

Surveyors of the Promised Land: hydrographic engineers and the techno- scientific resurgence of the Portuguese overseas empire (c. 1900–1935)

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Abstract

Hydrographic engineers played an important role in several techno-scientific endeavours, in Portugal and in her colonial empire. However, they have received little attention outside the intellectual circles of the Portuguese War Navy. This paper presents a comparative overview of the life-paths and careers of three hydrographic engineers: Ernesto de Vasconcelos (1852–1930), Augusto Ramos da Costa (1865–1939), and Hugo de Lacerda (1860–1944) and provides a general description of what it meant to be such an engineer in Portugal during the late nineteenth century and the first decades of the twentieth. The importance of personal agency in mobilizing the resources available to this community is also highlighted. The careers of Vasconcelos, Ramos da Costa and Lacerda are thus analysed in terms of their personal agendas, their relations with the political tapestry of coeval Portugal, and their activities towards production of textbooks, cartography, the constitution of their audiences, and the foundation of astronomical and meteorological observatories. These activities are framed in the broader picture of an ideal of imperial resurgence — in Vasconcelos’ words, a “Promised Land”, which was to be conquered by science and technology.

Keywords: Hydrography, military engineers, empire, colonialism, textbooks, cartography, popularization of science, observatories

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1 . Introduction

On 17 April 1901, Ernesto de Vasconcelos (1852–1930) delivered a speech to the Lisbon Geographical Society (Sociedade de Geografia de Lisboa, henceforth SGL) in which he put forward the vision of a great maritime empire centred in Lisbon and connecting the ports of the mainland, the islands of Azores and the overseas colonies under Portuguese rule – Cape Verde, Portuguese Guinea, S. Tomé and Príncipe, Angola, Mozambique, Goa, Macau and Timor. This re-enactment of the Portuguese empire, Vasconcelos claimed, required the preparation of technical personnel especially suited to deal with colonial affairs. As far as colonialism was concerned, Africa was his priority: it was urgent, he added, to make propaganda for the Portuguese domains in the Dark Continent. In Vasconcelo’s own words, “our Africa is not a no-man’s-land, it is rather the Promised Land, from where our welfare, tranquillity and wealth will come.”¹ In the following year, Ramos da Costa (1865–1939) addressed the National Maritime Congress, promoted by the Portuguese Naval League, with a call for the renewal of national fisheries, through the renovation of equipment and techniques, and the education of fishermen. He also appealed for the development of colonial fisheries.² Five years later, on 2 December 1907, the SGL convened to hear Hugo de Lacerda (1860–1944) reporting on the on-going enhancement of the port in Lourenço Marques (nowadays Maputo), Mozambique.³ After addressing several aspects of the port project that he was coordinating, Lacerda proudly described the hydrographic survey he had conducted in Lourenço Marques Bay, emphasizing its moral value as a proof of Portugal’s commitment to her colony. He further informed his audience about a new observatory already under construction in the area of the port.

Vasconcelos, Ramos da Costa and Lacerda (Figs. 1, 2 and 3) were three Portuguese hydrographic engineers (EHs).⁴ Only naval officers—that is, naval personnel who had received higher education from the Lisbon Naval School—could apply for the title. Successful candidates were required to pursue a programme of advanced training, which involved the Polytechnic

¹ Ernesto de Vasconcelos, *As colónias nas suas relações com o mar* (Lisboa: Sociedade de Geografia, 1901), p. 15.

² A. Ramos da Costa “O estudo profissional das pescas e a educação das populações marítimas”, in *Liga Naval Portuguesa, Congresso Marítimo Nacional de 1902 – 1ª sessão* (Lisboa: Typographia La Bécarre, 1902), pp. 3–5.

³ Hugo de Lacerda, *O Porto de Lourenço Marques* (Lisboa: Centro Typographico Colonial, 1907).

⁴ This acronym is used in Portugal to indicate the title of “engenheiro hidrógrafo,” and will be employed in the remainder of this paper.

School of Lisbon, the Army School, the Astronomical Observatory of Lisbon, and the Infante D. Luiz Meteorological Observatory, as well as a complementary course at the Naval School. Only then could they become professional surveyors of maritime and fluvial waterfronts. This was, at least, their official function. The quotations above suffice to reveal that the interests and agendas fostered by Vasconcelos, Lacerda and Ramos da Costa went far beyond hydrographic charts and surveys. They equally hint at the effort placed by the three EHs in persuading their audiences of the goodness of their ideas and pursuits.



Figs. 1, 2 and 3 - Ernesto de Vasconcelos (1852-1930), Augusto Ramos da Costa (1865-1939) and Hugo de Lacerda (1860-1944) (Instituto Hidrográfico, <http://www.hidrografico.pt>).

The three of them reached the rank of admiral, not so much for their military deeds, but mainly for the sound careers they paved as state servants and lecturers in higher education institutions. Ernesto de Vasconcelos⁵ completed the course of the Naval School in 1874. He played a prominent role in the Cartographic Board of the Ministry of the Navy, an entity that coordinated the cartography of colonial domains; he also acted as envoy of the Portuguese Government in geographical conferences and negotiations with other colonial sovereignties. Vasconcelos held teaching commitments throughout his whole career. He held the chair of Chronometers, Compass Needles and Meteorology at the Naval School, and taught colonial

⁵ Unless otherwise stated, elements for this brief biographical sketch, as well as others cited throughout the text, are taken from the following sources: António Costa Canas, “Ernesto de Vasconcelos 1852–1930”, in Francisco Roque de Oliveira (ed.), *Leitores de mapas: dois séculos de história da cartografia em Portugal* (Lisboa: Biblioteca Nacional/CEG/CHAM, 2012), pp. 69–79; Moura Braz, *Almirante Ernesto de Vasconcelos* (Lisboa, 1953); “Ernesto de Vasconcelos”, *Portugal em África* 19, 1895: 703–708.

geography at the School for Higher Colonial Studies (Escola Superior Colonial), a function he maintained until the last days of his life.

Lacerda⁶ started his naval studies in 1879, after a brief passage with the Land Army. He entered the career of naval officer in 1885, and obtained the title of EH six years later. Between 1897 and 1902 he taught hydrography at the Naval School. In the ensuing decades he held several appointments in Mozambique, S. Tomé and Príncipe and Macau, conducting the improvement of these colonies' ports. In 1912 he launched the Hydrographic Mission of the Portuguese Coast (Missão Hidrográfica da Costa de Portugal, MHCP). In 1926 he was appointed interim governor of Macau. After official retirement, he participated actively in reformations of the teaching of hydrography in Portugal, and in the construction of a new naval arsenal in the metropolis.

Ramos da Costa⁷ began his military studies in 1883, completed the course of the Naval School two years later, and entered an officer's career in 1887. After obtaining the title of EH and serving in a naval commission for buoys and maritime signals, he was entrusted, in 1897, with the verification of the compass needles used in state vessels. At the Naval School, Costa held a chair of Astronomy and Navigation and trained aspiring EHs. He also taught Topography and Geodesy in the Army School, and played an important role in national timekeeping affairs.

The fact that these EHs (especially Vasconcelos and Ramos da Costa) developed their careers in activities other than surveying is by no means unusual in the historical panorama of Portuguese hydrography.⁸ EHs constituted a naval technical elite whose members were frequently deployed to other functions. In 1869, the Portuguese Hydrographic Corps (Corpo de Engenheiros Hidrógrafos) was established to survey the mainland and above all the colonies. But practically none of its members was assigned colonial service. Charts of colonial waterfronts were usually produced by non-specialized officers deployed overseas, based on the immediate needs of local navigation. Most EHs worked instead in the renovation of the port of Lisbon (which developed throughout the last quarter of the nineteenth-century), took appointments at the observatories of the mainland, or taught in the military schools. The situation was aggravated by

⁶ Biographical elements on Lacerda are drawn from Livros-Mestre B, D, F, H, J and several documents in box 730 of the Historical Archive of the Portuguese Navy, Lisbon.

⁷ For a brief biography see Teixeira de Aguiar et al., *A Marinha na Investigação do Mar* (Lisboa: Instituto Hidrográfico, 2000), p. 58.

⁸ For an overview of the history of Portuguese hydrography see Teixeira de Aguiar et al, op. cit.

the fact that the Hydrographic Corps was a small and elitist body, limiting its staff to eight hydrographers and never admitting more than two new members per year. In 1895, its inefficacy was officially recognised; the Corps was dissolved, leaving Portuguese hydrography in an even looser situation.

However, the dispersal of hydrographers by other appointments and functions favoured the deployment of their expertise beyond the military sphere, and allowed them to foster their own agendas. The purpose of this paper is to shed light on how they did this. The careers of Vasconcelos, Lacerda and Ramos da Costa provide three cases in point. It is advantageous to approach them comparatively as each of the three hydrographers sought to incarnate a different *persona*:⁹ Vasconcelos, that of an imperial mastermind controlling the scientific re-enactment of the Portuguese empire from the metropolis; Lacerda, an expert of colonial ports, and, as such, a bringer of colonial prosperity and weaver of imperial connections; Ramos da Costa, a unifier of space and earth sciences for the sake of the nation's resurgence.

By fashioning themselves in these directions the three hydrographers combined official duties with their own personal outlooks. Those were challenging times for men who swore to serve a country the feted maritime glories of which were but shades of a distant, and to a great extent romanticized past. By the turn of the twentieth century Portugal was struggling to revamp itself politically whilst reviving her overseas empire. After the independence of Brazil in 1822, imperial aspirations diverted towards Africa. In the 1870s, when the so-called 'Scramble for Africa' spurred colonial ambitions in Europe, the hinterlands of Angola and Mozambique remained largely unexplored.¹⁰ Traditionally, Portugal had branded the argument of historical occupation to justify her sovereignty, but after the Berlin colonial conference of 1884-5 it was effective occupation that counted. Over the next decades Portugal had to craft her colonial policies in an arena of imperial powers largely dominated by England. Issues with the empire had a tremendous impact on the life of the metropolis. On 11 January 1890, British authorities compelled the Portuguese to retreat from disputed territories in Mozambique. The episode,

⁹ It must be noted that I am not looking here for "scientific personae" in the sense proposed by Daston and Sibum, that is, for scientific types of persons corresponding to certain social species (see Lorraine Daston & Otto Sibum, "Introduction: Scientific Personae and Their Histories", *Science in Context*, 16, 2003: 1-8). I am rather concerned with the idiosyncratic ways in which the hydrographers under focus sought to steer their personal interests and agendas, notwithstanding their common training, motivations and strategies.

