previously identified at the Hamburg Staatsarchiv,¹² that documents the dialogue between Oom, Folque and the Repsold Workshop. The letters are very numerous¹³ and work on them is still ongoing. However, it is already clear that this primary source will allow us to know, more precisely, which local adaptations were discussed with the instrument makers and why.

These letters also have the potential to expand our knowledge of Oom's journey¹⁴ and recover both technical details on the operation of the instruments and the mathematical calculations involved. An interesting example, found so far, is a passage where Oom explains the process of collecting spider silk to replace the crosswires of an ocular reticle:

'The instrument was cleaned by Mr. Brauer, the [Pulkova] observatory mechanic (...). The wires had to be replaced and I took it upon myself to learn the process (...). The process is this: the reticle plate is placed on a wire trivet that gives it a certain elevation, leaving the face that contains the lines to which the wires must correspond towards the top and its outer edge. From the cocoon of a certain species of spider that produces threads remarkable for fineness and regularity, a thread is held from each extreme; a weight, formed of two small lead plates which adhere to one another through a layer of wax, pinches the thread between them in order to hold them tight. You then dive the thread in hot water, holding it by one of the weights while letting the other weight extend the thread. After a few seconds, remove the thread from the water and make it run along a torn edge of paper, always in the same direction. This operation aims to release part of the humidity and, at the same time, facilitate the action of the hanging weight which extends the thread. This done, place it on the lines to which it must correspond, taking care to dry it on an absorbent paper. This detail aims to prevent the weight from sticking to neighbouring threads that will also be hanging from one outer edge of the reticule plate to the other, and which must not be neglected so that the lattice arrangement does not suffer. After placing all the wires in this manner, a magnifying glass is used to secure that they are made to coincide by means of a toothpick; finally, what is left to be done is to fix them by means of any varnish, for example, an alcoholic dilution of lacquer that is applied on the threads and on the plate. Only when it is completely dry can we remove the weights.'¹⁵

Conclusive evidence that this process was used in Lisbon remains to be found. However, in the documentation concerning the garden surrounding the OAL, a list of plants selected to protect the Observatory's activities includes *Opuntia ficus-indica* (fig opuntia, or prickly pear, a species of cactus, see Fig. 3), a plant particularly attractive for the species of spider in question.¹⁶

This archive was also instrumental in the survival of the OAL, well before it caught the expert attention of historians. In 1992, in the offset of a significant restructuring of Portuguese scientific institutions, management of the OAL was to be transferred to the Agronomy School, also located at the Tapada da Ajuda; its buildings were to be repurposed for



Fig. 3 The cactus *Opuntia ficus-indica* in the AOL Garden. Photo by the author, 2022.

the needs of the school. The then director of the Observatory, Ezequiel Cabrita, refused to surrender the keys and appealed the decision. Making use of the 19th-century legal documents stored at the archive, he demonstrated that a 200m radius around the precise center of the OAL's main building was ceded in perpetuity.¹⁷ This legal argument, in tandem with a connection to the Faculty of Sciences of the University of Lisbon, guaranteed the maintenance of the OAL as an autonomous institution, somewhat revitalised by accommodating the Centre for Astronomy and Astrophysics of the Faculty of Sciences which gave way to the Institute of Astrophysics and Space Sciences which uses these premises to this day.

Description of the Repsold Meridian Circle

The Repsold Meridian Circle is located in the Western room of the OAL (Figs. 4 and 5), where it is supported by two marble pillars of 2.15m in height. Both erected on a large slab crowning a massive brick foundation and completely insulated from the floor; mahogany sheaths cover them almost entirely without touching them. It was built in 1861, by the A & G Repsold workshop, in Hamburg. It has a Merz objective, with a focal length of 1.95m and an aperture of 0.135m, and three eyepieces (103x, 152x and 216x). The telescope tube can be reversed, and the eyepiece and objective can be swapped. The circles have a diameter of 0.99m; four micrometers allow the reading of the instrument by the tenth of a second. The two bronze circles are fixed to supports protruding from the internal faces of the pillars, their diameter is 1.11m externally and 0.99m in the bearing section, which is

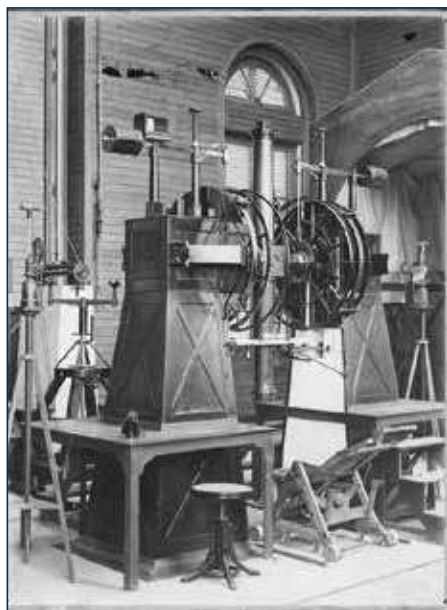


Fig. 4 The Repsold Meridian Circle at the OAL. Photo taken by Campos Rodrigues, exact date unknown (OAL: MUL/F477/AH-OAL).



