

PERSPECTIVES ON CONTEMPORARY HISTORY OF SCIENCE IN PORTUGAL

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The task of writing about historiography of science in a European periphery such as Portugal is particularly difficult due to the unavailability of a systematic inventory of sources for the history of science. In this paper we select a group of 20th century sources, having in view the extended timeline available to the sorts of questions which can be put to the historical material. We opted to analyze representative probes for four different categories of sources: a journal (1937-1951); the proceedings of a congress organized in the context of a commemorative event (1940); the works of two historians of science (1950s onward); and finally commemorative volumes celebrating the anniversary of the Academy of Sciences of Lisbon (1986, 1992). Besides briefly describing author's profiles, professional backgrounds, historical periods and scientific areas covered, we discuss the type of historical account produced. We conclude with a brief overview of the state of the discipline in the last fifteen years having in mind historiographical orientations.

Keywords: historiography, science in Portugal, 20th century sources

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INTRODUCTION

As all areas of knowledge the history of science has its own history. If descriptive or more or less analytical accounts which can be counted as history of science have existed always and everywhere in a par with the development of science itself, history of science has around one hundred years as an academic discipline. Influenced by Auguste Comte's insistence on its importance, a chair was created at the Collège de France in 1892, and Pierre Laffite became its first chair-holder. Not long thereafter the first international congress took place in Paris in 1900, immediately followed by the creation of the first scientific societies. Following the methodological guidelines of Comte and Paul Tannery, Georges Sarton launched an ambitious project of a synthetic and progressive history, of which he completed the first 4000 pages, which covered history of science up to the Renaissance. Editor of the journal *ISIS* since 1913, it was in the USA, where he settled two years later, that this program took shape. His 43-page long introductory paper "L'histoire des sciences,"¹ in the first volume of *ISIS*, certainly meant to be a manifesto, a founding document outlining the object and main methodological guidelines to be followed by historians of science in the years to come.

The nascent community was eager to strengthen the professionalization mechanisms by striving to establish and activate international networks of historians of science. Following the accreditation of the Académie Internationale d'Histoire des Sciences, centred in Paris, its main promoter, Aldo Mieli, visited Portugal in the early 1930s to let some of his Portuguese acquaintances know that the General Council was eager to include two Portuguese representatives. He further suggested the constitution of a local organising committee which soon took shape and came to be known as the Portuguese Group for the History of Science (Portuguese Group for short, in what follows). Not long after, in the fall of 1934, the Portuguese Group organized the III International Congress for the History of Science,² following unsuccessful attempts at organizing the meeting in Germany and Spain. The inaugural speech was delivered by Sarton, then President of the Académie Internationale d'Histoire des Sciences. Faithful to his own commitments to the discipline, Sarton stressed what he considered to be the two functions of the history of science – the analysis of the past without prior presuppositions in order to identify and isolate historical facts; the synthesis and integration of historical facts avoiding as far as possible value judgements. Speaking to an audience mainly composed of academicians and political representatives of the dictatorial regime that ruled Portugal at the time and feeling certainly uncomfortable by all the pomp and circumstance surrounding the ceremony,³ Sarton could not refrain to end his talk with a criticism and a warning:

Unfortunately at this point in several civilized countries we are witnessing

deliberate attempts to falsify history and use it not exclusively as an instrument of moral education and emancipation, but instead as an instrument of political action and subjugation.⁴

His condemnation of the misappropriation of history by certain political regimes felt certainly on deaf ears.

The life of the Portuguese Group for the History of Science was not long. Their collective involvement with the discipline stopped short of the fifteenth anniversary. We can follow their steps through the pages of the journal they launched. Its title was *Petrus Nonius* (1937-1951), the Latinized version of the name of Pedro Nunes (1502-1578), the 16th century Portuguese mathematician and chief-cosmographer who fostered world-widely the move of navigation from a practical art towards a scientific subject. The title recalled the golden period of Portuguese history associated with the maritime discoveries of 15th and 16th centuries, the starting point of an empire whose frontiers extended from South America to Africa and Asia. Furthermore, it implicitly associated the maritime expansion with the high point of Portuguese science, which was soon to be followed by a two-century period of decline. Their papers are a rich source to look at how history of science was envisioned. Not exactly a success story, they came to be more or less directly involved, not as a group but individually, in the subsequent development of the discipline in Portugal.

The task of writing about historiography of science in a European periphery such as Portugal is particularly difficult since there is not yet a systematic inventory of sources for the history of science and their identification and selection has often still to be made.⁵ Furthermore, not all sources can serve for historiographical purposes.⁶

In this paper we assess a group of possible sources for the history of science with the view of unveiling historiographical options.⁷ In order to become a manageable enterprise, we opted to narrow down such a broad topic by its restriction to 20th century sources. This choice is justified by the extended timeline available to the sorts of questions which can be put to the historical material. The sources available are many and not yet completely inventoried. They cover books written by scientists or scholars of different areas; papers in journals of scientific societies (such as the Academy of Sciences of Lisbon or specialized scientific societies such as the Portuguese Society of Physics, etc.); popularization of science journals or journals including popularization of science sections; commemorative volumes celebrating anniversaries of scientific institutions (such as the University of Coimbra, which underwent a reform inspired by Enlightenment ideals in 1772, the Academy of Sciences of Lisbon founded in 1779, the Polytechnic School of Lisbon or the Polytechnic School of Porto, both 19th century creations of Liberalism, etc.); history of science journals (the only short-lived instance is *Petrus Nonius*); works by historians of science and proceedings of exhibitions or conferences, including those more recently held in Portugal on the history of science.

In the impossibility of covering such a large variety of sources, we selected representative probes for four different categories: a journal; the proceedings of a congress organized in the context of a commemorative event; the works of two

historians of science; and finally commemorative volumes celebrating the anniversary of a scientific institution. The journal selected was obviously *Petrus Nonius* (1937-1951), the first Portuguese journal dedicated to the history of science. The commemorative event chosen was the Exhibition of the Portuguese World (*Exposição do Mundo Português*) organized in 1940 in the context of the official celebrations of the eight centenary of the foundation of Portugal (1140) and the third centenary of its independence from Spanish rule (1640), which lasted for sixty years. This exhibition became the most important political and cultural event promoted by the fascist regime which ruled Portugal for roughly fifty years, from 1926 to 1974, and the Congress of the History of the Portuguese Scientific Activity became its scientific high point. The historians of science are Rómulo de Carvalho (1906-1997), a physics high school teacher and autodidact historian, and Luís de Albuquerque (1917-1992), a mathematician turned historian, both having published steadily especially after the 1950s. Finally, the commemorative volumes chosen were those published to celebrate the 200th anniversary of the Academy of Sciences of Lisbon. We end with a brief survey of recent developments in the professionalization of history of science having in mind historiographical orientations.

Besides briefly describing author's profiles, including professional backgrounds, historical periods and scientific areas covered in the topics addressed, and type of historical account produced, these sources have been scrutinized having in mind specific questions which we deem particularly revealing of main historiographical approaches:

- What role held the Portuguese maritime discoveries of the 15th and 16th centuries in the onset of the Scientific Revolution of the 16th and 17th centuries? What role did science play in the maritime discoveries and the establishment of the Portuguese empire? Was there anything like a nautical science in Portugal?
- What role is ascribed to the argument of a scientific decline covering the 17th century and most of the 18th century? What sorts of factors are called for as explanatory devices? How are they related with the domination of the educational system by the Jesuits? What characteristics were attributed to the scientific practice of the Jesuits?
- What role does it play the argument of a scientific revival starting in the last third of the 18th century? What sorts of factors are called for as explanatory devices? How are they related with reforms of the educational system following the expulsion of the Jesuits from Portugal in 1759? What role was attributed to the appropriation of the ideas and practices stemming from the Scientific Revolution? Was there a Portuguese Enlightenment? What are deemed to be its most striking characteristics?
- What role did science and technology play in the modernization agenda associated with the move to a constitutional monarchy (19th century), and later on, with the onset of the Republican regime (20th century)? Did science and technology undergo a process of specialization and institutionalization in 19th century Portugal as it did in other European countries? How did the active occupation of colonial territories in Africa depend on the science and technology stemming from the metropolis?