¹⁰ Maria Manuela Lucas, "Organização do Império", in José Mattoso (ed.-in-chief.), Luís Reis Torgal, João L. Roque (vol. eds.), *História de Portugal*, Vol. V: *O Liberalismo* (1807-1890) (Lisboa: Editorial Estampa, 1993), pp. 246-266.

known as the British Ultimatum, shook the very foundations of the Portuguese liberal monarchy, triggering perceptions of imperial fiasco and international abashment that ultimately gave way to the implantation of a Republican regime in October 1910.¹¹ Fuelled by positivist tenets and ideals of social justice and universal education, Republicanism fully embraced empire as the ultimate panacea for the downtrodden nation. The new regime, however, was chronically plagued by political instability and social unrest.¹²

In the remainder of this paper I shall illustrate how Vasconcelos, Lacerda and Ramos da Costa steered their agendas through these troubled times. In section 2, the training they received will be summarily described. Their projects and outlooks are then outlined in section 3. In section 4, I describe how they positioned themselves in the complex political tapestry of the period. Section 5 addresses their cartographic undertakings, and section 6 their activity as authors of textbooks. In section 7 I analyse the strategies they employed to build wider audiences; finally, in section 8, I address their observatory projects.

2. Hydrographic engineers in the making

To become an EH a long track of study and training was required. First, it was necessary to attain the career of naval officer. Aspiring officers began by engaging in preparatory studies at the Polytechnic School of Lisbon,¹³ where they had to obtain approval in the chairs of mathematics and physics. Then they would move to the Naval School,¹⁴ to spend at least two years attending courses organized into five chairs, which covered topics such as spherical astronomy, artillery, naval architecture and fortification. The third chair included notions of hydrography but only at

¹¹ Maria Cândida Proença, “A questão colonial”, in Fernando Rosas, Maria Fernanda Rolo (eds.), *História da Primeira República Portuguesa* (Lisboa: Tinta da China, 2010), pp. 205–228; Sérgio Campos Matos, “A crise do sistema constitucional”, in João Medina (ed.), *História de Portugal*, vol. XI (Amadora: Ediclube, 2004), pp. 381–414; Nuno Severiano Teixeira, *O Ultimatum inglês: política externa e política interna* (Lisboa: Alfa, 1990).

¹² op. cit

¹³ The Polytechnic School of Lisbon (Escola Politécnica de Lisboa) was founded in 1837, in the context of the liberal reforms of higher education in Portugal. It provided a techno-scientific education to aspiring military officers and state servants. See Ana Simões et al., *Uma história da Faculdade de Ciências da Universidade de Lisboa (1911–1974)* (Faculdade de Ciências da Universidade de Lisboa, 2013), pp. 19–25.

¹⁴ The Naval School was founded in Lisbon in 1845 to provide techno-scientific training to aspiring Naval officers. On its origins and early history see Ana Patrícia Martins, *Daniel Augusto da Silva e o cálculo actuarial*, unpublished doctoral thesis, University of Lisbon, 2013 (especially chapter 1).

an elementary level.¹⁵ During and after attendance of the Naval School, cadets embarked a ship several times to practice the art of seafaring and to adapt themselves to life on-board. Besides finishing the courses of the Naval School, they needed to complete three years of naval service outside the river Tejo in order to become officers. This service usually took them to the overseas colonies, giving them the chance to visit, at least, their coastal areas.

Basic hydrographic surveys were sometimes carried out during these missions, but those willing to obtain the title of EH had to apply for an additional plan of studies that included courses in: Mechanics, Descriptive Geometry, and Astronomy and Geodesy at the Polytechnic School of Lisbon; Practical Geodesy, Topography and Drawing, and Canals and Rivers, at the Army School; and Hydrography, one-year advanced, taught at the Naval School by an experienced EH.¹⁶

An observatory apprenticeship of one year followed. Contrary to countries such as England, France, and the USA, Portugal had no naval observatory. The Royal Observatory of the Navy, founded in Lisbon in 1798, had rotated to various locations and functioned in precarious conditions for most of its existence. After a few decades at the Navy arsenal in Lisbon, it was officially closed in 1874.¹⁷ The Astronomical Observatory of Lisbon (Observatório Astronómico de Lisboa, OAL) and the Infante D. Luis Meteorological Observatory (Observatório Meteorológico do Infante D. Luís, OMIDL) functioned as surrogate naval observatories. Notwithstanding their civilian status, they were run by naval officers. The OAL was founded in 1857.¹⁸ It was initially meant to focus on the measurement of stellar parallax but, facing a dearth of qualified personnel, first director Frederico Augusto Oom (1830–1890) and sub-director Campos Rodrigues (1836–1919) chose to focus on timekeeping. By the mid-1880s

¹⁵ The five chairs were the following: 1– Elements of mechanics; spherical and nautical astronomy; 2– Principles of optics, practice of astronomical observations and navigational computing, performance of a complete journey; 3– Theoretical and practical artillery, principles of provisional fortification, geography and hydrography; 4– Naval architecture and technical drawing; 5– Naval manoeuvres and tactics. Complementary activities included fencing, swimming and military exercises. See Vicente Almeida de Eça, *Nota sobre os Estabelecimentos de Instrução Naval em Portugal principalmente sobre a Escola Naval* (Lisboa: Imprensa Nacional, 1892).

¹⁶ This course was attended only by naval officers studying for the title of EH; it must not be confounded with the chair of hydrography mentioned later in this paper, which was part of the officers' general training.

¹⁷ Similarly to the EPL, the Army School (Escola do Exército) resulted from the liberal reformations of higher education implemented in the mid-1830s. It played a central role in the training of state engineers who conducted important infra-structural projects. See Marta Macedo, *Projectar e Construir a Nação. Engenheiros, ciência e território em Portugal no século XIX* (Lisboa: Imprensa de Ciências Sociais, 2012).

¹⁸ For an overview of the foundation and early history of the OAL see Pedro M. P. Raposo, "Observatório Astronómico de Lisboa: um observatório nacional na Universidade", in Marta C. Lourenço, Maria João Neto (eds.), *Património da Universidade de Lisboa: Ciência e Arte* (Lisboa: Universidade de Lisboa/Tinta da China, 2011), pp. 99–105.

the OAL started to display its time signals to the port of Lisbon through a time-ball installed in the area of the Navy arsenal. The apparatus of the time-ball was also used to relay time signals to other institutions and services. Gradually, the OAL gained prominence as the national timekeeper. The exactness of time signals became a badge of the observatory's commitment to precision. This was, to a great extent, due to Campos Rodrigues' investigations in instrumentation, observing techniques, and computing methods.¹⁹ F. A. Oom and Rodrigues were both EHs, which reinforced the connection between the OAL and the hydrographic profession. Besides Campos, Rodrigues was regarded as a technical virtuoso, being frequently requested to give his advice on issues related to astronomy, geodesy, and other mathematical matters. Thus he became a scientific hero of Portuguese naval officers. Although obsessively low profile, he exerted a major influence over the trainee hydrographers who practised at the OAL. Under Rodrigues's guidance, Vasconcelos, Lacerda, Ramos da Costa and several other EHs observed with sextants and other portable instruments, performed transit observations by eye and ear and by the then called American method,²⁰ studied instrumental and observing errors, and measured their personal equations.²¹

After six months at the OAL, trainee EHs moved to the OMIDL, where they spent another six months carrying out meteorological and magnetic observations. The OMIDL was founded in 1853, to function as a centre of calculation for meteorology in the country and the overseas empire, and also to coordinate meteorological observations carried out aboard Portuguese war vessels.²² Similarly to the OAL, the OMIDL was a civilian institution but it developed a strong link with the War Navy, especially because of naval officer João Carlos de Brito Capelo (1831–1901). Capelo was admitted as an “observer” in 1855, and promoted to director in 1875, a post he held until his death. Capelo became an internationally well-connected

¹⁹ Pedro M. P. Raposo, “Charming tools of a demanding trade: the heritage of nineteenth-century astrometry at the Astronomical Observatory of Lisbon”, *Rittenhouse – The Journal of the American Scientific Instrument Enterprise* 22, 2008: 25–46.

²⁰ In the eye and ear method, the observer listened attentively to the beats of a clock and estimated the fraction of a second corresponding to the transit of the star by a reticule wire. In the American method, an electric chronograph was used to record both the signals from the clock and the signals from the observer, who pressed (or released) a switch in the moment he saw the star crossing the wire.

²¹ In this context, the personal equation corresponds to the individual error in the observation of star transits. This is an important topic in the historiography of astronomy. See Jimena Canales, *A Tenth of a Second: a History* (Chicago and London: The University of Chicago Press, 2009), esp. chapter 2.

²² See Conceição Tavares, *Albert I do Mónaco, Afonso Chaves e a Meteorologia nos Açores. Episódios oitocentistas da construção científica do mundo atlântico* (Lisboa: Sociedade Afonso Chaves/Centro Inter-Universitário de História da Ciência e da Tecnologia, 2009), pp. 55–61.

and renowned pursuer of astronomical, meteorological and magnetic investigations. His work covered topics such as the patterns of winds and currents in the Atlantic Ocean, the deviations of the compass needle at sea, and the relation between sunspots and terrestrial magnetism.²³ To the eyes of EHs and naval officers in general, Capelo was to geophysics what Rodrigues was to astronomy: the model of an accomplished naval scientist. Their influence on the three hydrographers under focus in this paper was paramount.

