Figure 13.1: *Recent picture of the main building of MAST (Photo from the MAST archives)*

13. Heritage and Observatories in Brazil at the Turn of the Twentieth Century: an Overview

Marcus Granato (Rio de Janeiro, Brazil)

Abstract

The first systematic astronomical observations in the southern hemisphere were in Pernambuco, northeastern Brazil, in the short period of Dutch rule in the region (1637–1644). Later, in the late nineteenth and early twentieth centuries, there were three observatories on Brazilian soil: Imperial Observatório do Rio de Janeiro, Observatório da Escola Politécnica, both in Rio de Janeiro, and Observatório Central, in the southern city of Porto Alegre. The first was created by Imperial decree by D. Pedro I, on 15 October 1827, while the second, linked to Universidade do Brasil, was established on 5 July, 1881. The third was planned in 1889, but only inaugurated on 24 January, 1908 as part of the Escola de Engenharia. All three institutions exist to this day, and their scientific instruments of historical value are included in cultural heritage preservation projects. The largest collection of this kind of objects is at Museu de Astronomia e Ciências Afins (MAST), most of whose 2000 artefacts come from the Imperial Observatory (today the National Observatory). Many of them were produced in Germany by manufacturers such as Gustav Heyde, Carl Zeiss, Askania-Werke, Carl Bamberg and Max Kohl. The buildings of the Observatório Central (1921) and Observatório Nacional (1921) are listed by federal and state heritage protection agencies, particularly because they were purpose built for astronomical research and have architectural features typical of the late nineteenth and early twentieth centuries that have not been altered over the years.

13.1 Introduction

Astronomical observatories, which count among the oldest scientific institutions, are of special interest to the history of science and in particular the history of astronomy. They are a testament to the importance that many nations have given to this branch of science, but one that is lost over time. Kings, tsars, presidents and government representatives of every kind have channelled great sums into constructing buildings, buying instruments, paying personnel and developing projects and activities in the area. It is a comparable commitment to one that was inspired by a different way of observing the sky, with religious sentiment, for which the construction of buildings such as cathedrals and temples also merited great investments and efforts.

Over the years, these institutions amassed great collections of scientific instruments, which have gained historic value for the events they were used for, the discoveries they made and the development of technology and precision they exemplify.

Observatories are both the outcome of and a main factor behind the development of astronomy and astronomical instruments. In the seventeenth and eighteenth centuries, the observatories in France and England boasted unrivalled facilities and instruments. In the nineteenth century, the observatories in Germany and at Pulkovo in Russia surpassed their English and French counterparts, only to be gradually superseded from the middle of the century onwards by the observatories in the USA, which have since taken the lead in the development of astronomy. Prior to the nineteenth century, there were only some thirty major observatories in the world. Just one century later, there were over 200, as well as many smaller stations. Keeping pace with these advances, instruments of ever greater precision were also developed, spearheading a veritable technological revolution.

Recounting some of these developments, this paper will present an overview of the astronomical observatories that existed in Brazil at the turn of the twentieth century. The three institutions to be presented are Imperial Observatório do Rio de Janeiro [Imperial Observatory of Rio de Janeiro]), Observatório da Escola Politécnica [Observatory of the Polytechnic], both in Rio de Janeiro, and Observatório Central [Central Observatory], in the southern city of Porto Alegre. The first of these was created by Imperial decree by D. Pedro I on 15 October, 1827, and the second, linked to Universidade do Brasil [University of Brazil], on 5 July, 1881. The third, which was originally planned in 1889, was eventually inaugurated on 24 January, 1908.

13.2 Origins of some Observatories in Latin America

The difficulties that most European countries faced in establishing national observatories in the seventeenth

century were great, but greater still were the hurdles to be overcome in Spain and Portugal's colonies in the New World. These two countries were going through a period of scientific stagnation that was mirrored in their colonies, where they also imposed a general policy of stifling free thought.

The Dutch had a different outlook, and made sure they took people to their colonies who were qualified to study the regions they had conquered. It was within this context that the first astronomical observatory in the American continent[1] and in the whole southern hemisphere[2] was built in 1639, in one of the towers of Friburgo palace, residence of Governor João Maurício de Nassau-Siegen, on Antonio Vaz island, Pernambuco, Brazil.[3] From this palace, the first ever systematic astronomical and meteorological observations in the southern hemisphere were made under Maurício de Nassau during the brief period of Dutch rule in Brazilian territory from 1637 to 1644.

The person in charge of these astronomical observations was George Marcgrave,[4] who was particularly keen to track the movement of Mercury, which was hard to observe from the northern hemisphere. Marcgrave arrived in Brazil in 1638 and died in 1644 in Angola; the fate of all his manuscripts is not known for sure. Abrahão de Moraes[5] uncovers some clues from the work of Pingré,[6] in which he describes Marcgrave's astronomical work, which highlights observations of Jupiter and Mercury, as well as the first solar eclipse ever to be observed scientifically in the Americas, on Antonio Vaz island in 1640.

The first national observatories in Latin America date back to the eighteenth and nineteenth centuries in Bogota (1803), Rio de Janeiro (1845), Santiago (1852), Cordoba (1870) and Mexico City (1878).[7] They all have some features in common. They came into existence thanks to the determination and enthusiasm of government officials, with the exception of Chile, where foreign expeditions to the country were the main driving force. Though some pragmatic concerns, such as measuring national territories and making geographical expeditions, were tied up with the creation of these institutions, the main aim of the observatories in Rio de Janeiro, Santiago, Cordoba and Mexico City was to contribute to pure research in astronomy. They all went through periods of stagnation, usually caused by political and/or economic factors, during which time only routine activities were carried out. Nonetheless, four of the original five have managed to survive, and exist to this day as active research centres.

13.3 Observatories in Brazil in the Nineteenth and Early Twentieth Centuries

The existence of observatories in Brazil is an indication of scientific activity in the country prior to the twentieth century, when Universidade do Brasil [University of Brazil] was created. At the cusp of the twentieth century, as mentioned before, three institutions were active in astronomical observations: Observatório Nacional [National Observatory], Observatório do Valongo [Valongo Observatory], linked to the Escola Politécnica (polytechnic) and Observatório Central [Central Observatory].