INTERNATIONAL NETWORKING. ALDO MIELI, THE PORTUGUESE GROUP AND THE JOURNAL *PETRUS NONIUS*

The Portuguese Group for the History of Science emerged as a result of the friendship of Mieli and the physician Arlindo Monteiro, following an exchange of correspondence concerning Mieli's review of Monteiro's publication "Socratic and Saphic Love" in the journal *Rassegna di Studi Sessuali* in 1924.⁸ Mieli visited Portugal yearly, from 1931 to 1936, to promote the creation of the Portuguese Group, the organization of the III International Congress for the History of Science,⁹ and, finally, to give some lectures on "Le role mondial de la science arabe." He stopped one last time in Portugal, in 1939, on his way to exile in Argentina, fleeing fascist Europe.

Arlindo Monteiro became the director of *Petrus Nonius*, and its main driving force. In fact, one gets the impression that the journal was basically a one man's show. It comes to mind Sarton's words to the Portuguese mathematician Armando Cortesão, then Counsellor for the History of Science at UNESCO: "the success of a review (sic) [journal] is very largely due to the devotion of a few men, and more often of a single man, willing to give, if not the best of his time, at least much of his time, generously."¹⁰ Although this comment was triggered by the projected revival, in the aftermath of WWII, of *Archeion*, the Italian journal founded by Mieli in 1919, it certainly fits like hand and glove to *ISIS* and Sarton, and applies, in the national context, to *Petrus Nonius* and Arlindo Monteiro. This may additionally be one of the reasons behind its end, if one bears in mind Arlindo Monteiro's permanence in Brazil since 1942, his state of decaying mental health, and the conflicts it triggered, which surfaced in the embarrassing tone of his correspondence with Sarton.¹¹

The changing composition of the Portuguese Group can be followed through the pages of *Petrus Nonius*. From start there was a very open approach to the group's constitution. Exception made of areas such as the history of nautical sciences, mathematics, and medicine, which grew in association with the history of Portuguese maritime expansion, not many Portuguese scholars could be classed as historians of science, and even in the previous areas their outlook was more consonant with the designation of scientists-historians. So the decision was made to accept all people whose scientific and literary output showed their sympathy to the field.¹² Mostly university professors or academicians, physicians and mathematicians, it comes as no surprise that history of mathematics and medicine were very well represented.¹³ Many held positions at the University of Coimbra, the older institution for higher education in Portugal. Politically, some key members explicitly endorsed the politics of "Estado Novo".

When the journal *Petrus Nonius* was launched the central committee of the Portuguese Group included the philosophically minded historian of ideas Joaquim de Carvalho (1892-1958), who suggested the name of the journal and was to become the editor of the complete works of Pedro Nunes not long afterwards.¹⁴ Taking the history of science as the youngest area within history,¹⁵ Joaquim de Carvalho was captivated by the newcomer inasmuch it could foster relations with philosophy and the history of philosophy, an epistemological project which was not mirrored in the journal's output. This was an exceptional case in the Portuguese context in which those involved in the history of

science came often from a scientific background.

Essentially a direct result of Mieli's efforts to build a truly international community, during the 1930s and 1940s the members of this group were regular participants in *Archeion*. In some instances papers published in *Archeion* were republished in the Portuguese journal. Alternatively, foreign scholars often authored papers in *Petrus Nonius*, eager to promote the new journal and help the internationalization of the discipline. Among them were Mieli, the physician Tricot-Royer, the specialists in Arab studies M. Meyerhof and H.P.J. Reynaud, and the historian Charles Boxer. News of the activities of the Portuguese group also appeared in *ISIS*,¹⁶ following Sarton's presence in Portugal for the 1934 international meeting. The importance of strengthening international networks of historians of science is also revealed by the structure of *Petrus Nonius*, which devotes one of its two parts, in charge of Monteiro, to detailed news of the dynamics of the profession, mentioning meetings and commemorative events, describing publications and giving summaries of papers, writing short biographical or obituary notices, etc. Sarton's project of using the history of science as an instrument of moral education was mirrored in the discussion of the importance of teaching the history of science at different educational levels in the national context.

Seven volumes of the journal were published, with four numbers each, extending from 1937 to 1951.¹⁷ During 1937, a single issue called *Petrus Nonius. Anuário (Petrus Nonius. Yearly volume)* was also released, but was given up in favour of the four-number per year project.

Monteiro subscribed Mieli's project of a steady foundation for the history of science, building on an exhaustive search for primary sources, their careful and detailed interpretation, and a rewriting of history of science whenever necessary.¹⁸ But while publications were often supported by bibliographical references, or were motivated by the presentation and transcription of newly found documents, they seldom went beyond a narrow view of history, reducing it to chronology, to the compilation of facts and dates, especially those involving Portugal and the Portuguese.

The first two volumes and the single yearly issue show a coherent organization, with a strong emphasis on the history of nautical science, mathematics and medicine, paying particular attention to the period of the Portuguese maritime discoveries. The life and work of Pedro Nunes is addressed, spurred by the 400th anniversary of the publication of the *Tratado da Sphera (Treatise on the Sphere)* (1537), which includes Nunes' first texts on nautical matters.¹⁹ Recent scholarship has stressed the foundational role of these texts in which Nunes opposed practical navigation (the basis of the training of seamen and pilots) to scientific (theoretical) navigation, and put forward a new program of theoretical navigation as a new sub-discipline within mathematics based on the demonstrative power and certainty of mathematics, and laying the ground for the mathematical study of nature.²⁰ The emergence of nautical science in Portugal is discussed implicitly by making documental inferences as to the recourse to astronomical methods by pilots and seamen,²¹ and evidence for the hypothetical arrival of the Portuguese in America before Columbus is also discussed. Generally, papers tend to claim priority for Portuguese science, assess the impact of Portuguese scientific

contributions abroad, or produce inventories of important dates for Portuguese science.²²

After the second volume, 18th century topics emerged but never took any prominent place. The role of some “*estrangeirados*” (Europeanized intellectuals) who travelled extensively abroad and brought back to Portugal the new sciences was discussed.²³ Examples are Rafael Bluteau’s introduction of Enlightenment ideas in the Portuguese context, the alleged discovery of the law of magnetic action by the Italian Dalla-Bella (to which we refer in detail in the next session), or the impact of the “*estrangeirados*” in Brazil.²⁴ From there on, volumes’ contents become quite eclectic including an increasing number of papers with tangential relation with the history of science (ethnography, archaeology, architecture, philology, folklore, etc.). One wonders, if the effects of WWII, dependence on contributions from abroad, and the amateurship of many contributors may account for such a situation. After the third volume, contributions to disciplinary history included topics in the history of geology by leading Portuguese geologists.

There are some interrelated historiographical trends we can discern in *Petrus Nonius*. A view tending to reduce the task of history of science to chronology, emphasizing the establishment of priorities, especially when involving Portuguese contributions so far unacknowledged, and the writing of history of science as the travails and successes of hero-scientists. History of science served a nationalistic purpose, and aimed at restoring Portugal’s due share in a glorious European scientific past.

HISTORY OF SCIENCE AT THE SERVICE OF A DICTATORIAL REGIME. THE EXHIBITION OF THE PORTUGUESE WORLD

While the Portuguese group materialized through international impetus, the case study discussed in this section took place in a strictly national context. Despite such different origins, members of the Portuguese Group were also participants in this event.