After the observatory apprenticeship, trainees engaged in actual hydrographic surveys for roughly one year, in order to obtain the title of EH. At this stage they were fully prepared, on paper, to tame both metropolitan and colonial shores. But Vasconcelos, Lacerda and Ramos da Costa had much higher ambitions.

3. Scientific agendas and imperial outlooks

The Lisbon Geographical Society (SGL) (fig. 4) was founded in 1875, in the wake of the “Scramble for Africa”. Its foundation was spurred on by the International Geographical Conference convened for that year, and emulated the geographical societies of Paris and London. Luciano Cordeiro (1844–1900), a politician and humanities teacher, steered the SGL with the aim of empowering Portugal against colonial competitors, through the scientific exploration of her overseas colonies, especially those in Africa.²⁴ Vasconcelos joined the SGL in the very year of its foundation. In 1900 he succeeded Cordeiro as secretary; in 1911, he was elevated to Perpetual Secretary.

Faithful to the Society’s tenets, Vasconcelos approached the re-enactment of Portugal’s maritime empire essentially as a scientific matter, the success of which depended on systematic research and study. Upon his promotion to Perpetual Secretary, Vasconcelos started to fashion himself as the imperial mastermind in control of these efforts. In the same year he presented a comprehensive research plan, which was promptly approved by the SGL.²⁵ The plan was divided

²³ Vítor Bonifácio, Isabel Malaquias, João Fernandes, “Solar photography in the nineteenth century: the case of the Infante D. Luiz Observatory in Lisbon (1871–1880)”, *Journal of Astronomical History and Heritage* 10, 2007: 101–113; António Costa Canas, Paulo A. R. da Silva, “O Desenvolvimento das Ciências Geofísicas em Portugal no século XIX. Contribuição de Brito Capelo”, in *Colóquio Vasco da Gama: Os Oceanos e o Futuro* (Alfeite: Escola Naval, 1999).

²⁴ Instituto de Investigação Científica Tropical, *Da Comissão de Cartographia (1883) ao Instituto de Investigação Científica Tropical (1983). 100 Anos de História* (Lisboa: Instituto de Investigação Científica Tropical, 1983), pp. 21–26.

²⁵ Ernesto de Vasconcelos, *Relatório acerca do Estudo dos Problemas Coloniais* (Lisboa: Typographia Minerva, 1913).

into four major sections: 1) geography (including surveying and identification of natural resources) and ethnographic investigations; 2) economy (laws to enforce native work, transport, banking system, taxes and navigation); 3) colonial administration (administration systems, autonomy, education, armed forces); 4) colonial policy (best strategies to achieve colonial domain, and relations with colonial nations). The investigations extended over almost a decade.²⁶ Vasconcelos partook in some of the studies. One of his favourite topics was colonial meteorology, as he believed that the knowledge of climate was essential to select suitable locations for new European settlements (see section 7).



Fig. 4 - A depiction of the Lisbon Geographical Society in 1901 (*O Occidente*, XXIV, no. 794, 1901, p. 12)

Vasconcelos persistently associated the rational exploration of the empire with the utopian idea of a “promised land”. If properly studied and efficiently administrated, he claimed, the overseas colonies would provide employment to civil servants and the military, host vast agricultural undertakings, and give entrepreneurs the chance to accumulate wealth that a benevolent tax system would redistribute in the metropolis.²⁷ To attain this prosperous state it was necessary not only to gain the respect of colonial competitors, but also to wipe out all resistance

²⁶ The final reports were published in 1920. See Ernesto de Vasconcelos (ed.), *Questões Coloniais e Económicas. Conclusões e pareceres, 1913–1919* (Lisboa: Tipografia da Cooperativa Colonial, 1920).

²⁷ Ernesto de Vasconcelos, *Portugal Colonial* (Lisboa: Livraria Colonial, 1918), p. 13.

from native populations. Vasconcelos did not discard violence as a means to fulfil this goal, but eloquently presented science and technology as the “modern weapons that replaced the rule of the sword.”²⁸ On the one hand, native populations would be tamed through the enforcement of laws carefully crafted on the basis of ethnographic studies, so that native habits and costumes were conveniently assimilated by the colonizer’s legal system. As Vasconcelos put it, referring to the native populations of Portuguese Guinea, “it is necessary to conduct those races just as a chess player conducts and distributes his pieces over the board, heading towards the final victory.”²⁹ An imposing colonial infrastructure—roads, railways, enhanced ports, etc.—would bring domain to completion: “everything that demonstrates our force and prevalence before the eyes of the niggers will result in their submission”, wrote Vasconcelos in 1895.³⁰ Besides vanquishing the natives and empowering colonial economies, Vasconcelos ultimately wanted to connect metropolis and colonies in a vast circuit of maritime trade, a modern version of the erstwhile seaborne empire. National navigation should thus collect the “moral and material advantages” of unfolding the Portuguese flag overseas.³¹

This vision of a re-enacted maritime empire was central in Lacerda’s scientific pursuits, which developed in connection with the enhancement of colonial ports. Hydrographic surveys constituted an important tool in this activity, as they revealed the configuration and dynamics of harbour coastlines, basins, tides, currents, etc. This knowledge was essential for a rational planning of the ports’ infrastructures (docks and wharfs, freight areas, transport connections, etc.) and their traffic. Lacerda was also concerned with charts as symbols of territorial possession, and with hydrographic activity as proof of scientific stamina. National authorship of charts constituted a seal of possession and domain. As Lacerda wrote in 1907, with respect to the survey of Lourenço Marques: “albeit of a moral order, one of the main advantages derived [from this undertaking] is that now we have a Portuguese chart, sparing us the shame of seeing foreigners doing it again. In the absence of other entitlements, the chart would suffice to sustain our rights

²⁸ “as armas modernas que substituíram o arbítrio da espada”, Ernesto de Vasconcelos, *Exposição colonial de algodão, borracha, cacau e café – catálogo* (Lisboa: Centro Typographico Colonial, 1906), p. X.

²⁹ Ernesto de Vasconcelos, *Guiné Portuguesa. Estudo elementar de geografia física, económica e política* (Lisboa: Tip. da Cooperativa Militar, 1917), p. 2.

³⁰ Ernesto de Vasconcelos, “Africa Portuguesa. Portos, emporios do futuro, estradas comerciais, caminhos de ferro, etc.”, *Portugal em Africa* 22, 1895: 990–995, on p. 993.

³¹ The quoted passages read, respectively, “vantagens morais e materiais” and “desfraldando mares em fora a nossa bandeira” (Ernesto de Vasconcelos, *Portugal Colonial*, p. 14).

over this port.”³² Consequently, Lacerda sought to endow the Portuguese Navy with the necessary basis of expertise, in number and skill, to survey the empire (a pressing need given the failure of the Hydrographic Corps). In section 5 it will be shown how he used the chair of hydrography of the Navy school for this purpose. Lacerda was also interested in meteorology and other observatory sciences, as shown in sections 6 and 7.

Ramos da Costa fostered interests in several scientific domains, but his most cherished topic was the integration of astronomical, atmospheric and oceanic research into what he called “astro-meteorology”. He started to write and lecture on this theme in earnest during the first years of the Republic. One of his first works on the subject, published in 1912, was entitled *The sun and its influence in agriculture, hygiene and navigation*.³³ As the title indicates, his concerns were not only scientific, but also societal. Against mainstream meteorological views, Ramos da Costa believed that precise weather forecast could be produced by means of a systematic study of the sun, together with lunar and planetary observations. This was a controversial line of inquiry but its pursuit by Jerome S. Ricard S.J. (1850–1930) at the Observatory of Santa Clara College (California) inspired the Portuguese hydrographer to proceed. From 1907 onwards, Ricard investigated the relations between sunspots and weather, receiving stark criticism from influential scientists such as George E. Hale (1868–1938), director of the Mount Wilson Observatory.³⁴ Ricard, however, was not deterred by the polemics, nor was Costa, who kept on promoting these inquiries in Portugal through various speeches, conference papers and publications.³⁵ By 1921 he was still confident that “astro-meteorology, under the aegis of astrophysics, is the only [approach] capable of supplying meteorology with the necessary elements to obtain forecasts with the desired

³² “ (...) embora de ordem moral, uma das principais vantagens que se colheu foi o ter-se agora uma carta portuguesa, evitando-se assim também, o quasi vexame de ella tornar a ser feita por estranhos. É ella um título que, se tantos outros não houvesse, nos daria direitos a este porto”, in Hugo de Lacerda, *O Porto de Lourenço Marques, 1907*, p. 11. Prior to this survey, the only existing charts of Lourenço Marques had been made by British officers; they were the “foreigners” mentioned by Lacerda.

³³ A. Ramos da Costa, *O Sol e a influencia solar na agricultura, hygiene e navegação* (Lisboa: Officina Typographica, 1912), p. 64.

³⁴ Agustín Udías, *Searching the Heavens and the Earth: The History of Jesuit Observatories* (Dordrecht: Springer, 2003), pp. 109–110.