Fig. 5 Manuel Peres, the director of the OAL poses with the Repsold Meridian Circle in 1938 (TT: PT/TT/EPJS/SF/001-001/0050/0210M).



Fig. 6 The Repsold Meridian Circle at the OAL photographed by the author in 2018.



Fig. 7 Two close-ups showing (a) the hand circle at the axis, for rapid movements, and (b) the arm with a pressure screw on the side of the hand circle. Photograph by the author:



flat and traced on a silver band 0.006m wide. Each circle is a single piece with ten spokes connected by spacers, weighs 30 kilograms and they are 0.962m away from each other. One of the circles is divided into arcs of 2', numbered every five degrees, from 0 to 360, in a clockwise direction. The other has 10' divisions, originally numbered like those of the other circle, but director Campos Rodrigues altered it, numbering, instead, all the degrees, from 0 to 90, in both directions, the two zeros being on the same diameter. This circle is only used for pointing: the index is placed in such a way as to mark zero when the telescope is par-

allel to the equator. Thus, to point the instrument, one only had to know the declination of the star to be observed. The axle is a bronze single piece. The central part of the axis forms a hollow cube with 0.218m sides. On two of its opposite sides are bolted the two pieces of the telescope tube, in brass, one marked 'I', the other 'II'. At the end of each part, either the objective or the ocular extremity of the telescope can be attached by three screws. The objective rests in the interior of its frame by the action of a weak spring exerting pressure towards the optical axis of the telescope, but oblique with respect to this axis. This system

allows the lenses to be perfectly fixed, both in the direction of the optical axis and in the plane perpendicular to it, suffering minimal position change by the effect of temperature. This mechanism was not original but produced and introduced at the OAL's workshop in 1880 (Fig. 6). There is also a hand circle at the axis, for rapid movements, and an arm with a pressure screw (Figs 7 a and b), placed near the central cube, on the side of this hand circle. This arm is connected to another arm, fixed to the pillar and carrying the pointing screw that marks the passage of the stars. The counterweights, which rest on the top of the

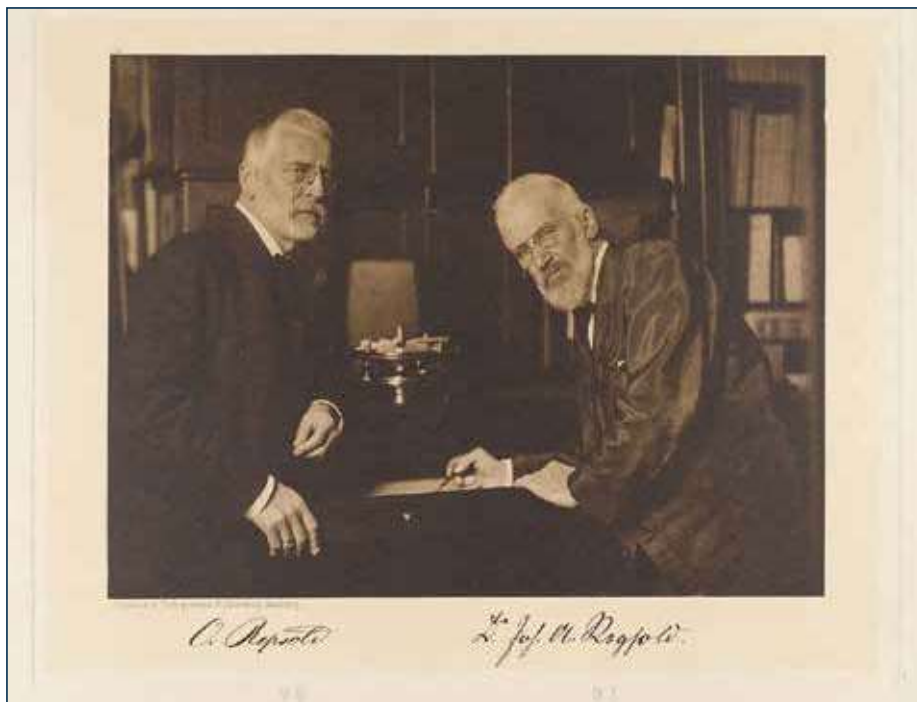


Fig. 8 Oscar Repsold (left) and Johann Repsold (right). The 'Sons' in A. Repsold & Sons, 1905. (P1991.516, Staatliche Landesbildstelle Hamburg, Sammlung zur Geschichte der Photographie).

pillars, exert their action on the axis, near the circles, by means of hooks with rollers.¹⁸

Concluding Remarks

The reason we have selected the Meridian Circle as our focus is due to its relation to the Director Campos Rodrigues and with instances in which Portuguese science was internationally recognised, the 1892 opposition of Mars and the 1901 Eros campaign. As stated before, there is interest in further exploring the success of these campaigns, particularly from the material culture perspective but, we must also not forget that we are also looking at a history of failure that also needs to be taken further than assuming it was part of a cycle of obsolescence.

