

**Proceedings of
the International
Conference**

**History of
Astronomy
in Portugal**

**Institutions, Theories,
Practices**

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BACK COVER:

Left image: The Scholar Observatory of the Polytechnic School, now integrated in the Science Museum of the University of Lisbon (Photo Marc Heller, MCUL)

Right image: «Observatorium Conimbricense. Academician [...] Anno M.DCC. XCII» (1792) The Astronomical Observatorium of Coimbra University [Archive from OAUC G-006]

Down image: The Astronomical Observatory of Lisbon, founded in 1861 (Photo Marc Heller, OAL-FCUL)

Proceedings of the International Conference History of Astronomy in Portugal: Institutions, Theories, Practices

Science Museum of the University of Lisbon

24-26 September, 2009

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The **National Seminar for the History of Mathematics** (SNHM), a section of the Portuguese Society of Mathematics, which for the last 24 years has regularly held meetings on the history of the mathematical sciences;

The **Portuguese Mathematics Society** (SPM) for its constant support of history of mathematics events, and in particular its support of the SNHM; in particular we thank Ana Pedro, who was responsible for the initial layout of the cover.

The **Centre for Mathematics and Fundamental Applications** (CMAF), the **Centre for Mathematics of Coimbra University** (CMUC) and the **Centre for Mathematics of Porto University** (CMUP) for paying the travel and accommodation costs of some of the participants; we also thank **CMAF** for funding the revision of Professor Baldini's text, and Paul Covill who revised it;

The **International Centre for Mathematics** (CIM), which also partially funded the conference;

The **Portuguese Astronomy Society** (SPA) for its support of the meeting, for providing information on it on its website, and for making available funds that made it possible to print these Proceedings;

The **Science Museum of the University of Lisbon** (MCUL) for all their technical and logistic support, which made all the sessions run smoothly;

The **Inter-university Centre for History of Sciences and Technology** (CIUHCT) for their support in publicizing the meeting and for the participation of its members in its organization.

We also thank all participants and chairpersons for the many stimulating talks and debates that were held during these three days, inside and outside the conference room; in particular we thank Samuel

Gessner, for preparing the conference's website. Last, but not least, we thank Luis Miguel Carolino, who first had the idea of holding this conference, and was essential in shaping it. Without him this conference would not have taken place.

A word concerning the standardization of the texts: after the end of the Conference, the standards to be followed in the writing of the papers for these Proceedings were sent to all authors. We accepted for publication all papers that, although not complying with some of these standards, did not significantly diverge from them.

Luís Saraiva
December 2012

Foreword¹

LUIS SARAIVA,

CMAF/Science Museum, University of Lisbon

To celebrate the 400th anniversary of Galileo's first telescopic observations, the 62nd United Nations General Assembly declared 2009 the International Year of Astronomy (IYA2009). This was intended to increase awareness of the importance of astronomy as a science and as a technique. Among the different strategies proposed for this purpose, the Portuguese National IYA2009 Committee, established by the Portuguese Society of Astronomy, highlighted the need to promote events related to the history of astronomy.

The conference on "History of Astronomy in Portugal: Institutions, Theories, Practices", held at the Science Museum of the University of Lisbon from 24 to 26 September 2009, coinciding with the 22nd meeting of the National Seminar for the History of Mathematics, was an excellent opportunity for scholars and Portuguese researchers on the history of astronomy not only to debate these matters among themselves but also to listen and talk to some of the best international researchers in this area, thereby helping to include Portugal in the international network of researchers in the history of astronomy.

The idea of holding such a meeting came from Luís Miguel Carolino (MCUL/CIUHCT) and was immediately adopted by other scholars. It was organized by researchers of the National Seminar for the History of Mathematics and of the Science Museum of the University of Lisbon (MCUL), with the support of these two organizations, of CIM, of three of the main Portuguese Mathematics centres: CMAF (University of Lisbon), CMUC (University of Coimbra) and CMUP (University of Porto), of the Portuguese Societies of Mathematics and of Astronomy, and of the Inter-university Centre for the History of Science and Technology (CIUHCT), and was sponsored by the Foundation for Science and Technology (FCT).