³⁵ A. Ramos da Costa, *O Serviço Meteorológico e a Ciencia da Meteorologia* (Lisboa: Officina Tipográfica, 1914); *As vagas de calor (estudo astrometeorológico)* (Lisboa: Oficinas Gráficas da Biblioteca Nacional, 1922); *O estudo da electricidade atmosférica na Meteorologia, na Higiene e na Agricultura* (Lisboa: Imprensa da Livraria Ferin, 1925); *Valor absoluto do potencial electrico atmosferico* (Madrid: Huelves Y Compania, 1927); *Algumas contribuições para o estudo progressivo da moderna Oceanografia* (Lisboa: Imprensa da Armada, 1930).

precision”.³⁶ Astro-meteorology would reach the status of an exact science, he claimed, when the relations between atmospheric phenomena and motions of celestial bodies were convincingly demonstrated.³⁷

Inspired by investigations that related oceanic currents with pressure patterns and solar irradiation,³⁸ Costa also defended the integration of astro-meteorology with oceanography. The hydrographer approached oceanography and meteorology as twin sciences not only because of overlapping investigations, but also because of common utilitarian value. In his own words, “their knowledge [of oceanography and meteorology] is useful to all matters concerning the economy of life”.³⁹ Influenced by the French geologist-turned-oceanographer Julien Thoulet (1843–1936), who had studied fishing communities in the Newfoundland,⁴⁰ Costa believed that a rationalization of fisheries grounded on oceanography would foster economic development⁴¹ and improve the miserable lives of fishermen and their families.⁴² This concern for the lower classes was possibly an echo of Republican leanings. But Costa promoted astro-meteorology within a wider economic outlook. He also defended, for instance, the exploration of solar energy in Portugal,⁴³ and investigations on the use of atmospheric electricity for industrial purposes.⁴⁴

In order to develop these scientific agendas and pursuits, the three hydrographers essentially resorted to the same strategy, which consisted in being well placed in the state apparatus and well connected with politically influential civil entities, whilst avoiding explicit commitment to any party, sect, or even ideology.

³⁶ “(...) instituída sob os auspícios da Astrofísica, é a única que supomos capaz de fornecer os ensinamentos indispensáveis à Meteorologia, no sentido da previsão do tempo atingir a exatidão pretendida”, in A. Ramos da Costa, *Dois palavras sobre Astrometeorologia* (Coimbra: Imprensa da Universidade, 1921), p. 8.

³⁷ *Ibidem*, p. 9.

³⁸ A. Ramos da Costa, *A Astrofísica e a Mathematica na Oceanografia* (Lisboa: Imprensa da Armada, 1927); *O Sol e a influencia solar na agricultura, hygiene e navegação* (Lisboa: Officina Typographica, 1912); *Noções gerais de oceanographia contendo elementos de biologia do mar, pescas, observações, etc.* (Lisboa: Officina Typographica, 1910).

³⁹ “(...) o seu conhecimento aproveita a tudo que se refere à economia da vida”, in A. Ramos da Costa, *Algumas contribuições para o estudo progressivo da moderna Oceanografia*, p. 3.

⁴⁰ See Julien Thoulet, *A Voyage to New Found Land*, edited and translated by Scott Jamieson (McGill-Queen’s University Press, 2005).

⁴¹ A. Ramos da Costa, *A Astrofísica e a Mathematica na Oceanografia*, p. 15.

⁴² A. Ramos da Costa, *Noções gerais de oceanografia...*, p. III. See also reference in note 2.

⁴³ A. Ramos da Costa, *As vagas de calor* (1922).

⁴⁴ A. Ramos da Costa, *A captação de electricidade do ar para os usos industriais* (Coimbra: Imprensa da Universidade, 1921).

4. Inside and above politics

Early in his career, Vasconcelos acted as an agent of the Portuguese Government in missions such as the laying of submarine cables along the coast of Angola (1885–1887) and S. Tomé (1889), the determination of the boundaries of East Timor (1902), and the African region known as Barotseland (1904). In the last years of the Portuguese monarchy, he was Member of Parliament (MP) for the Progressive Party (Partido Progressista), head of cabinet of the Minister of the Navy, counsellor of kings Carlos and Manuel II, and tutor of geography for Carlos' son, prince Luís Filipe. Throughout his career Vasconcelos maintained close ties with the Ministry of the Navy and Overseas Affairs,⁴⁵ especially with its Cartographic Board, constituted in 1883 to boost and legitimize Portuguese colonialism by reuniting old and newly produced maps of the overseas territories.⁴⁶ He was thus well placed in the circuits and networks of power.

The SGL was also an important node in such networks, congregating influential politicians, academics, military officers and businessmen (and often individuals who played several of these roles at once) around the idea of imperial revival. The Society maintained close ties with the state apparatus through the circulation of its members by cabinet and administrative posts, and particularly through the Cartographic Board.⁴⁷ But after his ascending to Perpetual Secretary of the SGL, Vasconcelos increasingly sought to craft an apolitical image of the society, and also in fact of himself. The research programme he presented to the SGL was explicitly promoted with the goal of shaping a major plan of colonial administration to be implemented regardless of the party in cabinet.⁴⁸ In 1920 Vasconcelos proudly affirmed that he was involved exclusively with institutions such as the SGL, which had no “concerns and intentions typical of

⁴⁵ Note that in 1914 the Naval and Overseas affairs were separated into two distinct ministries: the Ministry of the Navy, and the Ministry of the Colonies.

⁴⁶ This commission was replaced, in 1936, by the Board of Geographical Missions and Colonial Investigations (*Junta das Missões Geográficas e de Investigações Coloniais*). Its modern successor is the Institute for Tropical Science (*Instituto de Investigação Científica Tropical*). For an overview of the origins and activity of the Cartographic Board, see Manuel Lobato, “A Comissão de Cartographia e a produção científica colonial portuguesa da monarquia constitucional à I República (1883–1936)”, in *Instituto de Investigação Científica Tropical, Viagens e Missões Científicas nos Trópicos* (Lisboa: IICT, 2010), pp. 13–18.

⁴⁷ It was named *Comissão Central Permanente de Geographia* (Permanent Board for Geography). Established by the Ministry of the Navy and Overseas Affairs in 1876, it was officially placed under the aegis of the SGL in 1880, with governmental support (note that the SGL was a private institution).

⁴⁸ Ernesto de Vasconcelos, *Relatorio acerca do Estudo dos Problemas Coloniais* (Lisboa: Typographia Minerva, 1913).

politics and sects, to which our spirit does not conform.”⁴⁹ He allegedly refused five invitations to lead the Ministry of the Navy,⁵⁰ with which he remained strongly involved nonetheless. The political instability of the first ten years of the Portuguese Republic and the last decades of the monarchy had certainly taught him that staying in the backstage of political life and lobbying the powers-that-be was more effective than partaking in short-lived cabinets.

Lacerda seems to have embraced the Republican ideals, but also kept a distance from the forefront of political life. In 1934 he delivered a eulogy to naval officers⁵¹ at the Naval Military Club in Lisbon.⁵² Naval officers had had a prominent role in the Republican coup d'état; but 24 years later, with Portugal already under the dictatorial regime of “Estado Novo” led by Oliveira Salazar (1889–1970),⁵³ Lacerda was careful to detach them from the political turbulence that had followed. There is no notice of Lacerda having been involved in the coup of 5 October 1910.⁵⁴ But by 1912 he was in the metropolis commanding the first survey of the Hydrographic Mission of the Portuguese Coast (MHCP).⁵⁵ A former royal yacht named Rainha D. Amélia (after Queen Amélia, King Carlos’s wife) was transformed into a hydrographic vessel especially for the purpose, and renamed “5 de Outubro” (5th October). One of Lacerda’s closer collaborators in the MHCP, Vitor Hugo de Azevedo Coutinho (1871–1955), would even lead a cabinet for a short period between December 1914 and January 1915.

In spite of almost a quarter of a century of instability, social unrest and financial havoc, which the Estado Novo now intended to overcome with stark rule and repression, in 1934

⁴⁹ “ (...) nao tem intuios ou preocupações de politicas ou de seitas, a que o nosso espirito não se subordina”, Ernesto de Vasconcelos, *Colonias Portuguezas III – S. Tomé e Príncipe, Estudo elementar de Geografia física, economica e política* (Lisboa: Tip. da Cooperativa Militar, 1916), p. 4. A similar statement is made, for example, in his introduction to the 1920 report on the research programme he promoted at the SGL (Ernesto de Vasconcelos (ed.), *Questões Coloniais e Económicas. Conclusões e pareceres, 1913–1919*, pp. 93–94).

⁵⁰ Carlos Faria e Maia in *Homenagem à memória do seu segundo Secretário Perpétuo o Almirante Ernesto de Carvalho e Vasconcellos falecido em 15 de Novembro de 1930 dedicada à sua Ex.ma família, pela Sociedade de Geografia de Lisboa* (Sociedade de Geografia de Lisboa, 1931), p. 44.

⁵¹ Hugo Carvalho de Lacerda Castelo Branco, *Notícia sobre serviços prestados ao País por oficiais da Armada Portuguesa além do que respeita à parte militar marítima: o valor dos serviços de fomento na Marinha* (Lisboa, 1934).

⁵² The *Clube Militar Naval* (Naval Military Club) was established in Lisbon in 1866, to congregare Navy officers around the defence of corporative privileges and the pursuit of technical, scientific and literary interests. See *Anais do Clube Militar Naval – Número especial comemorativo do 1º centenário do Clube Militar Naval, 1886–1966* (Lisboa, 1996).

⁵³ For a general picture of Salazar’s regime see José Mattoso (ed.-in-chief), Fernando Rosas (vol. ed.), *História de Portugal*, vol. 7: o *Estado Novo* (1926–1974) (Lisboa: Editorial Estampa, 1998).

⁵⁴ Records in the Historical Archive of the Portuguese Navy (Livro Mestre F, leaf 167; Livro Mestre H, leaf 127) suggest that he would have just arrived from Mozambique, although it is not clear if he was already in Lisbon when the coup d'état took place.

⁵⁵ For further details on the MHCP see section 5.

Lacerda was adamant as to the “purity of intentions” that had led the revolutionary officers, whom, he remarked, were not interested in the struggles between parties and sects but solely in shaping a new Portugal, on the mainland and overseas. This profile of the naval officer as an apolitical revolutionary acting for the imperial rebirth of the motherland was, to a considerable extent, an idealized self-portrait. After all, without committing himself politically, Lacerda had paved a sound career through prominent administrative positions in Mozambique, S. Tomé and Macau, and taken metropolitan appointments that, as shown in the next section, allowed him to introduce significant changes to the teaching and practice of hydrography.