All three institutions continue to work to this day, and their scientific instruments of historical value are included in cultural heritage preservation projects. The largest collection of this kind of objects is at Museu de Astronomia e Ciências Afins (MAST), most of whose artefacts come from the Imperial Observatory (now the National Observatory). Many of them were produced by German manufacturers, including Gustav Heyde, Carl Zeiss, Askania-Werke, Carl Bamberg and Max Kohl. The buildings of the Central Observatory (1921) and National Observatory (1921) are listed by the federal heritage protection agency, particularly because they were purpose built for astronomy research and have architectural features that are typical of the late nineteenth and early twentieth centuries, which have not been altered over the years. Significant aspects of the history of these institutions and their collections of scientific instruments will now be discussed.

13.3.1 Observatório Imperial do Rio de Janeiro / Observatório Nacional [Imperial Observatory of Rio de Janeiro / National Observatory]

During the eighteenth century, the Portuguese government did little to encourage scientific activity in Brazil. It was only after D. João VI arrived in the country, fleeing Napoleon's invasion of Portugal, and later under the rule of D. Pedro I, that this situation took a turn for the better. Rudimentary astronomical observations were made as of the early nineteenth century at Escola Militar [Military School] in Rio de Janeiro, but it was only on 15 October, 1827 that the Emperor decreed the creation of an astronomical observatory with the purpose of producing astronomical and meteorological data, as well as giving courses in astronomy to students from the military and naval academies.[8]

For different reasons, the observatory only began its work in the middle of the century. It was first based at Escola Militar under the directorship of Soulier de Sauve, who died a year later. It was then transferred to a more suitable location on Castelo hill, Rio de Janeiro, in an unfinished Jesuit church.

In 1846, the observatory was given its official name, Imperial Observatório do Rio de Janeiro, in a decree that also established the work it should undertake.[9] It was to be responsible for making astronomical and meteorological observations, educating and training the students from Escola Militar and Academia da Marinha [Naval Academy], publishing an astronomical yearbook

and supplying the right time for ships docked at the port.

In 1858 and 1865, the new director, Antonio Manuel de Melo, organised field observations of solar eclipses and published some astronomical tables. The largest instrument from this period of which there is mention was a Dollond refractor telescope with a 7 cm aperture. Fig. 13.2 shows a picture of the Imperial Observatory on Castelo hill.

After the Paraguay War (1870), Emperor D. Pedro II, who was keen on astronomy, reorganised the observatory and appointed French astronomer Emanuel Liais as its director. This was the beginning of a period during which much work was produced at the observatory and was presented by the director at European academies. According to a study of the period by Christina Barboza (1994),[10] the observatory was held in higher regard than the other scientific institutions of the day in the country. An indication of this is the invitation it received to take part in a major event organised by the French to observe the transit of Venus across the solar disk. Under Liais' directorship, the Imperial Observatory became a hothouse of scientific activity, yet little of the knowledge acquired was actually applied. Liais managed to split the observatory off from the Escola Militar, but his administration was also dogged by many controversies, until he was finally dismissed in 1881.[11]

Liais was succeeded by his main collaborator, a Belgian engineer called Luiz Cruls. Under his directorship a number of scientific expeditions were undertaken: to Punta Arenas to observe the transit of Venus across the solar disk (1882); to the Central plateau to demarcate the Brasilia quadrilateral, site of the future capital city (1890); and to the border with Peru and Bolivia to determine the exact location of the source of the Javari river, which was crucial in the conflict between the countries (1898).[12] At the same time, in 1887, the observatory was invited to take part in another major international event also organised by France: to completely map out the celestial dome (*Carte du Ciél*). The standard scientific instrument needed for this project, an equatorial photographic telescope, was even purchased, but the political upheavals surrounding the proclamation of the Republic in 1889 prevented the observatory from actually taking part in the project. The instrument was never assembled in its original pavilion.

With Brazil a republic, the observatory was renamed Observatório do Rio de Janeiro, and then in 1909, Observatório Nacional [National Observatory], which continues to be its name to this day. At the time, it was entrusted with organising a meteorological service for the entire national territory, much against the wishes of its Director, Henrique Morize. Many meteorology instruments were accordingly acquired by the observatory and are now part of the MAST collection.

The location of the observatory on Castelo hill had been the subject of much debate since the mid 1800s. Reports by its directors had repeatedly pointed to the unsuitability of the site because the land was unstable, making the use of large-scale astronomical instruments unfeasible and severely limiting its activities. A mixture of political factors and plans to modernise the city were instrumental in the decision to finally move it to São Januário hill in the aristocratic district of São Cristóvão.[13]

Work on the new architectural complex was begun in 1913 and completed in 1920, and the following year the observatory was moved there. Meanwhile, the demolition underway in the centre of town, including Castelo, inspired rumours that treasures hidden by the Jesuits were to be found there. Fig. 13.3 shows a picture of the National Observatory in its new premises on São Januário hill in 1922.

The remit of the observatory included the following technical and research activities: determining the official time of the country, weather forecasting, astronomical tables, the demarcation of Brazilian borders, systematic observations of solar eclipses from Brazilian territory, magnetic mapping of Brazilian soil and many others.[14] Many different scientific instruments were used for these tasks, which now make up a varied collection with some high quality instruments.

At this time, several institutional and financial hurdles stood in the way of the acquisition and functioning of these instruments. There are cases of instruments that took years to be repaired or years to be delivered. Naturally, this meant the set of instruments needed for research could not be kept up-to-date. Also, the number of people employed by the observatory was minimal, so much so that there was a shortage of technical staff, while the scientific personnel were often underqualified for the tasks. One example of how this affected the work at the observatory was an intended study of latitude variations. A programme was prepared for the project, but it had to be abandoned because there was not enough staff to do the calculations.[15]

These two factors illustrate a characteristic feature of the early Republican years: the absence of "institutionalised" research activity. This is only developed in the second half of the twentieth century, when the instruments needed for such work were gotten.

Almost all the directors made an effort to ensure the observatory was supplied with the latest equipment. This culture was passed down from the very first directors during the Imperial era, who had managed to assure the effective engagement of the work carried out at the observatory with the international scenario. The directors were fully aware of the institutional and financial restrictions, and what was needed for the practice of astronomy, but there were countless difficulties to be overcome.