The organization of conferences and meetings became part of the ideological agenda of the “*Estado Novo*” aimed at giving an appearance of neutrality and objectivity to its biased and subjective interpretation of the history of Portuguese culture. In July 1937, the First Congress on the History of Portuguese World Expansion was organized, and the Portuguese maritime discoveries entered the realm of Portuguese mythology. The Congress “*History of Portuguese Scientific Activity*,” one of the ten congresses which took place during the Exhibition of the Portuguese World (1940), was a commemorative and partisan celebration in which the political agenda of the regime sought a scientific legitimization. In this context, Portugal was seen as having played a crucial role in building Western civilization starting with the Portuguese maritime discoveries, and leading to the colonization of Brazil and extended regions of Africa and Asia. However, the scientific and technological leadership of the 15th century was followed by a long period of decline voiced by Portuguese and foreigners alike. This interpretation had to be reassessed and the congress was meant to give credit to and establish priorities for Portuguese scientists and Portuguese science. Summing up, the history of science served an ideological purpose and turned to be the handmaiden of a political agenda.

Chaired by the historian Joaquim de Carvalho, founding member of the Portuguese Group, and respected by the political regime, the congress was organized in three sections: physical, mathematical and military sciences; biological and medical sciences; and social and moral sciences.²⁵ Most of the talks included in the first two sections were delivered by scientists. Belonging to the biographical or institutional genre, they were merely descriptive, making no evaluative assessments.

The history of medicine and mathematics were by far the most discussed topics, and the 18th century held a prominent place as a historical period under scrutiny. As such biographical contributions to science addressed, for example, the life and work of the 16th century physician Amato Lusitano, as well as three 18th century “*estrangeirados*”: the mathematician Anastácio da Cunha, the physicist Dalla-Bella, and the physician Jacob Castro Sarmiento, all participants in the educational reforms implemented by the Marquis of Pombal in the framework of enlightened despotism, and which introduced the new sciences in the national context.

The talks on Anastácio da Cunha and Dalla-Bella, who lived most of his adulthood in Portugal, are illustrative of the emphasis on Portuguese precursors with the view of building a heroic history of Portuguese science. They both aimed at the articulation of a long overdue history of a glorious Portuguese scientific past. The mathematician Vicente Gonçalves analysed carefully Cunha’s *Mathematical Principles* and claimed rightfully priority for Cunha’s definition of series.²⁶ The physicist Mário Silva, who had recently “discovered” the Cabinet of Physics of the reformed University of Coimbra as well as its first director, Dalla-Bella, claimed inadequately priority for Dalla-Bella’s 1781 proof that the magnetic force obeys an inverse square law in similarity with gravity, and presented Dalla-Bella as the Portuguese Coulomb.²⁷ In this priority claim, conflicting nationalistic overtones surfaced: two Italians, one writing in *Petrus Nonius* (as already mentioned), claimed also priority for Dalla-Bella and Italian science.

Ravished by the impressively rich collection of scientific instruments which the 18th century laboratory housed, faithfully described in Dalla Bella’s *Index Instrumentorum*, and shocked by the neglect to which the collection was voted in the late 19th century, culminating with the auction of pieces by the young Republic, Mário Silva was embarrassed by Dalla Bella’s scant publications in the *Memoirs of The Academy of Sciences of Lisbon*. The Italian physicist published just one paper, but a breakthrough one, in Mário Silva’s debatable opinion.²⁸ A believer in historical determinism, for him whenever material conditions were provided, an important scientific production ensued. Hence, the output of Dalla-Bella and his two immediate successors was interpreted as an outcome of Pombal’s reforms.

The contributions authored by the physician Luís de Pina, a member of the Portuguese Group, were the outcome of his collaboration in the project launched by Mieli on the compilation of Chronological Tables on the History of Science, as a starting point for future historical reflections. He had published preliminary conclusions in *Petrus Nonius*, and decided to present a summary of this ongoing project in the conference. In one of the talks he gave information on the project of construction of a database on Portuguese scientific activity during the 16th century; in the other he presented a

summary of a project of compilation of famous Portuguese men of science and humanities.²⁹

Another talk deserves special reference. It was part of the Colonial Congress, another meeting organized during the Exhibition. Despite its title "Portuguese scientific research in the past 100 years,"³⁰ it gave an overview of the history of science in Portugal since the maritime discoveries. Its author firmly acknowledged that Portuguese maritime expansion was not accidental, but the outcome of a solid scientific and technological preparation. The subsequent period of decline, a view to which he subscribed, resulted from the convergence of cultural, political and economic factors which were enumerated: gradual weakness of leadership as a result of two centuries of geographical discoveries and wars; the crisis of Christianity following Reformation and Counter-Reformation; and the political consequences of gradually rejecting the symbolic association of the king to moral power, following the Spanish dominion of Portugal. While things started to change slowly with the 18th century reform by the Marquis of Pombal, the author pointed out that science was then basically imported from abroad, contrary to what happened in former centuries. The Napoleonic invasions at the beginning of the 19th century and the establishment of a liberal regime did not provide an appropriate context for science to develop. Later on, with the consolidation of liberalism, new scientific institutions were created – the Polytechnic schools of Lisbon and Porto – and by mid-19th century onwards the geographic expeditions and the subsequent construction of a railway system in the African colonies slowly contributed to the onset of colonial scientific research, a question to which the author devoted much of his presentation.

TWO HISTORIANS OF SCIENCE, TWO DIFFERENT CHOICES

In different ways, both the contributions of the historians of science Rómulo de Carvalho and Luís de Albuquerque may be seen as a reaction to a hostile political environment. They both countered received historiography with its celebratory and nationalistic overtones, and its emphasis on a golden period of Portuguese science associated with the maritime discoveries and geographical expansion. Rising history of science to new standards of erudition, rigor, and scholarship, Rómulo de Carvalho avoided altogether the 15th and the 16th centuries, to concentrate on the 18th century. On the contrary, Luís de Albuquerque took upon himself the task of looking at it from a new historiographical perspective.

Rómulo de Carvalho: A loner's erudite look at the 18th century

Rómulo de Carvalho (1906-1997) graduated in physics and chemistry at the University of Porto and became a secondary-school teacher of physics, a profession he held until retirement. For him, science was a fundamental component of culture. He strove to express his convictions by becoming increasingly involved in establishing links between science and other areas of knowledge. He wrote popularization books addressed to

secondary school students in a period in which this sort of literature was almost non-existent in Portugal,³¹ conveying to young readers a sense of the excitement of science in an appealing and rigorous style.

Rómulo de Carvalho's contributions to the history of science started in the 1950s. If commemorative papers on natural philosophers such as Pascal or Descartes or scientists such as Lorentz or Einstein were his first historical pieces, he soon considered a priority to concentrate on the history of science in Portugal. Over a period of forty years, he contributed many books, case studies, and various papers. In short books for wider audiences, he wrote disciplinary histories of astronomy, experimental physics and the natural sciences in 18th century Portugal.³² He contributed to the biographical genre by writing short biographies of Portuguese men of science and instrument makers;³³ to institutional history by looking at the foundation of the College of Nobles in 1761, or the creation of the Laboratory of Physics at the reformed University of Coimbra, both due to the reforming action of the Marquis of Pombal, or the pedagogical activities developed in the context of the Academy of Sciences of Lisbon, founded already during the reign of Queen Maria I.³⁴ In a breathtaking book, he addressed in broad terms the impact of educational reforms in Portugal since the 12th century.³⁵ Scientific communication was addressed by looking at the networks established between Portuguese scientists and foreign fellow scientists, or between the Academy of Sciences and foreign academies.³⁶ These were different threads of a tapestry unveiling the patterns of scientific activity in Portugal during the 18th century.