Similarly to his fellow hydrographers, Ramos da Costa eschewed direct involvement with parliamentary and governmental politics, but held important positions in the state apparatus. Besides being entrusted with the verification of compass needles in state vessels, he was a member of a commission entrusted with the renewal of the time signals in the Port of Lisbon,⁵⁶ and director of the Department for Hydrography, Navigation and Nautical Meteorology, established in 1924. Costa also represented the Portuguese Government in the International Council for the Exploration of the Sea⁵⁷ and participated in the meetings that led to the foundation of the International Hydrographic Bureau in 1921. As already suggested, he might have fostered Republican sympathies, an hypothesis reinforced by his close involvement with the Academy of Sciences of Portugal (Academia das Ciências de Portugal, ACP). Journalist and self-styled mathematician António Cabreira (1868–1953) founded the ACP in 1907 as an alternative to the old Academy of Sciences of Lisbon.⁵⁸ Cabreira was a partisan of absolutism but shared with republicans a loathing for the declining liberal monarchy, which helped him to attract leading figures of the republican movement to the ACP.⁵⁹ After the 1910 revolution, the Republican authorities were quick to approve the statutes of the ACP and to turn it into an official academy of the regime,⁶⁰ entrusting it with the promotion and popularization of useful knowledge.

⁵⁶ See section 8.

⁵⁷ The International Council for the Exploration of the Sea was founded in 1902 in Copenhagen. On its origins and historical development see Helen M. Rozwadowski, *The Sea Knows No Boundaries. A Century of Marine Science under ICES* (University of Washington Press, 2002).

⁵⁸ *Documentos oficiais organizando, privilegiando e enaltecendo a Academia de Ciências de Portugal* (Coimbra: Imprensa da Universidade, 1916).

⁵⁹ Among them were Teófilo Braga (1843–1924), Bernardino Machado (1851–1944), and António José de Almeida (1866–1929), three prominent politicians who came to occupy the post of president of the Portuguese Republic.

⁶⁰ *Estatutos e Legislação da Academia das Ciências de Portugal* (Lisboa: Academia das Ciências de Portugal, 1915).

Cabreira, more akin to fame and prestige than to ideological coherence, was largely amenable to imprint this Republican drive to the ACP. Ramos da Costa is likely to have embraced it too, but, as shown below, he also found in the ACP a suitable forum for the promotion of his astro-meteorological agenda.

The three hydrographers were thus, at once, inside and above politics: they helped to implement official policy in the capacity of state servants, and used platforms of political influence to boost their agendas, but placed themselves and their pursuits on a higher sphere, where the idea of a reborn imperial motherland remained unstained by sectarianism. This strategy allowed them to go much beyond what, as EHS, they were meant to be: map makers at the service of the state. However, maps remained the favoured tools to legitimize the reality of conquest and empire,⁶¹ and that could by no means be neglected.

5. Cartography of an imperial destiny

After the Berlin Conference of 1884-5, historical rights lost their value as an argument for colonial sovereignty in Africa, but the extolment of historic deeds continued to constitute an important form of moral capital. Vasconcelos developed an interest in old maps as tools to explore this capital in the creation of a public opinion bent on imperialism, and in strengthening the international image of Portugal as an imperial power. The cornerstones of a grand historical narrative of the Portuguese empire had already been laid in the late eighteenth century. This narrative received a great impulse in the next century from the work of 2nd Viscount of Santarém (1791–1856). Santarém was a diplomat who put a great effort into refuting Alexander von Humboldt's dismissal of Portuguese accomplishments in early-modern navigation. He also compiled a catalogue of historical maps to celebrate Portugal's maritime glories.⁶² Vasconcelos sought to continue this venture on a sharper scientific basis. Whilst new maps and charts showed

⁶¹ On cartography and empire see, for instance: J. B. Harley, "Maps, Knowledge and Empire", reprinted in J. B. Harley, P. Laxton (ed.), *The New Nature of Maps* (Baltimore and London: The Johns Hopkins University Press, 2001), pp. 51–81; Matthew H. Edney, *Mapping an Empire: The Geographical Construction of British India, 1765–1843* (University of Chicago Press, 1997).

⁶² See Daniel Estudante Protásio, "2º Visconde de Santarém (1791–1856)", in Francisco Roque de Oliveira (ed.), *Leitores de mapas: dois séculos de história da cartografia em Portugal* (Lisboa: Biblioteca Nacional/CEG/CHAM, 2012), pp. 43–55.

that the Portuguese were actively taking care of their colonial possessions, the old maps would be used to reinforce the legitimacy of their imperial agenda.⁶³

Vasconcelos started by compiling a list of maps and charts belonging to the Ministry of the Navy and Overseas Affairs, which he published in 1892.⁶⁴ This was a first step towards a more ambitious and visible undertaking: a national exhibition of cartography that took place in the SGL between November 1903 and the beginning of 1904. The exhibition reunited maps scattered by various public institutions (the Directorate for Geodesic Works, the Academy of Sciences of Lisbon, and the General Command of Engineering, among others). The initiative counted on the patronage of King Carlos, who also contributed with maps from his private collection, and others taken from the library of the Royal Palace of Ajuda.⁶⁵ Vasconcelos intended the exhibition to demonstrate that Portuguese pioneers had already explored the African hinterlands, and to show that recent expeditions confirmed features present in old maps and charts.⁶⁶ The ultimate goal was to strengthen the idea of empire as a historic mission. As remarked by the president of the SGL in his opening speech, “[the maps] represent, in one word, centuries persistently spent in realizing the sacred ideal of national glories.”⁶⁷ In the ensuing years Vasconcelos continued to participate in the construction of this grand narrative. In 1916, for instance, he elaborated a list of early-modern Portuguese cartographers⁶⁸ to assist Joaquim Bensaúde (1859–1952), a civil engineer and stalwart historian of Portuguese maritime deeds, in the making of his *Histoire de La Science Nautique Portugaise*.⁶⁹

⁶³ A central myth of this narrative, which persisted in the twentieth century, was the “Escola de Sagres”, an alleged school of navigation founded by Prince Henry the Navigator in Sagres (in the far southwest of Portugal), where the Portuguese maritime expansion would have been carefully planned. For a historiographical debunking of this myth see G. L. Randles, “The Alleged Nautical School Founded in the Fifteenth Century at Sagres by Prince Henry of Portugal, Called the ‘Navigator’”, *Imago Mundi* 45, 1993: 20–28.

⁶⁴ Ernesto de Vasconcelos, *Relação de diversos mappas, plantas e vistas pertencentes a este ministério, com algumas notas e notícias* (Lisboa: Typ. da Companhia Nacional Editora, 1892).

⁶⁵ Since the exhibition had originally been conceived in the context of the visit of Alfonso XIII to Portugal, the Spanish government also contributed with some material.

⁶⁶ Ernesto de Vasconcelos, *Exposição de Cartographia Nacional (1903–1904)* (Lisboa: A Liberal – Officina Typographica, 1904).

⁶⁷ “[os mapas] representam, n’uma palavra, séculos de pertinaz insistência na realização do ideal sagrado das glórias nacionais”, in Ernesto de Vasconcelos, *Exposição de Cartographia Nacional*, p. XV.

⁶⁸ Ernesto de Vasconcelos, *Subsídios para a Historia da Cartografia Portuguesa nos Seculos XVI, XVII e XVIII* (Lisboa: Tipografia Universal, 1916).

⁶⁹ See José Manuel Azevedo e Silva, “Joaquim Bensaúde (1859–1952)”, Francisco Roque de Oliveira (ed.), *Leitores de mapas: dois séculos de história da cartografia em Portugal* (Lisboa: Biblioteca Nacional/CEG/CHAM, 2012), pp. 81–89.

Lacerda was much more focused on the production of new cartographic material. In order to tame the shores of the mainland and the empire, a wide pool of hydrographic expertise was necessary. The history of the ill-fated Hydrographic Corps had shown that concentrating hydrographic expertise in a small and elitist body within the Navy was not a viable solution. In 1897 Lacerda was placed in charge of a new chair of hydrography established in the Naval School, which was to be attended by all aspiring officers. Lacerda wanted every officer to master, at least, the operations involved in the production of elementary charts.⁷⁰ A decree issued in January 1901 established that the promotion of midshipmen to Naval tenants implied the successful participation in a hydrographic survey.⁷¹ Following the decree, Lacerda elaborated a stern set of rules for the conducting of students' surveys. All cadets had to go aboard an improvised hydrographic vessel and spend at least one week surveying a segment of the metropolitan coast, under the command of the hydrography lecturer. During the day ensigns would carry several out geodesic, topographic and hydrographic operations, such as angle and distance measurements, soundings, and tide gauges. In the evening, the ship served as a study room where they organized data and field notes and discussed them with the lecturer. After the survey was completed, each ensign had eight days to present a final report, which decided the promotion to Naval tenant. After Lacerda left the Naval School in 1902, his successor Vítor Hugo de Azevedo Coutinho (the same EH who collaborated in the MHCP and led a short-lived cabinet) proceeded with yearly surveys until 1907, when they were apparently interrupted by a reorganization of the War Navy. Besides preparing all officers to undertake at least fundamental hydrographic operations, the surveys also rendered useful cartographic material. As a whole, they resulted in the publication of at least 14 elementary charts at the scale 1/5,000.⁷²

Several of the young officers who participated in these surveys were later engaged in the works of the abovementioned Hydrographic Mission of the Portuguese Coast (MHCP). Lacerda launched the MHCP with the aim of producing a national hydrographic chart, whose

⁷⁰ See Pedro M. P. Raposo, "Method and much scientific probity": Hugo de Lacerda and the Chair of Hydrography of the Lisbon Naval School (1897–1907)", in R. Pisano, D. Capecchi (eds), *Physics, Astronomy and Engineering. A Bridge between Conceptual Frameworks, Society and Technologies* (Dordrecht: Springer, forthcoming).

⁷¹ Decree of the Ministry of the Navy, 25 January 1901.