The instruments in the MAST collection and the uses to which they were put give us a good picture of what kind of institution the National Observatory was: what role was envisaged for it and what its activities actually were. An analysis of these instruments shows us what could be done and allows us to draw inferences about the development, or in some cases the stagnation, of the

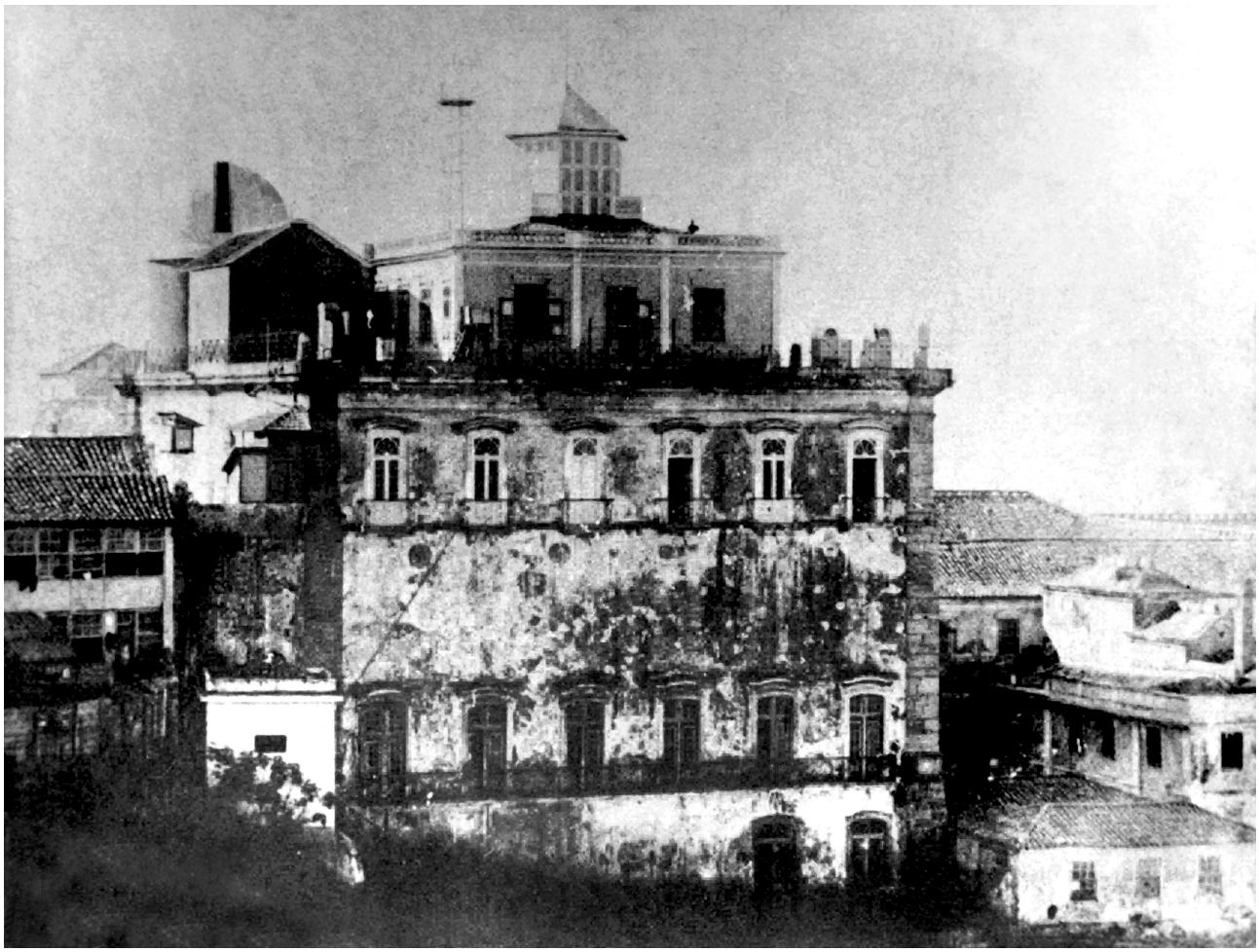

Figure 13.2: *Imperial Observatory on Castelo hill (second half of the 19$^{\text{th}}$ century) (Photo from the MAST archives)*

methods used. The National Observatory is an active research centre to this day, and still stands on the same historic site in new premises inaugurated in 1985.

13.3.2 The Collection of Historical Scientific Instruments at MAST

Museu de Astronomia e Ciências Afins (MAST) was first opened to the public in 1985. It is a research institute under the auspices of the Ministry of Science and Technology and one of its main activities is to preserve its collections, chief among which is the collection of scientific instruments, which is what defines MAST as a museum of science and technology. The museum occupies the former premises of the National Observatory in a number of buildings belonging to that institution. Both the buildings and the collections they hold are preserved by a federal law passed in 1986, and are registered in Livro Histórico [Historical Book] volume 1, pages 94–97, entry 509, of 14/08/1986.[16] The main building houses the museum's technical store, where much of the collection of historical scientific instruments is kept. Fig. 13.3 below shows a recent picture of the building.

The MAST collection currently contains 2000 objects, 1600 of which came from the National Observatory and were used in services and research of great importance to Brazil. Fig. 13.4 (a, b, c) contains pictures of some instruments in the MAST collection that originally came from the observatory and were manufactured in Germany.

Most of the instruments date back to the nineteenth and early twentieth centuries, though some of them, like the J. Sisson quadrant and the G. Adams theodolite, were made in the eighteenth century. It is a very rich collection and can hold its own against any of the great collections of its kind in the world.[17] Most of the objects were used for astronomy, topography, geodetics, geophysics, meteorology, metrology, time measurements and optics. These are all typical of this kind of institution, but the collection also has instruments from other scientific areas, such as electricity, magnetism and chemistry. As a collection, it has always grown, albeit not consistently. Its most recent additions have come from Instituto de Engenharia Nuclear [Institute of Nuclear Engineering] and Centro de Tecnologia Mineral [Centre of Mineral Technology], both also research institutes under the Brazilian Ministry of Science and Technology.