It has not escaped our notice that there is also potential to further advance history of science in Portugal. The narrative of peripherality and scientific passivity has already been successfully rebuked and is now time to move forward and give proper attention to the contingencies in place as patterns in a wider time-frame, a *longue-durée* if you will. Lack of funding and making do with obsolete instruments, lack of local scientific continuity beyond an original impulse, often associated with a more influential actor, and the appropriation of international pressures for the reinforcement of local political agency might all be recurring elements in Portuguese science, could these be integral to it?

Acknowledgements

I would like to thank Marta Lourenço, for

all the support and enthusiasm regarding my interest in material culture and this particular project; Pedro Raposo who suggested the Repsold Meridian Circle as an interesting case study; Ana Simões for the rich dialogues concerning history of science in Portugal; Gudrun Wolfschmidt for the help regarding the Repsold Workshop history; Paula Cunha dos Santos, for the information shared, namely regarding the hypothesis of spider silk usage; Halima Naimova for the help with the OAL Archive; and the Hamburg State Archive team for the help and digitization service.

Keywords: Lisbon Astronomical Observatory, Portugal, History of Science, Scientific Institutions, Meridian Circle, Material Culture.

Notes and References

1. The Repsold workshop, was run by several generations: it was funded in 1800 by Johann Georg Repsold, astronomer and fireman. After his death, in 1830, his sons Adolf and Georg took over the business, adopting the name A. & G. Repsold (see Fig. 8). The workshop was later passed on to Adolf's son, Johann Adolf Repsold, under the guise Repsold & Söhne. The workshop shut down in 1919. Negotiations for the OAL started with the A. & G. Repsold and were finished under Repsold & Söhne.
2. There was a Director of the OAL consecutively from 1878–1992.
3. The opposition of Mars in 1892 and the transit of Eros in 1900.
4. Marta C. Lourenço e José Pedro Sousa Dias, “Time Capsules” of Science: Muse-

ums, Collections, and Scientific Heritage in Portugal’, *Isis*, **108**:2 (2017), pp. 390–398, <https://doi.org/10.1086/692690>.

5. Pedro M. Abreu, José P., Jorge, Graça Bachmann, Rui J. Agostinho, Rita Batista, José D’Amorin, and Alexandra Melão, A. (2008). ‘The Astronomical Observatory of Lisbon: It’s Patrimonial, Social and Scientific Heritages’, in *Opuscula Musealia: Fasciculus XVI* (Issue November 2019). PDF available from https://www.researchgate.net/publication/336312907_The_Astronomical_Observatory_of_Lisbon_Its_Patrimonial_Social_and_Scientific_Heritages/

6. Several such cases have been demonstrated, a recent example, also reliant on scientific instruments, is the University of Coimbra Experimental Phonetics Laboratory (1936–1979). Quintino Lopes, *Uma Periferia Global, Armando de Lacerda e o Laboratório de Fonética Experimental de Coimbra (1936–1979)* (Lisbon: Caleidoscópio, 2020).

7. AAVV, *Ciência, Tecnologia e Medicina na Construção de Portugal*, 4 vols (Lisbon: Tinta da China, 2021).

8. P.M.P. Raposo, ‘Observatories, instruments and practices in motion : an astronomical journey in the nineteenth-century’, *Journal of History of Science and Technology*, **8** (2013), pp. 69–104.

9. Ibid.

10. Ibid.

11. H. Soares, ‘O Instituto Nacional de Investigação Científica - Percurso e Influência na Política Científica Portuguesa (1976–1992)’, PhD unpublished dissertation, 2021. NOVA School of Science and Technology.

12. Due to the COVID-19 pandemic, an in person visit to the archive was not possible, but the letters were nonetheless retrieved with the help of the Hamburg Archive staff and a digitisation request.

13. Around 300 images were received from the archive, most of them with double pages. This adds to a few more hundreds, obtained at the OAL’s archive.

14. In hopes of complementing the work already done by Pedro Raposo (see note 8).

15. Letter-Report from F.A. Oom, 1858 (PT-MUL-OAL-251).

16. These plants are invasive and survived until present day, having spread all around the OAL (see Fig. 3).

17. Archive of Science and Technology (ACT): PT/FCT/INIC/DSE/1346.

18. F. A. Oom, ‘Observações meridianas do grande cometa 1881 feitas no real observatório astronómico de lisboa (Ajuda)’, *Jornal de Sciencias Mathematicas Physicas e Naturaes*, **32** (Academia Real das Sciencias de Lisboa, 1892).

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