⁷² According to the decree cited in the previous note, fluvial and coastal surveys should cover at least half a mile of terrain and adopt the scale of 1:5,000; for preliminary surveys made from the ship at least a full mile and the scale of 1:10,000 were required.

absence he deemed “an unacceptable gap.”⁷³ Lacerda commanded the first survey of the MHCP, which took place between 1913 and 1915. The works of the MHCP extended through 1935. Fostering hydrography in the empire was a more complex issue. The systematic surveying of colonial coasts progressed slowly, with hydrographic brigades being sent at spaces to Guiné (1912), Timor (1937), Cape Verde (1945), Angola and S. Tomé (1953), and Macau (1960s).⁷⁴ Similar to the surveys of the MHCP, methods and the organization of work often varied from mission to mission. In fact, some officers accused Lacerda of having missed the opportunity to standardize hydrographic practice in Portugal. It was only in 1960 that metropolitan and colonial surveys were centralized and methodologically unified under a single institution, the Hydrographic Institute (Instituto Hidrográfico, IH). Lacerda had given, nonetheless, a decisive impulse to hydrography in the country and instilled Portuguese hydrographers with the confidence to participate actively in the foundation and works of the International Hydrographic Bureau.

Compared to his counterparts, after his apprenticeship Ramos da Costa maintained a much looser relationship with maps and their production. His major contribution was the elaboration of a guidebook of the Portuguese coast. It was first published in 1897.⁷⁵ A revised edition, conforming to international standards in oceanography and hydrography and accounting for new services and features of the port of Lisbon, appeared in 1920.⁷⁶ These works complemented the hydrographic charts made by Portuguese hydrographers. Ramos da Costa also used the second version of the guidebook to address several topics of his interest, enriching it with advice and information related to magnetism and compass needles, tides, wind and current patterns, and weather. Thus it functioned as a practical textbook for the personnel engaged in the practice of navigation. By then, Costa was actually an experienced author of textbooks; and so were Vasconcelos and Lacerda.

⁷³ “uma lacuna inqualificável”, in Hugo de Lacerda, “Extracto do relatório da missão hidrográfica do ano lectivo de 1901–1902”, *Anais do Clube Militar Naval* 33, 1903: 97–103, 168–177, 207–214, see p. 213.

⁷⁴ Mozambique stands out in this picture. Due to the strategic importance of its seaports for south-eastern Africa, several surveys were undertaken there between 1870 and 1914. After leaving the Naval School of Lisbon in 1903, Lacerda went on to coordinate the enhancement of the harbour in Lourenço Marques (nowadays Maputo), which involved a comprehensive surveying of its area.

⁷⁵ A. Ramos da Costa, *Roteiro da barra e porto de Lisboa* (Lisboa: Typographia da Cooperativa Militar, 1897).

⁷⁶ A. Ramos da Costa, *Resumo do Novo Roteiro e Porto de Lisboa* (Lisboa: Imprensa de Manuel Lucas Torres, 1920).

6. Science, patriotism and empire by the book

A recent survey of literature on textbooks⁷⁷ highlights several themes the historical approach of which has benefitted from inquiries on textbooks: pedagogical and training practices, the formation of new disciplines, the development of ideas, priority disputes, epistemological concerns, and more generally the social context of science. In what follows it will be shown that this list may be extended to include topics such as imperial and colonial propaganda, the nationalistic appropriation of disciplines, the consolidation of military expertise, and the reinforcement of personal authority.

In 1906, the School for Higher Colonial Studies was established in Lisbon, seemingly as a consequence of Vasconcelos' lobbying.⁷⁸ As already mentioned, Vasconcelos took teaching duties in geography. Comprehensive and diversified in its scope, geography provided an optimal disciplinary umbrella under which to assemble his colonial viewpoints and investigations. It was to this field that Vasconcelos dedicated some of his most representative works. Among the latter, two textbooks deserve special attention. The first is *As Colónias Portuguesas* (The Portuguese Colonies), Vasconcelos's most successful publication. The first edition, dedicated to the SGL and to the memory of Portuguese navigators, was published in 1896.⁷⁹ It was primarily conceived as a textbook for high-school students and those who dealt with territorial, diplomatic and economic disputes involving the Portuguese colonies. Its scope and aims, however, were significantly more ambitious. Primarily an emulation of British, French and German books of the kind, the *Colónias* was, at once, an encyclopaedic repository of information on the Portuguese colonies, a claim to the historical legitimacy of the Portuguese empire, a seal to Vasconcelos's agenda of scientific colonialism, and a call for support to its implementation. The description of each colony usually started with an emphasis on the erstwhile deeds of Portuguese navigators and explorers. Detailed information followed, divided by three sub-sections: physical geography (territorial features, geology, orography, hydrography, climate), economic geography (natural resources, industry, agriculture, trade) and political geography (population, ethnography, administration). The

⁷⁷ Marga Vicedo, "The Secret Lives of Textbooks", *Isis* 103, 2012: 83–87.

⁷⁸ By 1901 he was already defending this idea. See, for instance, Ernesto de Vasconcelos, *As colónias nas suas relações com o mar* (Lisboa: Sociedade de Geografia, 1901).

⁷⁹ Ernesto de Vasconcelos, *As Colónias Portuguesas. Geographia Physica, Política e Economica* (Lisboa: Typographia da Companhia Nacional Editora, 1896).

success of the first edition, which even garnered positive reviews abroad, motivated a second edition, which was released in 1903.⁸⁰ A third and updated edition, incorporating results of the colonial investigations developed meanwhile, appeared in 1921.⁸¹

In 1916 Ernesto de Vasconcelos authored another textbook, in this case a manual of economic geography⁸² addressed to the students of the new Republican schools: the Instituto Superior Técnico, the Instituto Superior de Comércio, and the Escola de Construções, Indústria e Comércio.⁸³ In the introduction he acknowledged following various foreign authors, but accused the latter of self-centeredness: the English ones focused on England, the French on France, and so forth. In this textbook Vasconcelos served up his “revenge”: doing the same as the authors he criticized, he delivered a synopsis of the world’s geography centred on Portugal and Brazil, the former great colony of Portugal, and a source of inspiration for Vasconcelos’s Africanist agenda.⁸⁴ After a first section dedicated to general notions of economic geography (agents of production, goods, fisheries, ores, etc.), the book proceeded to a second section entitled ‘Portugal, Brazil and the main powers of the globe’,⁸⁵ where, as the title indicates, Portugal, her colonies and Brazil preceded countries such as Great Britain, France and the United States. It was perhaps an expression of Vasconcelos’s wildest dreams. But preposterous as it may seem, one must not underestimate the potential of such an approach to raise patriotic feelings and imperial sensibilities; and overall, to shape a colonialist mind-set among the target audience of the textbook, no less than the future administrative and technical elite of the Republic and the empire.

A blend of patriotism and science was also a central element in Lacerda’s textbooks. Hydrography textbooks were regularly elaborated upon since the first year of Lacerda’s tenure at the Naval School, a practice that was continued by his successor Azevedo Coutinho. The National Library of Lisbon holds a copy of the first part of the textbook for the academic year

⁸⁰ Ernesto de Vasconcelos, *As Colónias Portuguesas. Geographia Physica, Política e Economica* (Lisboa: Typographia da Companhia “A Editora”, 1903).

⁸¹ Ernesto de Vasconcelos, *As Colónias Portuguesas. Geografia Física, Económica e Política* (Lisboa: Livraria Clássica Editora, 1921).

⁸² Ernesto de Vasconcelos, *Compendio de Geografia Comercial* (Lisboa: Livraria Classica Editora, 1916).

⁸³ Respectively (my translation): the Institute for Advanced Technical Studies (to this day, one of the leading schools of engineering in Portugal), the Higher Institute of Trade, and the School of Construction, Industry and Trade.

⁸⁴ After visiting the plateau of S. Paulo in 1910, Vasconcelos took this Brazilian city as a model for the colonization of the African plateaus. See Ernesto de Vasconcelos, *Missão ao Brasil. A Cidade e o Estado de S. Paulo* (Lisboa: Typ. Colonial, 1911), and also section 8 of this paper.

⁸⁵ “Portugal, Brasil e as principaes potências do globo”.

1904-5. It is entitled *Apontamentos para um Curso Elementar de Hydrographia* (Notes for an elementary course in hydrography), and addresses the theory of errors, the measurement of angles and distances, and the instruments employed in topography and hydrography.⁸⁶ The *Apontamentos* were significantly based on English and French reports and textbooks on hydrography, topography, oceanography and related matters.⁸⁷ But more than appropriating hydrography and reinforcing its disciplinary contours, there was an assumed intention to shape a national version of it. The sections addressing errors and the measurement of angles and distances were clearly influenced by the OAL. The bibliography also included the Portuguese textbook *Curso de Topographia* (Course in Topography), written by the military engineers Mendes de Almeida (1854–1943) and Rodolfo Guimarães (1866–1918). Here Lacerda collected several descriptions of techniques and devices developed by Portuguese officers, deceased and alive, who had been involved in geodesic, topographic and hydrographic surveys. The science conveyed in the *Apontamentos* should be, as much as possible, recognised as a Portuguese science. This point was clearly stated by Lacerda in the preface to a more polished version of the *Apontamentos*, revised by Azevedo Coutinho and published in 1906. Lacerda introduced it as a “hydrography book written in Portuguese, following methods established by Portuguese masters such as Folque, Batalha, e Brito Limpo, already deceased, and also by Campos Rodrigues, fortunately still alive for the glory and profit of Portugal”. Such a book was necessary, he added, “not only for the Naval School cadets, but in fact for the majority of the War Navy”.⁸⁸

Ramos da Costa was much less concerned with patriotism and empire in his production of textbooks. He used them mainly to build and reinforce his status as the nation’s leading expert in the fields he dealt with in his official appointments. For instance, in 1899 he published a

⁸⁶ Escola Naval, *Apontamentos para um Curso Elementar de Hydrographia: Livro Primeiro, 1904–1905* (Lisboa: Lithografia da Escola Naval, 1904). Comparing to the source cited below in note 88, there should be at a second part dedicated to surveying techniques.