The set of listed buildings includes the MAST main building as well as a number of pavilions housing some of the largest instruments in the collection (equatorial

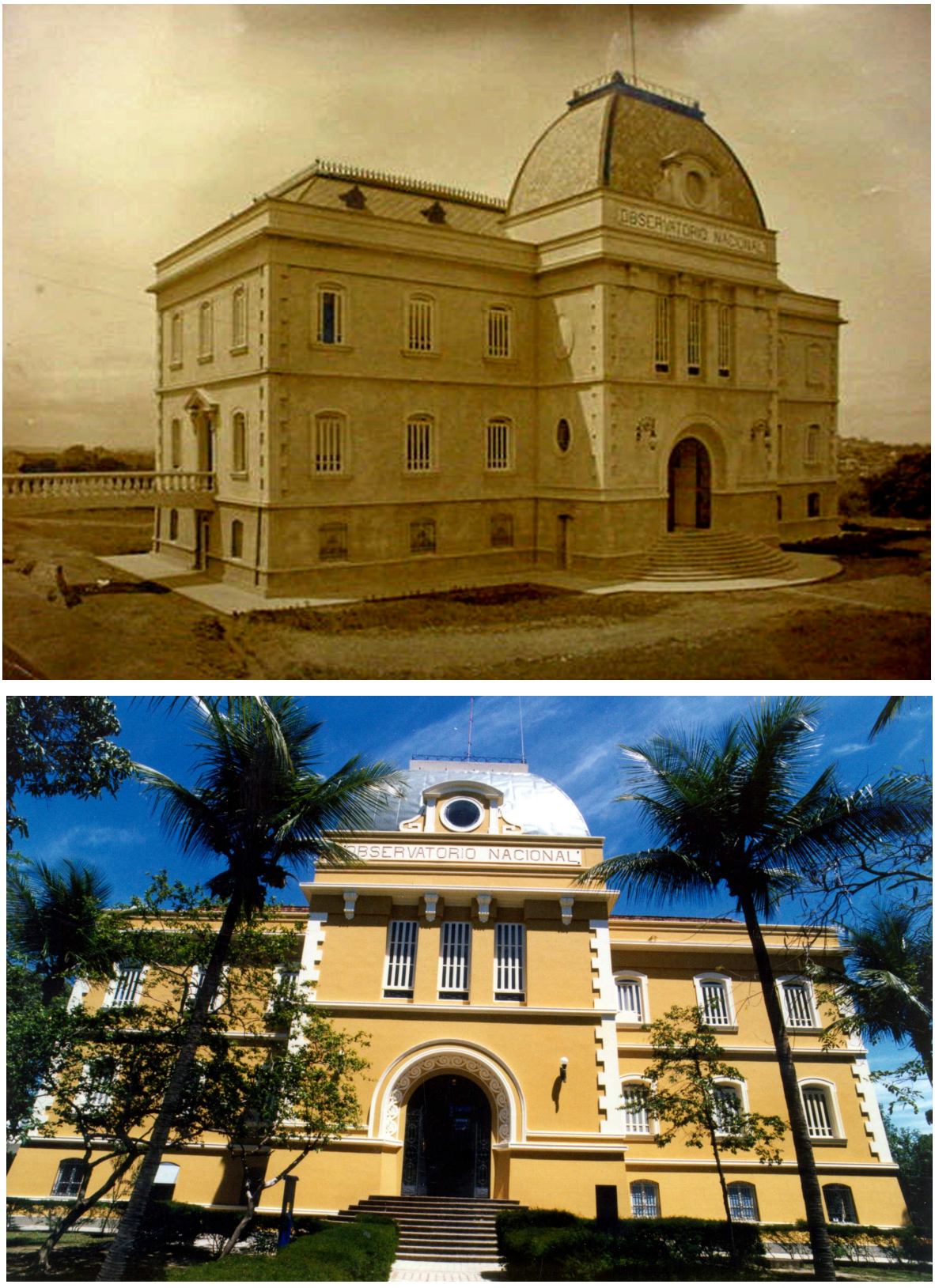

Figure 13.3: *Above: View of the main building of the National Observatory on São Januário hill (first half of the 20$^{\text{th}}$ century), Below: Recent picture of the main building of MAST (Photo from the MAST archives)*

Figure 13.4: *Instruments in the MAST collection (from left to right): meridian refractor (Askania), equatorial refractor (G. Heyde) and analytical balance (Max Kohl) (Photos from the MAST archives)*

telescopes with 32 cm and 21 cm objective lenses; meridian instruments manufactured by Heyde, Carl Bamberg and Cooke & Sons, and a Zeiss photoheliograph) in their original places. These instruments are in a good state of repair and have all their original parts. This is surprising if we bear in mind that at similar institutions across the world, many astronomical instruments were modernised after the Second World War and many elements, such as circle dividers, eyepieces and clockwork mechanisms were often removed and replaced with more modern parts.

Some of the pavilions and their domes were restored quite recently. One such example was the restoration of the pavilion that houses the 32 cm equatorial refractor telescope, which involved restoring the moving metal dome and building, and conserving the telescope.[18] Another was the rehabilitation of the pavilion for a meridian refractor telescope manufactured by Gautier, which included a complete restoration of the instrument.[19]

The smaller instruments are mostly kept in cabinets in seven storerooms, and most are protected by heritage agencies. A typological classification was devised for these instruments based on international criteria and with the help of an international consultant.[20] It divides the instruments into the following categories: astronomy, calculation and drawing, cosmography and geography, time measurement, electricity and magnetism, geodetics and topography, geophysics and oceanography, mechanics, meteorology, metrology, navigation, optics, thermology and chemistry.[21]

One interesting feature of the collection is the great variety of objects it contains. As well as instruments that can be found in institutions and museums of a similar ilk (telescopes, theodolites, meridian circles, transits, precision clocks, magnetometers, meteorology instruments, comparators, etc.), MAST also preserves some quite singular pieces, such as a Kelvin tide predictor, an Henrici harmonic analyser, an instrument by Salmoiraghi to determine personal equation errors, instruments to lay cross-wires in reticules, division machines and other special instruments. One of the instruments is unique, and highlights the capacity for quality manufacturing that existed in Brazil: an altazimuth from the late 1800s designed by astronomer Emanuel Liais and manufactured in the workshops of José Hermida Pazos in Rio de Janeiro.[22] optics workshop from Jose Maria dos Reis family) till 1910 This instrument won a number of awards at different exhibitions in Brazil and Europe.[23]

The manufacturers represented in the MAST collection were among the most acclaimed, skilled manufacturers in Europe and the leading names of the contemporary precision industry, including: Brunner Fréres, from Paris (magnetometers, meridian circles and theodolites); A. Hilger,[24] from London (spectroscopes and accessories); G. Heyde, from Dresden (transits and theodolites); Carl Zeiss,[25] from Jena (astronomical and optical instruments); Ph. Pellin,[26] from Paris (physical optics instruments); T. Cooke & Sons, from York (telescopes and accessories); Paul Gautier, from Paris (meridian circle and astronomy accessories); L. Leroy, U. Nardin and C. Riefler (astronomical clocks and chronometers); and Societé Genevoise des Instruments de Précision (comparator),[27] from Geneva. Added to which, as mentioned above, there are some quality instruments made in Rio de Janeiro by local manufacturer José Maria dos Reis and his successor, Hermida Pazos.[28]

An analysis of certain groups of objects in the collection together with the historical archives from the observatory raises interesting questions for historical analysis. Certain groups contain five, six or more identical instruments, like theodolites or thermometers. Many instruments were never even taken out of their original packaging and are in a perfect state of repair, as new. Some instruments belong to areas where the observatory never did any work.