¹ This text appeared in a slightly modified and abridged form in the *Bulletin of CIM*, in December 2009

At the opening ceremony, José Francisco Rodrigues, director of CIM, emphasized the reciprocal influence between mathematics and astronomy in shaping our understanding and measurement of space and time throughout human history. According to Rodrigues, this can be seen as far back as the early calendars, with their numerical attempts to count the days, seasons and years, and the ingenious method of Eratosthenes to measure the circumference of the Earth with remarkable accuracy. Three other significant examples of this historical and scientific interaction were also mentioned: Kepler's laws of planetary motion, the first two of which were published in 1609, the year of Galileo's first telescopic observations; Le Verrier's 1846 prediction of the existence of the then unknown planet Neptune, using only mathematics and astronomical observations of the planet Uranus (later confirmed by Galle and d'Arrest, within 1° of the predicted location); and the confirmation in 1919, by a team led by Eddington, of Einstein's prediction of gravitational deflection of starlight by the Sun using photographs of a solar eclipse taken on twin expeditions in Sobral, northern Brazil, and on the African island of Príncipe (then a Portuguese colony), which showed the distortion of the structure of space-time by matter, as predicted by Einstein's theory of general relativity, in turn built upon earlier contributions to differential geometry by mathematicians including Riemann and Levi-Civita.

In Portugal, throughout its history, astronomy developed in the context of the mathematical sciences. At the time of Portugal's maritime discoveries, astronomical navigation was based on spherical trigonometry, and so it was the mathematicians who taught astronomy to the navigators. During the 19th century astronomy teaching and research developed in the new centres of science teaching, such as the Polytechnic School in Lisbon and the Polytechnic Academy in Porto, in the context of their mathematics courses. The inheritors of these 19th-century institutions, the Faculties of Sciences of Lisbon and Porto respectively, upheld this tradition during the 20th century and continued to consider astronomy as a subject to be taught in their mathematics departments.

The conference organizers decided on a programme that covered a wide time span, from the dolmen builders of south-west Europe to the echoes in Portugal of Einstein's theory of relativity. There were 17

talks, nine of them by Portuguese researchers. Eleventh-hour problems prevented three of the speakers, Michael Hoskin, Jim Bennett and José Vaquero, from attending the conference, but their texts were read by Luís Saraiva, and the corresponding slides for each talk were shown during the readings. Twelve of these talks are in these Proceedings, in the order in which they were presented at the conference.

The opening talk, *“The cosmovision of dolmen builders of south-west Europe”* by Michael Hoskin (St. Edmund’s College, Cambridge), analyzed the role of astronomy in the orientation of dolmens in south-west Europe. In Portugal, for instance, all dolmens faced within the range of sunrise or moonrise. In *The astronomy presented by Isidore of Seville in his Etymologiae (7th century)*, Sérgio Nobre (UNESP- Rio Claro) gave an overview of the astronomy in Isidoro of Seville’s *Etymologiarum sive Originum* *libre XX*, an encyclopaedic work written at the beginning of the 7th century. José Chabas (Pompeu Fabra University, Barcelona), in *“Traditions in Computational Astronomy in the Iberian Peninsula in the late Middle Ages”*, presented a review of the traditions in mathematical astronomy that had a major impact on Portuguese astronomical activity, with special emphasis on authors associated with Portugal, including Abraham Zacut and Judah Ben Verga towards the end of the 15th century. In *“Instruments and Astronomical Observations at the Jesuit College of Santo Antão o Novo, 1724-1759”*, Luís Tirapicos (MCUL) presented a preliminary survey of the instruments used in Santo Antão and characterized the observations for which they were used, putting this data in the context of 18th-century astronomical observatories in Europe. In *“Portugal and the European consensus of eighteenth-century astronomy”*, Jim Bennett (then at the Museum of the History of Science, University of Oxford, now at the Science Museum, London), analyzed how an increasing uniformity in astronomical practice was established in Europe during the 18th century, showing that it required agreement on instruments and procedures. After giving an overview of the mainstream story of observatory instrumentation, Bennett considered the cases of Denmark and Portugal, two examples from the European periphery, and highlighted the factors that distinguished their achievements from the mainstream. António Costa Canas (Escola Naval), in *“The introduction of the Nautical Almanach in Portugal: the contribution of Monteiro da Rocha”*, examined the problem of computing