By portraying the 18th century in Portugal as a confrontation between Jesuits and Oratorians, "ancients" and "moderns", late advocates of Aristotle and Scholasticism and those who opposed them, Rómulo de Carvalho saw experiment as the methodological clue to the divergences opposing these groups, accounting for the success of the latter. He therefore paid particular attention to experimental physics in contrast to the natural sciences, and considered of paramount importance to identify and describe the strategies to teach and disseminate experimental physics through laboratory experiments, practical demonstrations for wide audiences, and its support by the acquisition and construction of scientific instruments. Despite the opposition outlined above in which the Jesuits were pictured as a conservative group, Rómulo de Carvalho acknowledged their contributions to science, especially to astronomy, and never going into specifics acknowledged that some were conversant with the latest scientific novelties.³⁷

Belonging to an essentially descriptive tradition, Rómulo de Carvalho produced many detailed and highly erudite accounts, and raised the standards of historical research about science in Portugal by a thorough reliance on the use and interpretation of archival sources. He took for granted present-day disciplinary boundaries, focused almost exclusively on lasting contributions to science, over-emphasized the role of experiment on a theoretical level without ever going into any detailed analysis of the characteristics of experimental practices, and discarded the analysis of natural-history practices. Despite former Whiggish leanings, he opposed the widespread historical search in the past for Portuguese precursors. For example, he countered Mário Silva's claim according to which Dalla-Bella anticipated Coulomb's discovery of the law of magnetic action,³⁸ in the

process becoming the sole Portuguese to engage in experimental history of science.

Despite Rómulo de Carvalho's reliance on primary sources and archival material, certainly a refreshing breeze in the national context, he was a loner, writing in the solitude of his office, always in Portuguese, and never showing any need to interact with the international community, then making strides in the reappraisal of 18th century science.

Luís de Albuquerque and R. Hooykaas: reappraising the role of Portugal in the Scientific Revolution

Luís de Albuquerque (1917-1992) was another prolific historian. Despite the fact that a substantial part of his work was written in Portuguese, he also published in international forums, and left an imprint on the international landscape.

He graduated in mathematics at the University of Coimbra in 1939. At the time, the curriculum of the bachelor degree included courses on physics, astronomy, celestial mechanics, mathematical physics, rational mechanics, geodesy and cartography. He became a university teacher in 1949 in charge of the drawing classes. Due to his political leanings opposing Salazar's rule, his PhD degree in mathematics was only granted in 1959.³⁹

In the meantime he had become a regular contributor to Coimbra's cultural journal *Vértice*, which held a broad view of culture including science. He initially addressed themes pertaining to the institutionalization of science in 18th century Portugal, the teaching of the new sciences, and specifically of mathematics, in the context of Pombal's reform of the University of Coimbra. But he soon became involved with the Portuguese contributions to the Age of Discoveries. Keeping with his mathematical research, the history of nautical science was to become a dominant theme in his research, probably stimulated by the contribution to the book *The History of Portuguese Culture* authored by António José Saraiva.⁴⁰

He wrote papers and books, small newspaper's commentaries, edited collective volumes, to which he often appended extended introductions. Besides, he edited facsimile editions or transcriptions of early-modern manuscripts, an activity which has no counterpart in the contributions of Rómulo de Carvalho.⁴¹ We may say without exaggeration that his contributions transformed the history of nautical science in Portugal into a discipline in its own right, analysing its different stages of development, and putting forward a coherent interpretative framework. He took a fresh look at old questions, putting in context Portuguese contributions, never concentrating on the Portuguese with exclusion of others of diverse nationalities, and never hesitating in taking credit away to the Portuguese, or, contrary-wise, giving credit to them where other historians previously had found none.

He approached the topic from a non-traditional direction in the international context, by positioning himself as heir of a tradition of Portuguese mathematicians. While the topic was addressed abroad from the standpoint of social history, in the local context it was approached from the standpoint of mathematics, cartography, and navigation theory. This disciplinary vantage point was assessed from a contextual perspective. For

example, he did not hesitate to claim that for Renaissance men astrology was as scientific as astronomy.⁴² Statements like this seem a triviality today, but at the time and in the Portuguese positivist context, they were quite a novelty, bordering the totally unacceptable.

As Luciano Pereira da Silva and Duarte Leite before him, Luís de Albuquerque criticized the received view on the role of science in the Portuguese discoveries, advocated, for example, by Joaquim Bensaúde, with unprecedented thoroughness, clarity and forcefulness.⁴³ He settled a controversy initiated in the 1940s and 1950s, opposing Jaime Cortesão (supported by his brother Armando Cortesão) to Duarte Leite, as to the beginning of nautical astronomy in Portugal, which he postponed to the end of the 15th century, in agreement with the latter historian. He therefore argued against the myth of the "Escola de Sagres" (School of Sagres) as a sort of scientific research and teaching institution for nautical science created by Prince Henry, the navigator, which he dubbed "as fallacious as it was famous."⁴⁴ For him, as for Luciano Pereira da Silva before him, the initial input propelling the maritime discoveries was not scientific. It was navigational practice, a know-how passed on to successive generations of pilots and seamen, rather than theoretical knowledge, which dictated nautical solutions. Astronomical navigation and the emergence of a truly nautical science appeared much later, at the end of the 15th century. At the same time, he proved wrong the myth of the supposed German origin of Portuguese nautical astronomy. Besides, he discussed Pedro Nunes's contributions to nautical science, and its impact on Europe, claiming that the mathematical expertise of the 16th century Portuguese mathematician and chief-cosmographer was simply too advanced to be understood by the few pilots attending his classes and examined by him.⁴⁵ He further analysed the teaching of nautical science at the Jesuit College of Santo Antão, summarizing courses taught by various professors. In sum, he put forward evidence of a sustained tradition of Portuguese nautical science extending from mid-15th century to the beginning of the 18th century.

Through Luís de Albuquerque, the Dutch historian of science R. Hooykaas became aware of the Portuguese role in the geographical discoveries and maritime expansion, a role that tended to be obfuscated by that played by the Spanish and the Dutch for European and North-American historians. A regular visitor and participant in conferences held in Portugal, Hooykaas correlated the Portuguese maritime discoveries and the onset of the Scientific Revolution. One of his papers finished with the following statement: "Henry the navigator, who initiated the great voyages, was not a scientist nor had a scientific aim in mind. However, his initiative fostered a movement which was transformed in the avalanche of scientific events covering the 16th century."⁴⁶ Luís de Albuquerque said it often in different but equivalent ways.⁴⁷

Besides Hooykaas' role in putting Portuguese contributions to the emergence of modern science in the international agenda of historians of science, Hooykaas was also involved in the attempts of Albuquerque, supported by Armando Cortesão, in introducing the history of science in the university curricula. Hooykaas visited the Faculty of Sciences of the University of Coimbra for the first time in 1962 to deliver a set of two lectures about "L'histoire des sciences, ses problèmes, sa méthode, son but"

specifically addressed to an audience of scientists and science students. Faithful to the Sartonian tradition, while elaborating on the historical foundation of the methodology followed by historians of science, he was eager to stress the importance of history of science in "humanizing" the man of science.⁴⁸ He returned in April and May of 1963, and again in 1964 to deliver courses on the history of science, in which he covered extended periods of time and crossed disciplinary boundaries to the astonishment of his audience used to centre on the history of his own specialty.⁴⁹ It was then that the idea occurred to send a group of selected scholarship holders to the Netherlands to follow an intensive specialization program and create a solid basis for the teaching of the history of science at the University of Coimbra. Failing due to the lack of political and financial support, it was only in the 1970s that history of science courses were introduced in the curricula of science students in some Portuguese universities.

COMMEMORATIVE PRACTICES. HISTORY OF SCIENCE AT THE ACADEMY OF SCIENCES OF LISBON

Despite a steady publication covering four decades, one wonders if the standards of scholarship associated with the works of the two historians of science discussed in the previous section were able to overcome former historiographical biases. Rómulo de Carvalho worked by himself and left no students. Luís de Albuquerque's work was appropriated by historians of European expansion, a strong niche in the community of Portuguese historians for obvious reasons. Notwithstanding Joaquim de Carvalho's claim, referred in the beginning of this paper, according to which history of science could foster relations with history of philosophy and philosophy, historians were never sympathetic in accommodating the history of science in their discipline. The two authors illustrate isolated and individual responses, and do not seem to have altered substantially the collective response of the community delving with the history of science.