These questions are central to the research of the collection that is being carried out to shed light on some obscure corners of the history of science in Brazil, even if they often uncover the least productive periods of the country's scientific institutions.

For certain periods of time, the observatory seems to have served as a repository for instruments to be loaned out to other government departments, such as for the many science and technology expeditions across the nation's territory or even to do meteorology work in different regions. The difficulty of finding and hiring specialised technical staff for the observatory may have been another factor that determined the fate of certain instruments that were purchased but never used.

Most of the instruments in the collection are in a good state of repair, a fact that is worthy of note, especially given the tropical climate in Rio de Janeiro. Additionally, the instruments have not been cannibalised, which means that most of them are complete, and many of these in working condition. This begs other questions, such as whether they were really used (the vast majority of them) or wether the observatory went through periods when its activities were stopped, which would explain the instruments' having been abandoned because they were no longer up-to-date.

In 1993, work was started on an inventory of the objects, which is still ongoing. All the objects have an inventory number[29] and set location. The instruments have also been photographed and an image archive has been created, as well as a database of digital images. Finally, a computerised record has been introduced using software developed by MAST especially for this kind of collection.

13.3.3 Observatório do Valongo – Escola Politécnica [Valongo Observatory / Polytechnic]

The roots of the current Observatório do Valongo date back to a small observatory built by astronomer Manoel Pereira Reis in partnership with Joaquim Galdino Pimentel and André Gustavo Paulo de Frontin. Pereira

Reis was a researcher, professor and astronomer at the former Imperial Observatório do Rio de Janeiro, which he left after falling out with its then director, Emmanuel Liais. The site chosen to build the new observatory in the capital city was Santo Antônio hill, near the Escola Politécnica in Largo de São Francisco square in the centre of Rio de Janeiro.

Galdino Pimentel and Pereira Reis joined the teaching staff at Escola Politécnica and donated the observatory to the institution, along with all the instruments, which had been donated by different researchers and institutions.

On 5 July, 1881, the Escola Politécnica observatory was officially instated on Santo Antônio hill, Rio de Janeiro, forming the beginnings of what is now the Observatório do Valongo.[30]

New instruments started to be purchased in 1901, and in 1907 a refractor equipped for astronomical photography manufactured by Cooke & Sons arrived. The same instrument still exists, having gone through reforms from 1997 to 2000. Fig. 13.5 shows the observatory in its original location.

When Santo Antonio hill was demolished in 1921 as part of the major urban reform of the centre of Rio de Janeiro, all the observatory's equipment was transferred to Valongo farm, a smallholding on Conceição hill. It was there in 1924 that the Observatório do Valongo was inaugurated, and where it remains to this day.[31] The premises at Conceição hill are almost the same as those on Santo Antônio hill, such as the entrance to the observatory and the buildings for the Cooke telescope and Pazos refractor domes.

The observatory was left virtually abandoned between 1930 and 1957,[32] then two astronomers were transferred from the National Observatory to begin organising an undergraduate course in Astronomy at the Faculdade Nacional de Filosofia [National Faculty of Philosophy],[33] part of the former Universidade do Brasil. The course was officially started on 22 September, 1958.

After the national higher education reform of 1968, the Observatório do Valongo came under the administration of the Federal University of Rio de Janeiro, and its premises were used by the Department of Astronomy. Since then, it has provided the infrastructure for the department's teaching, research and post-graduate activities.

Recently, MAST has been working in partnership with Valongo to preserve a set of scientific instruments that remain there. Though it is small, the collection provides a clear depiction of the history of the institution, most of whose instruments were manufactured between 1880 and 1921. These include two middle-sized telescopes, one by Cooke & Sons and the other by Zeiss (Jena), with a 300 mm and 150 mm objective lens, respectively. However, the most important instrument is a refractor manufactured by Brazilian maker José Hermida Pazos in 1880, with a 110 mm diameter objective lens. This has been installed in its own building since 1920. Fig. 13.6 shows a recent picture of the building that shelters this telescope.

The joint project has already recorded 150 objects, which have been cleaned, photographed and semi-permanently marked. The next step is to produce an inventory and input the computerised records into a database so the collection can be accessed via the Internet in the future.[34] The study undertaken has unearthed a number of instruments by German manufacturers, including an astronomical refractor telescope, a coudé refractor, an astrophotographic plate comparator, a diffraction grating, a polarising solar prism and case with eyepieces manufactured by Carl Zeiss, a barograph manufactured by R. Fuess, a meridian coudé refractor manufactured by Julius Wanschaff, and a bellows for macrophotography by Max Kohl. Fig. 13.7 (a, b, c) shows pictures of some of the instruments in the Observatório do Valongo collection.

On 22 September 2008, a small commemorative exhibition was opened to mark the fiftieth anniversary of the creation of the undergraduate course in Astronomy at the observatory, on the ground floor of the building that houses the Pazos refractory telescope.

The Observatório do Valongo is the only institution of its kind in Brazil that has an undergraduate course in Astronomy. Its first astronomy students graduated in 1961, and since 2003 it has offered a masters in Astronomy.

13.3.4 Instituto Astronômico e Meteorológico – Observatório Central (UFRGS) [Institute of Astronomy and Meteorology – Central Observatory]

In the late 1800s, Porto Alegre, a city in southern Brazil, was going through major reforms. These included introducing a comprehensive electricity network, a sewage system, electric transport, piped water, hospitals, a telephone network and industries. At the same time, the first higher education institutions in the region were also created, including the Escola de Engenharia [School of Engineering], which opened in 1886. A little later, in 1889, a project was drafted to build an observatory to be part of the school.