longitude at sea and the proposed solutions, using chronometers and lunar distances. The *Nautical Almanach* had pre-computed values of lunar distances. In his talk, Canas contextualized the introduction of this almanac in Portugal and the role of the Portuguese mathematician and astronomer José Monteiro da Rocha (1734-1819), who worked at the Observatory of Coimbra, and presented other contributions by Monteiro da Rocha towards solving the longitude problem. "*Giovanni Lembo's lessons in Lisbon: a partial content analysis*" was the theme of the talk by Ugo Baldini (Padua University). These lessons (1615-1617) are known for documenting the first knowledge in Portugal of Galileo's telescopic observations and for spreading non-Ptolemaic models of planetary motions. Baldini centred his talk on other topics in Lembo's lessons which were unusual either in the S. Antão courses or in the mathematics teaching in other Jesuit colleges around Europe (including hydraulic engines and the hydrography of the Mediterranean sea), showing that Lembo's lessons conveyed information on some aspects of the "inner" mathematical practice of the Society of Jesus' specialists in the major colleges which went far beyond the official teaching programmes and the content of Jesuit mathematical handbooks prior to 1630/40. Carlos Ziller Camenietzki (Rio de Janeiro Federal University), in "*O Astrônomo e a Restauração. Manuel Gomes Galhano Lourosa e sua intervenção na política de Portugal Restaurado*", discussed the work of the astronomer and astrologer Manoel Gomes Galhano Lourosa after Portugal regained its independence from Spain in 1640, and his own attitude towards the Restoration. Through this analysis we are given ideas on the role of astrologers during the 17th century, at least of those who made their forecasts public. Fernando Figueiredo (Coimbra University) focused on "*A Astronomia na Faculdade de Matemática da Universidade de Coimbra depois da Reforma de Pombal (1772-1820)*" and in particular on the founding of the Astronomical Observatory of Coimbra University, analyzing the work and astronomical research of Monteiro da Rocha, its first director and the main force behind the founding and publication of Coimbra's *Astronomical Ephemeris*. Pedro Raposo (then at St. Catherine's College, Oxford, now at CIUHCT) presented "*The quest for stellar parallax in the nineteenth century, the "astronomical capital of the world" and the foundation of the Observatory of Lisbon*". This observatory, whose cornerstone was laid in 1861 and which represents and embodies

the agenda of stellar astronomy prior to the rise of astrophotography and astrophysics, was closely modelled on the Pulkovo Observatory in Russia, which in the first half of the 19th century was at the forefront of astronomical instrumentation and practice. Isabel Malaquias (University of Aveiro) presented "*Between astronomy and instrumentation - João Jacinto de Magalhães (1722 - 1790), a remarkable case*". In it she analyzed the case of Magalhães, who established an important European scientific network, through which he contributed significantly to the dissemination of astronomical observations and the knowledge of new instruments. Finally, in "*The beginning of astrophysics in Portugal*", Vitor Bonifácio (University of Aveiro) examined the development of Portuguese astrophysics in the 19th century. Emphasis was placed on two items: first, an analysis of the efforts made by the Portuguese scientific community to obtain meaningful results in the observation of the solar eclipse of 22 December 1870; and second, a study of the main Portuguese institutions of the time engaged in astronomy and meteorological studies. However, by the end of the 1870s all Portuguese astrophysical research projects had either failed or were suspended, and the field was only revived in the country in the first decades of the 20th century.

We hope that all readers of these Proceedings will find something to their liking in them, and that some of the ideas and texts herein will be starting points for further research.

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Contents

- 9** Acknowledgements
- 11** Foreword
LUÍS SARAIVA
- 16** Authors
- 25** The cosmovision of the dolmen builders of south-west Europe
MICHAEL HOSKIN
- 39** The astronomy presented by Isidore of Seville in his *Etymologiae* (7th century)
SÉRGIO NOBRE
- 49** Traditions in computational astronomy in the Iberian Peninsula in the Late Middle Ages
JOSÉ CHABÁS
- 65** Instruments and astronomical observations at the Jesuit College of Santo Antão-o-Novo, 1724-1759
LUÍS TIRAPICOS
- 85** Portugal and the European consensus of eighteenth-century astronomy
JIM BENNETT

- 103** The introduction of the Nautical Almanac in Portugal:
Contribution from Monteiro da Rocha
ANTÓNIO COSTA CANAS
- 123** Giovanni Paolo Lembo's lessons in S.Antão
UGO BALDINI
- 183** O Astrônomo e a Restauração. Manuel Gomes Galhano
Lourosa e sua intervenção na política de Portugal Restaurado
CARLOS ZILLER CAMENIETZSKI
- 203** Astronomy in the Mathematics Faculty of the Coimbra
University after Pombal's University Reform (1772-1820)
FERNANDO FIGUEIREDO
- 241** The quest for stellar parallax in the nineteenth century, the
'astronomical capital of the world' and the foundation of the
Observatory of Lisbon
PEDRO RAPOSO
- 265** Between Astronomy and instrumentation - João Jacinto de
Magalhães (1722 - 1790), a remarkable case
ISABEL MALAQUIAS
- 279** The beginning of astrophysics in Portugal
VITOR BONIFÁCIO