To substantiate our claim, in what follows we look at the commemorative volumes published to celebrate the 200th anniversary of the Academy of Sciences of Lisbon, one of the oldest scientific institutions in Portugal, and certainly one having a steady impact on Portuguese scientific life, for good and for worse. Its memoirs published irregularly since the end of the 18th century are undoubtedly an important source for the history of science.

Two commemorative meetings were organized in 1985 and 1989: the first focused on contributions to science in Portugal until the 20th century, and the second surveyed the 20th century. The proceedings were published in 1986 (2 volumes) and in 1992 (3 volumes), respectively. The contributions to the second meeting were organized by disciplines or sub-disciplines and offer assessments partaking characteristics of the review article and of participants' recollections. In this sense they are sources for the history of science rather than sources useful for the analysis of historiographical trends, especially when one wants to pose questions pertaining to historical events covering the period from the 15th to the 18th centuries. Of all contributions, we should single out

Rómulo de Carvalho's inventory of sources for the history of science in Portugal written during the 20th century, and comprising more than 1300 references.⁵⁰

Of the 45 contributors to the first meeting's proceedings, all were Portuguese except historians of science Allen Debus and William Shea.⁵¹ Most were university professors holding top positions in academia, and 21 were members of the Academy of Sciences of Lisbon. Among them were Luís de Albuquerque and Rómulo de Carvalho. Half of the 50 papers presented covered extended periods of time, and often reveal a tendency for sweeping overviews. Less than 1/5 address the period of the maritime discoveries, and the rest was divided evenly between the 18th and the 19th centuries. While topics formerly addressed by Luís de Albuquerque and Rómulo de Carvalho are dealt with in less than half of the papers presented, 19th century scientific topics take increasing prominence, especially in relation to the history of geology and allied sciences.

The majority of papers focus on aspects of the history of a single discipline with a small fraction (around 1/5) concerned with institutional histories (including the history of the Academy of Sciences of Lisbon or the University of Coimbra) or biographical accounts (mostly of 18th century "estrangirados"). Medicine continues to emerge as a major topic, followed now by chemistry, geology and allied sciences. Only three papers address aspects of the history of nautical sciences, two being authored by Luís de Albuquerque, and the other by another mathematician who discusses the life and work of Pedro Nunes.

Despite the opening address by Pinto Peixoto, the president of the Academy and an internationally renowned geophysicist, who argued for a history of science paying attention to the social, political and philosophical contexts of science, papers, including the president's one, seldom went beyond naïve internalism, still on the look out for Portuguese hero-scientists and precursors. A considerable number of papers, though not all, relied on primary sources and listed more or less extended bibliographical references, an indication that the standards of scholarship imposed by Rómulo de Carvalho and Luís de Albuquerque's historical writings were striking a responsive chord.

Albuquerque's ongoing project of revision of the received view on the historiography of the nautical sciences was summarized in his two contributed papers. He recalled the importance of the first Portuguese nautical charts (1440s) and their role in Renaissance reeditions of Ptolemy's *Cosmographia* which came to include in the beginning of the 16th century new charts ("Tabulae Novae") incorporating recent geographical knowledge. He also recalled contributions of Portuguese pilots in the realm of earth magnetism. The systematic determination of magnetic declination refuted the existence of a long-sought relation between magnetic declination and longitude, accounted for the discovery of a phenomenon later known as the "shifting of the compass", and opened the way for later theoretical endeavors such as those of Simon Stevin and William Gilbert.⁵² Despite Albuquerque's agenda summarized in the volume, many papers still subscribed uncritically to the standard view. They associated indiscriminately maritime expansion with the high point of Portuguese science, followed by a long period of decline slowly reversed in the aftermath of the Marquis of Pombal's reforms of the teaching system, which introduced the new sciences in the national context. Besides Luís de

Albuquerque's contributions, only one paper reacted to this historiographical trend, assessing the relation between the Portuguese role in the European maritime and geographical expansion and the onset of the Scientific Revolution, by giving an overview of past theses revisited in the context of international scholarship.⁵³ Furthermore, this case study was used to criticize Thomas Kuhn's discontinuity model of scientific change, showing the author's awareness of recent discussions held within the international community of historians of science.

With one exception, the role of the Jesuits was usually bypassed, and implicitly associated with the period of scientific decline which extended from the 17th to the second half of the 18th century. The exception addressed a specific case study. It focused on the reaction of the Jesuit Inácio Monteiro to the controversy opposing Cartesians and Newtonians over the nature of gravity, in which he advocated a mechanistic foundation for gravity.⁵⁴ Keeping with the general trend, an overview of history of astronomy discussed Jesuit's contributions to mathematics, astronomy and nautical sciences very cursorily.⁵⁵

In the opening remarks, Pinto Peixoto criticized the stage in which stood the teaching of history of science at the university level. Despite a discussion going back to *Petrus Nonius*, it barely existed on an acceptable level, if at all. He argued for cooperation between scientists and historians in reversing this state of affairs. But he preached what he did not practice. Including members from the humanities and the sciences, the Academy was not the place to overcome disciplinary barriers or propel new disciplines. Old academicians were representatives of the *status quo*.

While commemorative practices have been always and everywhere occasions for the use of the history of science,⁵⁶ often in charge of senior (or not so senior) scientists,⁵⁷ in the Portuguese context they took on a domineering role in relation to other forms, a role which did not wane with the passing of time. The standard view continued to held many advocates, who tended to correlate scientific peaks of activity with high points in the history of Portuguese culture, be it the period of the maritime discoveries or the 18th century reforms of the Marquis of Pombal. With few exceptions science was associated with a glorious by-gone past often unacknowledged by foreigners, a past which was to be recovered in accounts aimed at the identification of historical facts, precursors and founding fathers, to be fed into chronological surveys centered on answers to "who did what and when" type of questions. While this was certainly part of the international project for the history of science fostered by Mieli and Sarton during the 1920s and 1930s, surfacing in publications included in journals such as *Archeion* or *ISIS*, it gradually gave rise in succeeding decades to more sophisticated accounts, to such an extent that by the 1980s, when the 200th anniversary of the Academy of Sciences was celebrated, a sharp contrast opposed the problématique of international historiography of science, influenced by the recent trends in the social and cultural history of science, to the national historiography as displayed in the event's proceedings. This state of affairs bears witness to the secondary role still played by science in Portuguese society, despite efforts to reverse this situation, as well as to the lack of importance attributed to history of science as a discipline and profession in its own right.

HISTORY OF SCIENCE AFTER 1992: THE VERY RECENT PAST

The task fell on a newly emerging generation of historians of science to foster the history of science at the national level, to raise it to international standards of scholarship, participate actively in international networks and implement courses at university level (undergraduate and graduate). While the consolidation of a discipline is a process usually associated with the increasing professionalization of its practitioners and their concomitant internationalization, in the national context the last fifteen years reveal the cohabitation of different stages of development: together with episodic contributions to the discipline by people marginally related to it, and the still large participation of scientist-historians (especially mathematicians-historians), a steady increase of professional historians of science is taking place. By professional historians of science we mean those who hold graduations in the field and/or those who, irrespective of their fields of origin, publish regularly on international forums. Opposing an old trend in which the great majority of professional historians of science come from a scientific background, some professional historians of science hold undergraduate degrees in history, the interface with economic history, history of culture and history of ideas being noticeable. In the national scene there are now three research centers on the history of science and technology accredited and funded by the Fundação para a Ciência e a Tecnologia (Foundation for Science and Technology), and there are two graduate programs on the history and philosophy of science and technology, both in Lisbon. While there is not yet in Portugal any undergraduate degree on the history of science, it was during the 1960-70s, as we stated in a previous section, and specifically with the onset of the democratic regime, after 1974, that history of science courses were introduced in the curricula of science students, with the sole exception of history of medicine courses which were part of the curricula of students of medicine for a long time before and were taught by physicians.