On 18 September, 1906,[35] Instituto Astronômico e Meteorológico (IAM) was founded as part of Escola de Engenharia, and works began to construct its premises. At the end of 1907, the building was finished[36] and in 24 January 1908,[37] the IAM[38] building was opened and months later the first scientific instruments installed: a 190 mm equatorial refractor telescope and a meridian circle with 75 mm, both manufactured by Gautier in Paris. By the end of the year, the observatory's four floors were occupied by a workshop, an administrative area, the Meridian Circle Room with the Time Service and the Equatorial Telescope Room topped by a metal dome for observing the sky. Fig. 13.8 shows a picture of the IAM and observatory buildings in 1909.

Figure 13.5: *Observatory of the Escola Politécnica (Observatório do Valongo archives)*

The most important work undertaken at this time was on the request of the Rio Grande do Sul state government: to introduce a state-wide meteorological service, which would involve establishing a meteorology network of 34 stations, 26 of which would be for meteorology and eight for pluviometry. In 1911, astronomer Friedrich Rahnenführer, from Königsberg, Germany, was hired to undertake the main tasks of determining the local time to a precision of 0.03 seconds, and giving the positional astronomy course to the students of Civil Engineering. The following year, a meridian circle telescope manufactured by A. Repsold & Söhne, Germany, was purchased, as well as two pendulums made by Riefler and naval chronometers. The instruments are installed in a shelter beside the observatory, with sufficient thermal insulation to assure the necessary stability of the clocks.

In June 1921,[39] the Meteorology Section was installed in a new building together with the IAM's administrative department. In 1942, the meteorology service was separated from the observatory, which continued to be linked to the Escola de Engenharia as the Institute of Astronomy.

The observatory first opened to the public in the 1960s. At the time, the most important research and teaching activities were: the training of engineers specialised in geodetics, the determination and distribution of the official local time, logistical support for and active participation in observations of the solar eclipse at Bagé (1966) – a small location in the south of the Rio Grande do Sul State, measurements of magnetic declination across the state, meteorological services and news bulletins, seismographic measurements, observations of double and variable stars, determination of the height of the pole (latitude) of Porto Alegre and photographic records of comets, planets and aspects of the moon. For decades, the observatory was also responsible for bringing out a monthly publication of astronomical tables, including a map of the sky, in the traditional regional newspaper *O Correio do Povo*.

In the early 1970s, when the Brazilian higher education system underwent a major reform, the observatory was annexed to the Institute of Physics, itself part of Universidade Federal do Rio Grande do Sul [Federal University of Rio Grande do Sul]. Astronomical research could no longer be carried out at Observatório Central because of the glare of the lights in Porto Alegre. In the same year, with the arrival of a 500 mm Zeiss telescope from the German Democratic Republic, works were begun for a new observatory on Santana hill, Morro de Santana Observatory, which was opened in 1972.

In 1986, the Department of Astronomy formed a team of observers to record the passage of Halley's comet, while in 1994, in a bid to resume the tradition of recording major astronomical events, an observation site was set up to observe the solar eclipse on 11 November in Erechim, a town in the same state.

In August 2002, the restoration of the Art Nouveau observatory building was concluded as part of a university project to reform its historical buildings. Fig. 13.8

Figure 13.6: *Recent picture of the building that shelters the refractor telescope (110 mm diameter) manufactured in the workshops of Hermida Pazos, Rio de Janeiro (MAST archives)*

Figure 13.7: *Some of the instruments in the Observatório do Valongo collection (from left to right): a pendulum clock, a refractor (Zeiss) and a meridian refractor (Julius Wanschaff) (MAST archives)*

shows a recent picture of the Observatório Central building.

Since 2006, MAST has been working in partnership with Universidade Federal do Rio Grande do Sul on a preservation project for the observatory archives. Diagnoses have been made of the state of the set of scientific instruments, the building and the paper and book archives. Additionally, software has been provided for the instruments to be recorded systematically and a project for an institutional exhibition has been prepared. The Observatório Central collection is not large – it has just 60 artefacts – but it contains objects produced by leading manufacturers, especially Maison Gautier. The most significant pieces in the collection are:

- 190 mm equatorial refractor by Gautier (1907), 75 mm meridian refractor by Gautier and a 75 mm meridian refractor by Repsold;
- printing chronograph (Gautier) and recording chronograph (Favarger);
- Naval chronometers: mean time (Kullberg) and sidereal time (Nardin);
- pendulum clocks: mean time pendulum (Oppermann), standard sidereal time pendulum (Riefler), electric sidereal time display (Riefler) and electric mean time display (Salmoiraghi);
- pocket sextant (Hurlimann), sextant (Zeiss) and sextant (Fairchild);
- theodolite with compass (W. & L. E. Gurley Troy), astronomical theodolite (Chasselon), astronomical theodolite (Gautier), theodolite (Troughton & Simms) and theodolite (Hurlimann, Ponthus & Therrode).
- thermograph with glass mounting (Richard), mercury barometer (Tonnelot), inclinometer (Casella), declinometer (Carl Bamberg).

Fig. 13.9 (a, b, c) shows pictures of some of the objects from the Observatório Central collection.

13.4 Final Considerations

Much of Brazil's scientific heritage is yet to be discovered. The current state of knowledge on the topic is limited, and many of the objects from the area may well have been modernised or thrown away as institutions have sought to acquire the most recent, up-to-date instrument or apparatus. Observatories and universities are a great potential source of such heritage. There are few institutions devoted to preserving collections of this kind, and their work is often hindered by a shortage of funding and qualified personnel. However, there are a few initiatives underway, such as those presented in this paper, while others can be learnt about in a previously published article.[40] This brief overview shows that astronomy research and teaching started in Brazil in the nineteenth century. It also notes the existence of preservation projects at the three institutions presented, with MAST taking responsibility for the collection from the former Imperial Observatório do Rio de Janeiro and for providing technical guidelines for the work carried out by the others. These projects are part of the institution's overall policy to salvage Brazil's science and technology heritage.

Chief amongst the collections of scientific instruments from the observatories presented here is the MAST collection, both for its size and for the quality of the objects and the extent of the work carried out. However, some rare items are contained in the other collections, such as the set of objects manufactured in Brazil by José Hermida Pazos, especially the astronomical refractor telescope, which belongs to the Observatório do Valongo collection, and the set of objects manufactured by


Figure 13.8: *View of the IAM and observatory buildings in 1909; Recent picture of the Observatório Central building (Observatório Central archives)*

Gautier, including letters written by the manufacturer himself, which belong to the Observatório Central collection.