⁸⁷ The following works are cited as references: Frochot, *Marées – Campagne du “Ougnay-Frouin, 1903–4*; A. Germain, *Traité d’hydrographie* (Paris, 1882); Thompton S. Lecky, *Wrinkles in practical navigation* (1884); Le Bail, *Hydrographie: Campagne du “Ougnay-Frouin”, 1903–4*; Eugène Prévot, *Topographie: la topographie expédiée* (Paris, 1898); M. J. Thoulet, *Océanographie dynamique* (Paris, 1896); M. J. Thoulet, *Océanographie statique* (Paris, 1890); William J. L. Wharton, *Hydrographic surveying: A Description of the Means and Methods Employed in Constructing Marine Charts* (London, 1898).

⁸⁸ “Um livro de hydrographia escripto em portuguez, segundo processos estabelecidos por mestres portuguezes, como Folque, Batalha, e Brito Limpo, já fallecidos, e ainda por Campos Rodrigues, felizmente ainda vivo para glória e proveito de Portugal, não era só preciso para os alumnos da Escola Naval; era-o para a maioria da Corporação da Armada”, in the preface to Victor Hugo de Azevedo Coutinho, *Apontamentos para um curso elementar de hydrographia* (Lisboa: Tip. do Anuario Commercial, 1906), p. VII. Caetano Maria Batalha (1810–1881) was among the first group of specialised hydrographers in Portugal, who were trained in the 1830s. Francisco António de Brito Limpo (1832–1891) was a Land Army engineer and surveyor who gained local prestige as a designer of geodesic and topographic instruments.

textbook on compass needles. It was addressed to the merchant navy and conveyed the “most recent notions of the science of magnetic deviations.”⁸⁹ In a second version, issued in 1918,⁹⁰ the textbook was elevated to a treatise. Again, Costa showed a special concern for the novelties in the topic, dedicating part of the book to the electromagnetic compass needle (or radio-goniometer),⁹¹ by then still under test. Costa also used textbooks to cement his authority in timekeeping, a vital matter in terms of imperial domain and order.⁹² In 1902 he presented a practical textbook of chronometry,⁹³ that is, the science of rating marine chronometers. This first edition helped him pave the way for a prominent position in timekeeping affairs. A revised and expanded edition, published two decades later,⁹⁴ served to confirm him as an authority in the topic. The new version included instructions for the use of the time-zone system in the sea,⁹⁵ which had been adopted by the Portuguese Navy in 1921. This new version went beyond applications to seafaring, including an additional chapter entitled ‘The Measurement of Time’.⁹⁶ It explained time concepts—universal time, legal time, day-light savings, etc.—important to understand reformations of Portuguese time implemented in the first years of the Republic, and in which, as shown in section 8, Costa played a central role. Thus the revised textbook also served to seal his intervention in these matters.

7. Building audiences

The formation and circulation of knowledge has been increasingly approached as a multidimensional phenomenon involving both experts and lay audiences.⁹⁷ Vasconcelos, Lacerda

⁸⁹ A. Ramos da Costa, *Manual Elementar da Regulação e Compensação da Agulha Magnética* (Lisboa: Typographia Mattos Moreira & Pinheiro, 1899).

⁹⁰ A. Ramos da Costa, *Tratado Elementar das Agulhas Magnéticas, Gyroscópicas, Electromagnéticas* (Lisboa: Centro Typographico Colonial, 1918).

⁹¹ This device was conceived to determine the direction of electro-magnetic waves emitted from broadcasting stations.

⁹² See Peter Galison, *Einstein’s Clocks, Poincaré’s Maps: empires of time* (W. W. Norton & Company, 2003).

⁹³ It is mentioned in the second version, cited in the next note. It was not possible to access it.

⁹⁴ Augusto Ramos da Costa, *Tratado Prático de Chronometria (Contendo um capítulo sobre a “Medição do Tempo”)* (Lisboa: Tipografia da Cooperativa Militar, 1921).

⁹⁵ See Ian R. Bartky, *One Time Fits All: The Campaigns for Global Uniformity* (Stanford University Press, 2007), esp. chapter 9.

⁹⁶ “A medição do tempo”.

⁹⁷ See: Bernadette Bensaúde-Vincent, *L’opinion publique et la science: à chacun son ignorance* (Paris: Éditions La Découverte, 2013); Agustí Nieto-Galan, *Los públicos de la ciencia. Expertos y profanos através de la historia* (Madrid: Fundación Jorge Juan, Marcial Pons Historia, 2011); James Secord, “Knowledge in Transit”, *Isis* 95, 2004: 654–672.

and Ramos da Costa were clearly aware that their pursuits would not be successful unless they managed to secure a basis of support extending beyond the political milieu and the circle of their techno-scientific peers, military comrades, and students.

Vasconcelos knew well how to use SGL's resources for this purpose. When presenting his research programme in 1911, he remarked that its major goal was to generate "a strong current of opinion"⁹⁸ favourable to Portuguese colonialism. Following the map exhibition of 1903-4, a landmark in the public promotion of Portugal's imperial rebirth,⁹⁹ Vasconcelos organized a series of other thematic exhibitions. After displaying the cartographic images, he would now make the empire tangible to metropolitan audiences through the exhibition of natural products, raw materials, and native artefacts. Maps conveyed the notion of possession and historical legitimacy; those objects associated empire with material productivity and economic potential. The first exhibition of the series, showing cotton, rubber, cocoa and coffee in their various stages of production, took place between April and May 1906.¹⁰⁰ With contributions from farmers of Angola and Mozambique, Vasconcelos assembled an exhibition that he summarized as "a success of the first order, and, for the great majority of the public, a notable lesson."¹⁰¹ The "lesson" was that the SGL was re-enacting the "overseas period" not by warfare, but rather through systematic exploration and colonization.¹⁰² The next exhibition, held in 1909, was dedicated to native transport – boats, animal-traction vehicles, etc. In the introduction to its illustrated catalogue, Vasconcelos remarked that the displayed objects often showed the abilities and the degree of civilization of the natives.¹⁰³ But what readers and visitors were expected to admire was obviously the vastness and cultural diversity of the empire, and the efforts spent by the SGL in cataloguing its resources and civilizing the native populations. A third exhibition was held in 1913. Entitled

⁹⁸ "uma forte corrente de opinião", Ernesto de Vasconcelos, *Relatório acerca do Estudo dos Problemas Coloniais*, 1913.

⁹⁹ On the role of exhibitions in the construction of empire see Jeffrey A. Auerbach, Peter H. Hoffenberg (eds.), *Britain, the Empire, and the World at the Great Exhibition of 1851* (Aldershot: Ashgate, 2008).

¹⁰⁰ Ernesto de Vasconcelos, *Exposição colonial de algodão, borracha, cacau e café – catálogo* (Lisboa: Centro Typographico Colonial, 1906).

¹⁰¹ " (...) um sucesso de primeira ordem, e, para a grande maioria do público, constituiu uma notável lição e aprendizagem", in Ernesto de Vasconcelos, *Ibidem*, p. VI.

¹⁰² *Ibidem*.

¹⁰³ Ernesto de Vasconcelos, *Museu Colonial. Exposição parcelar (secção de meios de transporte terrestres e fluviais). Catálogo ilustrado* (Lisboa: Typographia da Cooperativa Militar, 1909), p. VI.

“Gums, resins and cereals of the colonies”,¹⁰⁴ it conveyed the idea that empire would set Portugal free from the need to import cereals.

Besides these activities, Vasconcelos maintained a steady presence in the press. In 1897 he founded his own journal, fully dedicated to colonial and maritime matters: the *Revista Colonial e Marítima* (Maritime and Colonial Review), which stayed in print between 1897 and 1910. Vasconcelos was also a frequent contributor to national magazines and newspapers. In 1916 he published *Investigações Geográficas* (Geographical Investigations),¹⁰⁵ a compilation of newspaper articles penned with the aim of debunking foreign writings that questioned or obliterated Portuguese priority in the exploration of territories such as Pamir, Tibet, the Nile spring, Mozambique, and the banks of the Amazonas River in Brazil. In the same year, Vasconcelos started to publish a series of short books derived from the *Colônias Portuguesas*, one for each colony, with which he expected to get a readership wider than that of his masterpiece.¹⁰⁶ His ultimate goal was to reinforce empire and colonialism as national designs immune to political fluctuations. He made this explicit in the preface to a work of juvenile fiction published in 1926, where the Portuguese colonies were gracefully depicted through the imperial journey of two youngsters, a boy and a girl. As explained by Vasconcelos, the book addressed both genders, and was part of a wider effort to get the masses interested in the colonies. A public opinion attuned to empire, he remarked, would constitute an “unfathomable fortress against the morbid principles of political sectarianism.”¹⁰⁷

Lacerda strived not only to build an audience in the metropolis, but also to seduce colonial and foreign publics. The press provided an especially suitable means for this purpose; Lacerda explored its potential especially during his stay in Macau, between 1920 and 1927. In 1920, he was appointed head of the works of Macau’s port. The Portuguese authorities had been seeking to revamp it since 1883, when the Hong Kong port was placed under British

¹⁰⁴ Sociedade de Geografia de Lisboa, *Exposição parcelar. Gomas, resinas e cereais das colônias* (Lisboa: Centro Typ. Colonial, 1913).

¹⁰⁵ Ernesto de Vasconcelos, *Investigações Geográficas* (Lisboa: Centro Tipográfico Colonial, 1915). The four articles included in this publication were originally published in the newspaper *Diário de Notícias*.

¹⁰⁶ It seems that Vasconcelos did not complete the series, but at least the following volumes were published: *S. Tomé e Príncipe – Estudo elementar de Geografia física, económica e política* (Lisboa: Tip. da Cooperativa Militar, 1916); *Guiné Portuguesa – Estudo elementar de geografia física, económica e política* (Lisboa: Tip. da Cooperativa Militar, 1917); *Arquipélago de Cabo Verde – Estudo elementar de geografia física, económica e política* (Lisboa: Tip. da Cooperativa Militar, 1917) (note that this last reference is for a second edition).