An on-line journal specifically devoted to the history of science and technology will be launched in 2007, the first after the short-lived attempt associated with *Petrus Nonius*, but there is no active scientific society.⁵⁸ A considerable number of national and international meetings have recently been organized by the Portuguese scholarly community whose members have been participating on a regular basis in international forums. Meanwhile, special attention has been paid to provide the national audience with translations of recent landmarks of the literature on history of science. At the same time the publication of primary sources, both printed and manuscript, aims at emphasizing the importance of recovering and studying primary sources.⁵⁹

To avoid qualitative and unwittingly subjective interpretations of the state of the field, in what follows we present some conclusions stemming from an analysis of a recent bibliographical survey which lists, for the five year period 2000-2004, all publications by Portuguese authors addressing history of science and technology topics, publications by foreign authors on the history of science and technology in Portugal, and translations

into Portuguese of work on the history of science.⁶⁰ Having in mind the lack of a straightforward method to secure the completeness and correctness of such data gathering, aggravated in the Portuguese scene by a scattered and irregular publication pattern, often relying on obscure and provincial journals, we take as indicative of recent trends in the discipline the conclusions extrapolated by the analysis provided by the publication list gathered for this 5-year period.

Surprisingly, a much larger number of publications and authors than expected were found (1108 publications; 703 authors, of which 563 (80% are Portuguese). Of the total number of authors, half (350 authors) published just one work in the five year period surveyed, denoting a large fraction of accidental contributions to the discipline. Of all Portuguese authors, just 36 (6,4 %) published six or more works.⁶¹ Of these, 16 (44%) are historians of science, 13 (36%) are scientists and the rest (7 – 19,4 %) stem from different backgrounds (including history, etc.). Additionally, just 14 (39%) have 5 or more publications in international forums (papers, books or chapters of books and proceedings). Of these 14, all except 3 are professional historians of science (or historians of technology) and just 3 publish on topics with no intersection with the history of science and technology in Portugal. That is, of the authors publishing on a regular basis on history of science topics, 44% are professional historians of science, the others being mostly scientists-historians. The first category – professional historians of science – includes mostly authors who participate in mainstream history of science, a trend denoting a strong correlation between professionalization and internationalization. The fact that most professional historians of science publish on Portuguese topics reveals, therefore, not the lack of internationalization but the willingness to unveil and interpret many new episodes, revise received views in the few cases in which they exist, offer case studies informed by recent mainstream historiographical trends, in the process enriching international scholarship with case studies stemming from the history of science in Portugal. Reinforcing and propagating a very old trend, history of mathematics' topics continue to belong to the realm of mathematicians who publish usually in national forums, and therefore do not apply in their secondary field of interest the same standards of scholarship adopted in their main scientific field. Topics which do not follow this trend are often associated with the role of nautical sciences and mathematics in the geographical discoveries in the 15th and 16th centuries, and specifically with the assessment of Pedro Nunes's contributions to science. Contrary-wise, history of medicine (and pharmacy) has now become the subject of study of professional historians of science and technology, although this sub-field constitutes a very small fraction within history of science.

The small community of professional historians of science covers a wide variety of thematic areas, ranging from the 16th to the 20th century, and applies a broad range of methodological approaches, including essentially descriptive ones, internalist-oriented, or approaches more consonant with recent trends in the area of science studies. Methodological choices depend often on the scientific background of practitioners or their willingness to frame their works in the context of the new social and cultural history of science and technology. Especially important has been the input from the

framework developed within the international group STEP (Science and Technology in the European Periphery), which has called attention to the received view about science and technology in the European periphery, the often implicit images concerning the relationship between centre and periphery conveyed in many works, and the various difficulties which have hampered a systematic study of the sciences and technology in the European periphery. Among STEP members, some have been receptive to frame the study of science in Portugal by shifting the emphasis from transmission to appropriation, from the perspective of the centre to the perspective of the periphery, and from the isolated study of the periphery to the comparative assessment of developments.⁶² At this juncture and despite the rather small community of historians of science and technology, it is not too optimistic to predict that a first preliminary overview of many episodes can be offered, answering new questions, and contributing in the not so distant future to a sketch of a "big picture" of the history of science and technology in Portugal, a framework in which detailed case studies should find a place.

NOTES

1 GEORGES SARTON, "L'Histoire des Sciences," *ISIS*, 1913, 1: 3-46.

2 Reports on the meeting appeared in volume 16 of *Archeion*, in volume 1 of *Petrus Nonius*, and on a more personal note, Sarton's recollections of the event were published in volume 22 of *ISIS*.

3 In Portugal, the beginning of the 20th century is associated with the end of the monarchy and the establishment of the Republic (1910), a complex process marked by deep ideological, political and religious confrontations, which converged in the late 1920s in the establishment of the dictatorial regime of Salazar known as "Estado Novo" (New State). It abolished parliamentary rule, subscribing to a totalitarian "strong regime" and a nationalist corporative model which subordinated individual rights to the nation's interests, in such a way as to make the State and the Roman Catholic Church the core building blocks of society. The aftermath of WWII imposed successive adaptations to the regime, but Portugal remained an economically fragile country, politically and culturally isolated from Europe. In 1974 a non-violent revolution, which came to be known as the revolution of carnations, was at last successful in establishing a democratic regime.

4 "Discours de G. Sarton," *Archeion*, 1934, 16: 340-343, p. 343.

5 A recent paper along these lines is P. FONTES DA COSTA, H. LEITÃO, "Portuguese imperial science, 1450-1800: a historiographical review," in *Science, Power and the Order of Nature in the Spanish and Portuguese Empires* edited by Daniela Bleichmar, Paula de Vos, Kristin Huffine, and Kevin Sheehan (Stanford: Stanford University Press, in print).

6 HELGE KRAGH, *An Introduction to the Historiography of Science* (Cambridge: Cambridge University Press, 1987); JAN GOLINSKI, *Making Natural Knowledge. Constructivism and the History of Science* (Cambridge: Cambridge University Press, 1998); KOSTAS GAVROGLU, *The past of the sciences as history* (Crete: University of Crete Publishers, 2004) (in Greek), translated in Portuguese *O passado das ciências como história* (Porto: Porto Editora, 2007).

7 Few works authored by Portuguese have addressed this topic. See LUÍS SARAIVA, "Historiography of Mathematics in Portugal" in *Writing the History of Mathematics: its historical development* edited by J.W. Dauben, and C.J. Scriba (Berlin: Birkhäuser Verlag, 2002), pp. 239-247; FÁTIMA NUNES, "História da ciência e a filosofia da ciência em Portugal até ao último quartel do século XX" in *História do Pensamento Filosófico Português*, vol.5: Século XX, edited by Pedro Calafate (Lisboa: Editorial Caminho, 2000), pp.541-582. This last chapter was the outcome of a research project entitled *Printed Sources relevant to the History of Portuguese Science, from the 17th to the first quarter of the 20th century* (1997 to 1999).

8 ARLINDO MONTEIRO, "O Professor Aldo Mieli (1879-1950)," *Petrus Nonius* 1951, 7: 183-193, p. 185.

9 With the rise of Nazism it became clear that the meeting could not take place in Germany, as

previously discussed.

10 Houghton Library, Harvard University, Papers of George Sarton, bMS Am 1803.1 (142), letter Sarton to Cortesão, 23 June 1947.

11 Houghton Library, Harvard University, Papers of Georges Sarton. bMS Am 1803. In one letter Sarton says: "Arlindo Monteiro complained bitterly of the lack of consideration shown to him and to Brazil at the Congress of Lausanne. He wrote letters to me which were so long and a bit incoherent that I could not read them completely. I am afraid that he is not quite himself, or perhaps he is too much of himself!" Letter Sarton to Cortesão, 23 September 1949.

12 "O grupo português de história das ciências, sua organização e labor – documentos do seu passado", *Petrus Nonius* 1937, 1: 143-145.

13 In fact, both in the history of mathematics and the history of medicine a tradition can be identified going back at least to the 19th century. The physician Maximiliano Lemos contributed to the history of medicine, and the mathematician Gomes Teixeira to the history of mathematics, both playing leading roles in conferring authority and credibility to their respective areas.