There are some information published[41] mentioning a fourth observatory in Brazil at the beginning of the 20th century, at São Paulo city, sate of the same name, but they need to be checked. The building of the so called Observatório Oficial do Estado de São Paulo [Official Observatory of São Paulo State] could be started to be built in 1910 and opened in April, 1912.[42] Its mains activities might be related with the Diretoria do Serviço Meteorológico do Estado de São Paulo [Directorship of the Meteorology Service of the São Paulo State] and it could be in charge of the determination and distribution of the official local time, but everything about these should be checked.

---

1. Mello 1986.
2. North 1980.
3. Cajori 1928.
4. Azevedo 1955.
5. Moraes 1984.
6. Pingre 1901, p. 126.
7. Keenan 1991.
8. Morize 1987.
9. Videira 2002.
10. Barboza 1994.
11. Videira 2002.
12. Brasil 1898.
13. Morize 1987.
14. Barreto 1987.
15. Morize 1987.
16. Iphan 1994.
17. Brenni 2000.
18. Granato et al. 2005.
19. Granato et al. 2007.
20. Brenni 2000.
21. MAST 2000.
22. Novo 1880.
23. CATTALOGUE 1889; EXPOSIÇÃO 1909.
24. Hilger 1924.
25. ZEISS 1926.
26. Pellin 1913.
27. SOCIETÉ 1914.
28. NOVO 1880.
29. MAST 2000.
30. UFRJ 2008, p. 43.
31. Boechat-Roberty, 2004, p. 180.
32. UFRJ 2008, p. 44.
33. Boechat-Roberty and Videira 2003, p. 10.
34. `http://www.ov.ufrj.br` (Jan. 2009).
35. Vasconcelos et al. 2008, p. 13.
36. Livi 1996, p. 48.
37. Vasconcelos et al. 2008, p. 13.

Figure 13.9: *Some of the instruments from the Observatório Central collection (MAST archives)*

38. Even called Observatório Central [Central Observatory].
39. Vasconcelos et al. 2008, p. 22.
40. Granato and Câmara 2008, p. 180.
41. Livi 1996, p. 52.
42. Mantovani and Santos 1994, p. 515.

13.5 References

Azevedo, Fernando: *As Ciências no Brasil.* Rio de Janeiro: Editora UFRJ, v. 1, 1955.

Barboza, Christina H. M.: *O Encontro do Rei com Vênus. 1994.* Masters thesis – Instituto de Ciências Humanas e Filosofia, Universidade Federal Fluminense. Niterói 1994.

Barreto, Luiz M.: *Observatório Nacional: 160 anos de história.* Rio de Janeiro: Observatório Nacional 1987.

Boechat-Roberty, Heloísa M. and Antonio A. P. Videira: *Imagens da Astronomia na Cidade do Rio de Janeiro: os 120 anos do Observatório do Valongo.* Rio de Janeiro: Observatório do Valongo 2003.

Boechat-Roberty, Heloísa M.: O Observatório do Valongo e o ensino da astronomia. In: Domingues, Heloisa Maria Bertol (ed.): *Memória da Astronomia, MAST Colloquia series, v. 1.* Rio de Janeiro: MAST/MCT 2004, p. 171–185.

Brasil, Rellatório do Ministério das Relações Exteriores – 1898. Rio de Janeiro: Imprensa Nacional 1898, p. 241. Referente ao "Relatório do 2° Commissario razileiro" sobre a "Comissão de Limites entre o Brazil e a Bolivia – Manáos, 11 de janeiro de 1898." Arquivo do Ministério das Relações Exteriores, Palácio do Itamarati. Rio de Janeiro.

Brenni, Paolo: Instruments in South America: the collection of the Museu de Astronomia e Ciências Afins do Rio de Janeiro. In: *Bulletin of the Scientifique Instrument Society* **65** (2000), p. 25–28.

Cattalogue officiel: exposition universelle de Paris 1889. Empire du Brésil 1889, p. 35.

Cajori, Florian: *The early mathematical science in North and South America.* Boston: The Gorham Press, 1928.

Exposição Nacional de 1908 Prêmios concedidos pelo Juri Superior da Exposição Nacional. Rio de Janeiro: Imprensa Nacional 1909, p. 240 and 296.

Granato, Marcus; Duarte, Jusselma and Cristiane Suzuki: Restauração do Pavilhão, Cúpula Metálica e Luneta Equatorial de 32 cm: Conjunto Arquitetônico do Museu de Astronomia e Ciências Afins – Mast. In: *Anais do Museu Paulista, São Paulo* **13** (Jan.–Jun. 2005), n. 1, p. 273–314.

Granato, Marcus; Resende, Ive Luciana C. da Costa; Martins, Antonio Carlos; Reis, Durval Costa and Cristiane Suzuki: Restauração do Círculo Meridiano de Gautier e reabilitação do pavilhão correspondente – Museu de Astronomia e Ciências Afins (MAST). In: *Anais do Museu Paulista, São Paulo* **15** (Jul.–Dec. 2007), n. 2, p. 319–357.

Granato, Marcus and Roberta Nobre da Câmara: Patrimônio, Ciência e Tecnologia; inter-relações. In: Granato, Marcus; Carvalho, Claudia S. Rodrigues de; Bezerra, Rafael Zamorano R. and Sarah F. Benchetrit (eds.): *Um olhar contemporâneo sobre a preservação do patrimônio cultural material.* Rio de Janeiro: Museu Histórico Nacional 2008, p. 175–204.

Hilger, Adam, Ltd. (manuf.): *General Catalogue of The Manufacturers of Adam Hilger, Ltd.* Dresden, Oct. 1924.

Iphan Depto. de Promoção: *Bens Móveis e Imóveis Inscritos nos Livros do Tombo do Instituto do Patrimônio Histórico e Artístico Nacional.* 1994.

Keenan, Philip C.: The Earliest National Observatories in Latin America. In: *Journal for the History of Astronomy* **22** (1991), p. 1, n. 67, p. 21–30.

Livi, Silvia H. Becker: Observatório Central da UFRGS: o mais antigo do Brasil? In: *Epistéme* **1** (1996), n. 1, p. 45–57.