14 Since 2002 the task of completing the edition of Pedro Nunes's complete works, which had covered roughly half his publications, has been retaken under the editorial leadership of the historian of science Henrique Leitão.

15 JOAQUIM DE CARVALHO, "Evolução da historiografia filosófica em Portugal até finais do século XIX" in *Obra Completa* vol.2 (Lisboa: Fundação Calouste Gulbenkian, 1981), 121-153.

16 GEORGES SARTON, "Lusitanian memories," *ISIS* 1935, 22: 440-455.

17 Volumes came out in 1937 and 1938 (volume 1), 1938, 1939 and 1940 (volume 2), 1940 and 1941 (volume 3), 1941 (volume 4), 1942 (volume 5), 1943 and 1947 (volume 6), and finally 1951 (volume 7).

18 ARLINDO MONTEIRO, "Vida científica em Portugal e no estrangeiro," *Petrus Nonius*, 1938, 2: 27-30, p. 28.

19 FONTOURA DA COSTA, "Quatro centenário da publicação do "Tratado da Sphera" de Pedro Nunes," *Petrus Nonius* 1938, 1: 337-356.

20 H. LEITÃO, "Ars e ratio: a náutica e a constituição da ciência moderna" in *La Ciencia y el mar*, edited by Maria Isabel Vicente Maroto and Mariano Esteban Piñero (Valladolid: Sever-Cuesta, 2006), pp. 183-207; H. LEITÃO, "Maritime discoveries and the discovery of Science: Pedro Nunes and Early Modern Science" in *Beyond the Black Legend: Spain and the Scientific Revolution. Proceedings* edited by William Eamon and Victor Navarro Brotóns (in press).

21 A. BARBOSA, "José Vizinho, autor do "Regimento do Astrolábio"," *Petrus Nonius* 1937, 1: 19-48.

22 LUÍS DE PINA, "Tábuas Cronológicas da História das Ciências em Portugal no século XVI", *Petrus Nonius. Anuário*, 1937, 145-162.

23 On the networks of "estrangeirados" see ANA CARNEIRO, ANA SIMÕES, MARIA PAULA DIOGO, "The Scientific Revolution in Eighteenth-century Portugal: The role of the *Estrangeirados* (Europeanized Intellectuals)," *Social Studies of Science* 2000, 30: 591-619; ANA SIMÕES, ANA CARNEIRO, MARIA PAULA DIOGO, "Constructing Knowledge: Eighteenth-century Portugal and the New Sciences", *Archimedes*, 1999, 2: 1-40.

24 G. CONSTANZO, "Un insigne fisico italiano del settecento in Portogallo – Giovanni Antonio Dalla Bella," *Petrus Nonius*, 1939, 2: 201-213; HERNANI CIDADE, "D. Rafael Bluteau – o alvorecer do "Século das Luzes" em Portugal," *Petrus Nonius*, 1939, 2: 104-106; ARLINDO MONTEIRO, "Os professores doutores Miguel Franzini e Domingos Vandelli da Universidade de Coimbra, através de alguns inéditos do Arquivo Nacional do Brasil," *Petrus Nonius*, 1947, 6: 188-225.

25 The section on the physical, mathematical and military sciences included 18 talks: 4 on mathematics, 3 on military topics, 2 on chemistry, meteorology, physics and engineering, and 1 on astrophysics, astronomy, and a methodological question. The section on biological and medical sciences, 28 talks: 15 on medicine, 6 on biology and 2 on biological techniques, 4 on anthropology and 1 about criminal research. And the section on social and moral sciences 17 talks: 5 on philosophy, 3 on history, 2 on literature, and 1 on philology, psychology, geography, geology and nautical science, and 2 overviews of Portuguese contributions.

26 J. VICENTE GONÇALVES, "Análise do Livro VIII dos "Principios Mathematicos" de José Anastácio da Cunha" in *Congresso do Mundo Português, Discursos e comunicações apresentadas ao Congresso da História da actividade científica portuguesa (VIII Congresso), Tomo 1º, 1ª secção (ciências físico-matemáticas e militares)*, XII (1940), pp. 123-140. For once this was not an undue priority claim.

27 MÁRIO AUGUSTO DA SILVA, "A actividade científica dos primeiros directores do Gabinete de Física que a reforma pombalina criou em Coimbra em 1772 – A descoberta, feita em Coimbra, da lei das

acções magnéticas," in *Congresso* (cit. note 26), pp. 291-305.

28 DALLA BELLA, "Memórias sobre a Força Magnética," *Memorias da Academia Real das Sciencias de Lisboa*, 1797, 1: 85-199.

29 LUÍS DE PINA, "Cultura e actividade científica em Portugal no século XVI. Nota," in *Congresso do Mundo Português, Discursos e comunicações apresentadas ao Congresso da História da actividade científica portuguesa (VIII Congresso)*, XIII (1940), pp.625-631; "Os portugueses mestres de ciências e letras no estrangeiro (resumo)," in *Congresso* (cit. note 29), pp.611-624.

30 JOSÉ GONÇALO SANTA RITA, "A investigação científica portuguesa nos últimos 100 anos," in *Comissão Executiva dos Centenários, Congresso do Mundo Português, Memórias e Comunicações apresentadas ao Congresso Colonial (IX Congresso), Tomo 1º, I Secção*, XIV (1940), pp. 13-29.

31 For example RÓMULO DE CARVALHO, *História do Átomo* (Coimbra: Atlântida Editora, 1962), *História da Radioactividade* (Coimbra: Atlântida Editora, 1969).

32 RÓMULO DE CARVALHO, *A Física Experimental em Portugal no século XVIII* (Lisboa: Biblioteca Breve, 1982), *A Astronomia em Portugal no século XVIII* (Lisboa: Biblioteca Breve, 1985), *A História Natural em Portugal no século XVIII* (Lisboa: Biblioteca Breve, 1987).

33 RÓMULO DE CARVALHO, "Joaquim José Soares dos Reis, construtor das máquinas de física do Museu Pombalino da Universidade de Coimbra," *Vértice* (1958), 177: 1-8, "João Chevalier, astrónomo português do século XVIII," *Memórias da Academia das Ciências*, 1992-93, 32: 297-332, "Bento de Moura Portugal, homem de ciência no século XVIII," *Memórias da Academia das Ciências*, 1993-94, 33: 153-224.

34 RÓMULO DE CARVALHO, *História da Fundação do Real Colégio dos Nobres de Lisboa* (Coimbra: Universidade, 1959), *História do Gabinete de Física da Universidade de Coimbra (1772-1790)* (Coimbra: Universidade, 1978), Rómulo de Carvalho, "A Física na Reforma Pombalina" in *História e Desenvolvimento da Ciência em Portugal-I Colóquio-até ao século XX* (Lisboa: Academia das Ciências de Lisboa, 1986), *A Actividade pedagógica da Academia das Ciências de Lisboa nos séculos XVIII e XIX* (Lisboa: Academia das Ciências de Lisboa, 1981).

35 RÓMULO DE CARVALHO, *História do Ensino em Portugal, desde a fundação da nacionalidade até o fim do regime de Salazar-Caetano* (Lisboa: Fundação Calouste Gulbenkian, 1986).

36 RÓMULO DE CARVALHO, *Relações entre Portugal e a Rússia no século XVIII* (Lisboa: Sá da Costa, 1979), "Portugal nas 'Philosophical Transactions' nos séculos XVII e XVIII," *Separata da Revista Filosófica*, 1956: 15-16, "Relações Científicas do Astrónomo francês Joseph-Nicolas de Lisle com Portugal," *Arquivo de Bibliografia Portuguesa*, 1964-1966: 37-38, 27-48. Some of these works were compiled in *A Actividade Científica em Portugal no século XVIII* (Évora: Universidade de Evora, 1996).

37 Different historiographical trends in the historiography of Jesuit science in Portugal are discussed in Henrique Leitão, "A História da Ciência e a revista *Brotéria*," in *Fé, Ciência, Cultura: Brotéria – 100 anos* edited by Hermínio Rico and José Eduardo Franco (Lisboa: Gradiva, 2003), pp.327-350.