Mantovani, Marta and Paulo M. dos Santos: Instituto Astronômico e Geofísico. In: *Estudos Avançados* **22** (1994), n. 8, p. 515–527.

MAST: Departamento de Museologia. *Inventário da Coleção de Instrumentos Científicos do MAST.* Rio de Janeiro: MAST/MCT 2000.

Mello, Sylvio Ferraz: Astronomy in Brazil. Rev. In: *Mexicana de Astronomia y Astrofisica* **12** (1986), p. 13–18, special number.

Moraes, Abrahão de: *A Astronomia no Brasil.* São Paulo: USP 1984.

Morize, Henrique: *Observatório Astronômico: um Século de História (1827–1927).* Rio de Janeiro: Museu de Astronomia e Ciências Afins/Salamandra 1987.

Novo Alt-Azimut. Invenção do Dr. E. Liais, Descrição succinta e dimensões do novo alt-azimut com prisma e collimador construído nas officinas de instrumentos mathematicos, physicos, nauticos e opticos de José Hermida Pazos. Rio de Janeiro: Typ. Academica 1880, p. 6.

North, John: Astronomia no Brasil Holandês. In: *Crônica da Holanda* **79** (1980), p. 12–15.

Pellin, Ph. & F. (manuf.): *Instruments d'Optique et de Précision*: Polarimetrie, Saccharimétrie, Colorimétrie. Paris 1913, VIII^o fascicule.

Pingré, Alexander C.: *Annales célestes du dix-septième siècle.* Ed. by Guillaume Bigourdan. Paris: Gauthier-Villars 1901.

Société Genevoise pour la Construction d'instruments de Physique et de Mécanique. Geneva 1914.

Turner, Herbert Hall: *The Great Star Map, Being a Brief General Account of the International Project Known as the Astrographic Chart.* London: John Murray 1912.

Universidade Federal do Rio de Janeiro – UFRJ: *Observatório do Valongo: 50 anos de criação do curso de astronomia.* Rio de Janeiro: UFRJ 2008.

Vasconcelos, César A. Z.; Bernasiuk, Christoph and Eduardo D. Bica: *Observatório Astronômico da Universidade Federal do Rio Grande do Sul: 100 anos.* Porto Alegre: UFRGS 2008.

Videira, Antonio A. P.: *Os 175 anos do Observatório Nacional.* Rio de Janeiro: Observatório Nacional 2002, p. 3–11.

Zeiss (manuf.): *Catalogue des Appareils pour la Microphotographie.* Jena 1926.

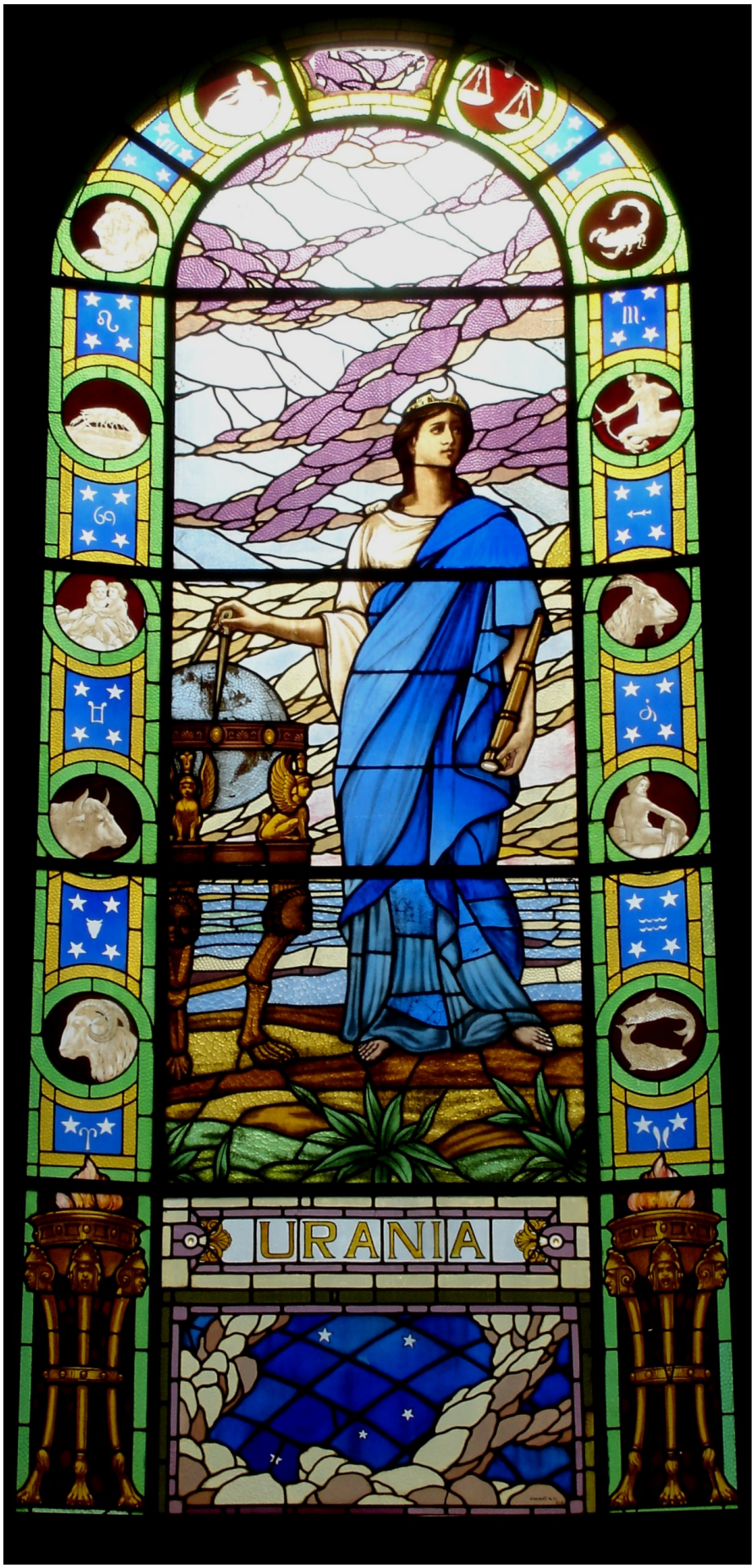

Figure 13.10: *Urania, the muse of astronomy, Rio de Janeiro, main building of the National Observatory (Photo: Gudrun Wolfschmidt)*