38 RÓMULO DE CARVALHO, "A pretensa descoberta da lei das acções magnéticas por Dalla-Bella em 1781 na Universidade de Coimbra," *Revista Filosófica*, 1954, 11: 103-138.

39 J.J. DIONÍSIO, "Luís de Albuquerque professor e cientista," in *Luís de Albuquerque historiador e matemático. Homenagem de amizade a um homem de ciência* (Lisboa: Chaves Ferreira, 1998), pp. 115-125.

40 LUÍS DE ALBUQUERQUE, "As navegações e as origens da mentalidade científica" in António José Saraiva, Oscar Lopes, Luís Albuquerque, *História da Cultura em Portugal* (Lisboa: Jornal do Foro, 1955), vol.2, pp.369-507.

41 A rather exhaustive list of Albuquerque's contributions together with biographical details is compiled Francisco Contento Domingues, "Bibliografia," in *Albuquerque* (cit. note 39), pp. 11-94. Some compilations of Albuquerque's papers are: *Estudos de História*, vols.1 to 5 (Coimbra: Biblioteca Geral da Universidade de Coimbra-AUC, 1974-7); *Ciência e experiência nos Descobrimientos Portugueses* (Lisboa: Biblioteca Breve, 1983); *As Navegações e a sua projecção na Ciência e na Cultura* (Lisboa: Gradiva, 1987); *Dúvidas e certezas na História dos Descobrimientos Portugueses* (Lisboa: Vega, 1991); *Para a História da Ciência em Portugal* (Lisboa: Livros Horizonte, 1973).

42 LUÍS DE ALBUQUERQUE, "A astrologia e Gil Vicente," *Separata dos Arquivos do Centro Cultural Português*, 1971: 3, 54-75.

43 JOAQUIM BENSÁUDE, *L'Astronomie nautique au Portugal à l'Époque des Grandes Découvertes* (Bern: Akademische Buchhandlung von Max Drechsel, 1912); *Lacunes et surprises de l'Histoire des Découvertes maritimes* (Coimbra: Imprensa da Universidade, 1930); Luciano Pereira da Silva, *Obras Completas*, 3 vols.

(Lisboa: Agência Geral das Colónias, 1943-6)

44 Quoted in WILCOMB E. WASHBURN, "Luís de Albuquerque in the USA" in *Albuquerque* (cit. note 39), pp.166-168, p. 167.

45 W.G.L. RANGLES, "Luís de Albuquerque and the history of nautical science in Portugal" in *Albuquerque* (cit. note 39), pp.135-142.

46 R. HOOYKAAS, "Contexto e razões do surgimento da ciência moderna" ("Context and factors behind the emergence of modern science") in *A Abertura do Mundo. Estudos de História dos Descobrimentos Europeus*, vol. 1, edited by Francisco Contente Domingues and Luís Filipe Barreto (Lisboa: Editorial Presença, 1986), pp. 165-182, p.182.

47 In an unpublished manuscript titled "Os descobrimentos: tempos de mutação" Albuquerque claimed: "in my opinion the period of the great transoceanic navigations accelerated in an irreversible way the bursting of modern science, right at the beginning of the 17th century, starting certainly with Galileo" in *Albuquerque* (cit. note 39), pp.231-238, p.231.

48 LUÍS DE ALBUQUERQUE, "Professor R. Hooykaas and the History of Sciences in Portugal," *Janus*, 1977, 64: 1-13, p. 4.

49 In 1966 Hooykaas delivered a lecture on "The Portuguese Discoveries and the Rise of Modern Science" at the International Academy of Portuguese Culture, which elected him a member. He stated that "the Portuguese seafarers and scientists of the 15th and 16th centuries made an important contribution to the rise of modern science by unintentionally undermining the belief in scientific authorities and by strengthening the confidence in an empirical, natural-historical method". Cited in ALBUQUERQUE, "Hooykaas" (cit. note 49), p.8. He was also invited by Albuquerque and Armando Cortesão to participate in the First International Conference on the History of Nautical Sciences, which took place in Coimbra in 1968. See FRANCISCO CONTENTE DOMINGUES, "International Commission for the History of Nautical Sciences and Hydrography," *e-Journal of Portuguese History*, 2004, 2: 1-5.

50 RÓMULO DE CARVALHO, "Bibliografia das obras de autores nacionais publicadas durante o século XX que se ocupam das actividades científica e técnica dos portugueses nos séculos anteriores," in *História e Desenvolvimento da Ciência em Portugal no século XX*. Publicações do II Centenário da Academia das Ciências de Lisboa, vol. 3 (Lisboa: Academia das Ciências de Lisboa, 1992), pp.1781-1922.

51 Allen Debus contributed a historical paper focusing on chemistry and iatrochemistry in early 18th century Portugal and Spain, and William Shea discussed from a philosophical point of view current trends in the history and philosophy of science, paying specific attention to Kuhn's and Feyerabend's proposals. Hooykaas was the other foreign invitee but did not contribute a paper.

52 LUÍS DE ALBUQUERQUE, "A contribuição portuguesa para o conhecimento do magnetismo terrestre no século XVI," in *História e Desenvolvimento da Ciência em Portugal*, vol.1 (Lisboa: Academia das Ciências de Lisboa, 1986), pp.169-190; "A cartografia portuguesa dos séculos XV a XVII," in *História e Desenvolvimento da Ciência em Portugal*, vol.2 (Lisboa: Academia das Ciências de Lisboa, 1986), pp.1061-1084.

53 This paper is authored by a Portuguese, professor at Brown University, USA. ONÉSIMO TEOTÓNIO ALMEIDA, "Sobre o papel de Portugal nas etapas preliminares da Revolução Científica do século XVII" in *História*, vol.2 (cit. note 52), pp.1173-1222.

54 RESINA RODRIGUES, "Física e filosofia da natureza na obra de Inácio Monteiro," in *História*, vol.1 (cit. note 52), pp.191-242.

55 J. PEREIRA OSÓRIO, "Sobre a história e desenvolvimento da astronomia em Portugal," in *História*, vol.1 (cit. note 52), pp.111-142.

56 *Commemorative Practices in Science. Historical Perspectives on the politics of collective memory* edited by Pnina Abir-Am and C.A. Elliott, *OSIRIS* 1999: 14.

57 S.G. BRUSH, "Scientists as historians," *OSIRIS*, 1995: 10, 215-231.

58 A Portuguese Society for the History and Philosophy of Science was founded in 1988 but its existence never went beyond the formalities of its creation.

59 We refer specifically to two series of books which are being published by the well-known publisher Porto Editora starting in 2003: the first is titled *History and Philosophy of Science* (so far 10 volumes came out) and is organized by Ana Simões and Henrique Leitão; and the second is called *Science and Enlightenment* (so far 5 volumes came out) and is organized by Ana Simões, José Luís Cardoso and Francisco Contente Domingues.

60 CONCEIÇÃO TAVARES, HENRIQUE LEITÃO, *Bibliografia de História da Ciência em Portugal 2000-2004* (Lisboa: Centro de História das Ciências da Universidade de Lisboa, 2006).

61 In this quantitative assessment we just listed original publications authored by Portuguese, not edited volumes or proceedings.

62 KOSTAS GAVROGLU, MANOLIS PATINIOTIS, FAIDRA PAPANELOPOULOU, ANA SIMÕES, ANA CARNEIRO, MARIA PAULA DIOGO, JOSÉ RAMÓN BERTOMEU SÁNCHEZ, ANTONIO GARCÍA BELMAR, AGUSTÍ NIETO-GALAN, "Science and Technology in the European Periphery. Some historiographical reflections", accepted for publication in *History of Science*, and references therein to the output of the STEP group. For a local example see ANA SIMÕES, MARIA PAULA DIOGO, ANA CARNEIRO, *Cidadão do Mundo. Uma biografia científica do Abade Correia da Serra* (Porto: Porto Editora, 2006).