¹⁰⁷ Preface to Armando Augusto Gonçalves de Moraes Castro, António Pereira Cardoso, *Uma Viagem Através das Colônias Portuguesas* (Porto: Companhia Portuguesa Editora, Lda, 1926), pp. 9–15. The cited passage reads “uma opinião ultramarina que valeria por um baluarte inexpugnável, contra o qual os princípios mórbidos do partidarismo político não investiriam” (p. 10).

administration. The main objective was to secure a relevant position for Macau in the economy of the region, but the works to renovate the Portuguese port started only in 1919. Upon taking command of this venture, Lacerda developed an especial concern with the external image of Macau. This far-eastern colony (a small peninsula near to Hong Kong conceded by the Chinese authorities in the sixteenth century) had a reputation of getting its revenues from gambling and opium trade.¹⁰⁸ Lacerda regarded the enhancement of the port as a way of moralizing and strengthening Macau's economy. He expected the undertaking to reinforce its position as a hub for freight transport in the region, to stir up the development of local industry, and to turn it into a touristic attraction. In 1922 Lacerda published a compilation of newspaper articles on Macau's port, written by several authors, which had appeared in the colonial and metropolitan press.¹⁰⁹ The aim was clearly stated in the preface: "what we have to do, side-by-side with the enhancement of the port, is to advertise the advantages of Macau, in its various aspects, by means of a well-crafted scientific propaganda, properly addressing the conditions required for the development of industries and transport connections."¹¹⁰ The compilation was varied in its scope, but discussions on several aspects related to the hydrography, the economy, and the climate of the territory conveyed the notion of a technically well-grounded venture. Most of the articles were written in Portuguese, but material from Anglophone Hong Kong newspapers was also included. Lacerda was especially careful to stress climatic aspects, which were crucial in terms of tourist promotion. In the preface to a second compilation, published in 1924,¹¹¹ he keenly praised the soft climate, the healthy environment, and the charming landscapes of Macau.¹¹²

Later in life Lacerda refined his techniques of climatic propaganda, in a study requested by the director of a sanatorium on Madeira Island. The study, with versions in French and

¹⁰⁸ See Alfredo Dias Gomes, *Portugal, Macau e a Internacionalização da Questão do Ópio, 1909–1925* (Livros do Oriente, 2004), esp. pp. 215–223.

¹⁰⁹ Hugo de Lacerda Castelo Branco, *Macau e o seu futuro porto* (Macau: Tipografia de Fernandes e Filhos, 1922).

¹¹⁰ "O que é preciso é, a par da construção do porto, tomar conhecidas as condições vantajosas de Macau, nos seus múltiplos aspectos com uma propaganda científica, bem ordenada, em que bem se estudem as circunstâncias que concorram para se desenvolverem indústrias e estabelecerem comunicações", *Ibidem*, p. 23.

¹¹¹ Hugo de Lacerda Castelo Branco, *Macau e o seu porto artificial através a imprensa portuguesa*, Vol. I (Macau, Tipografia Mercantil, 1924).

¹¹² *Ibidem*, p. 4.

English,¹¹³ extolled the virtues of Madeira’s climate for tuberculosis patients, and more generally to those who wished to spend their retirement years in an attractive environment. Lacerda, who had himself moved to Madeira after retiring, began the study by flaunting his authority as a well-travelled climate expert. Then he proceeded to justify his claims with a thorough comparison of meteorological tables (temperature, humidity, evaporation, winds, clouds, atmospheric pressure, and solar irradiation) concerning Madeira and several other places with attractive climates (Tenerife, Nice, Malta, among others). Lacerda approached the touristic valorisation of Madeira as the completion of the first colonising efforts undertaken by the Portuguese in the nineteenth century.¹¹⁴

More focused on his own scientific interests, Ramos da Costa used the agenda of scientific promotion and popularization of the Academy of Sciences of Portugal to foster his astro-meteorological programme. Shortly after the implantation of the Republic he was already lecturing on the subject, in the context of the ACP’s activities.¹¹⁵ He also explored the boundaries between the textbook and popular book genres, in order to cement his scientific authority whilst addressing larger audiences. For instance, in 1910 he published a brief book on oceanography, in the guise of a manual, where the basic concepts of this emerging field were presented.¹¹⁶ Costa acknowledged that it conveyed but a “pale image” of the teaching of oceanography in Scandinavia;¹¹⁷ but, as he explained, this was a necessary compromise to make an “important and useful” branch of science accessible to the laymen.¹¹⁸ A decade later he engaged in the popularization of relativity, a theme that attracted the attention of a small community of science

¹¹³ Hugo de Lacerda Castelo Branco, *The Climate of Madeira – with a comparative study* (Madeira, 1938). A French version is mentioned in the English one, but it was not possible to access any copy. Since this work was originally prepared for a medical conference, the French version was possibly the text of Lacerda’s communication.

¹¹⁴ Note that the islands of Madeira and Azores were not considered to be colonies, as they were uninhabited when Portuguese navigators found them. They were usually referred as “appended islands”, and nowadays hold the status of autonomous regions of the Portuguese Republic.

¹¹⁵ António Cabreira, *Relatório dos Trabalhos da Academia de Ciências de Portugal no ano de 1911–1912* (Lisboa, 1912), p. 6.

¹¹⁶ The already cited A. Ramos da Costa, *Noções gerais de oceanographia contendo elementos de biologia do mar, pescas, observações, etc.* (Lisboa: Officina Typographica, 1910).

¹¹⁷ Scandinavian countries played a pivotal role in the early development of oceanography. See: Helen M. Rozwadowski, *The Sea Knows No Boundaries. A Century of Marine Science under ICES* (University of Washington Press, 2002), esp. pp. 15–21; Gary E. Weir, *An Ocean in Common: American Naval Officers, Scientists and the Ocean Environment* (Texas A&M University - Military History Series, 2001), esp. chapter 1.

¹¹⁸ “este tão importante, quanto utilitario ramo de sciencia”, A. Ramos da Costa, *Noções gerais de oceanographia ...*, p. III.

practitioners centred on the OAL.¹¹⁹ In 1921, inspired by a popularization contest launched by the North American journal *Scientific American*, Costa published a short book on relativity,¹²⁰ of which a bulkier version appeared two years later.¹²¹ Albeit longer, the second version had maths and formulae reduced to a minimum, so that the “Einsteinian trilogy” – space, matter, time – could be presented and explained to a wider public. Ramos da Costa considered astrophysics and relativity to represent the avant-garde of science, the two fields that were effectively pushing the boundaries of knowledge about the physical universe. Consequently, he strived not only to keep abreast of their developments, but also to maintain the status of a public expert able to disclose their intricacies to lay audiences.

8. Observatory ventures

To a considerable extent, the careers of Vasconcelos, Lacerda and Ramos da Costa developed through the exploration and mobilization of observatory sciences and techniques.¹²² The subjects they chose to investigate and popularize, and the way they organized research ventures and surveys, bear an unmistakable mark of their passage by the Astronomical Observatory of Lisbon and the Infante D. Luiz Observatory. But more than being influenced by these observatories, they all sought to steer the foundation of new ones.

In 1901, Vasconcelos convened the first national colonial congress, to which he presented his outlook for Portuguese colonialism in Africa.¹²³ A programme of colonial meteorology was necessary, he claimed, to correct an historical mistake. The first settlers had been seduced by luxuriant vegetation and natural harbours sheltered from the wind. Vasconcelos seemingly upheld to the out-dated theory of miasmas, according to which “bad air” (air contaminated by rotting

¹¹⁹ Elsa Mota, Paulo Crawford, Ana Simões, “Einstein in Portugal: Eddington’s expedition to Principe and the reactions of Portuguese astronomers (1917–25)”, *British Journal for the History of Science* 42, 2009: 245–273.

¹²⁰ A. Ramos da Costa, *A Teoria da Relatividade* (Lisboa: Oficinas Gráficas da Biblioteca Nacional, 1921).

¹²¹ A. Ramos da Costa, *Espaço, matéria, tempo, ou a trilogia einsteiniana* (Lisboa: Imprensa Lucas & Ca, 1923).

¹²² I am referring to “observatory techniques” here in the double sense proposed by Aubin, Bigg and Sibum, that is, as technological methods and procedures, and as social strategies used to organize labour in observatories and connect them with wider networks of institutions and practitioners. See David Aubin, Charlotte Bigg, H. Otto Sibum, “Introduction: Observatory Techniques in Nineteenth-Century Science and Society”, in David Aubin, Charlotte Bigg, H. Otto Sibum (eds.), *The Heavens on Earth – Observatories and Astronomy in Nineteenth Century Science and Culture* (Durham and London: Duke University Press, 2010), pp. 1–32.

¹²³ Ernesto de Vasconcelos, *Postos Meteorológicas nas Colónias* (Lisboa, 1901).

organic matter) was the cause of epidemics.¹²⁴ He was concerned with “mephitic” emanations and malaria bouts in the hotter lowlands, especially in the proximity of rivers and lakes. New colonial ventures, he argued, should preferentially aim at higher-altitude plateaus where circulation of air was stronger. The climatic suitability of prospective sites should be assessed on the grounds of systematic observations. For this purpose, Vasconcelos conceived a network of meteorological stations covering high-altitude areas. Religious missions¹²⁵ already established there would conduct the observations. In coastal areas, this function was to be maintained by port captains and health delegates. A new imperial observatory in Lisbon would coordinate the African network from afar, leaving local coordination to the Luanda Observatory in Angola.¹²⁶ Vasconcelos also suggested the foundation of a new observatory in Lourenço Marques (nowadays Maputo), to play an identical role in Mozambique.

Five years later, the construction of a new observatory began in the Mozambican capital. However, it was due to the initiative of Lacerda, who, by that time, was in charge of Lourenço Marques port and coordinating its renovation. The Campos Rodrigues Observatory (Observatório Campos Rodrigues, OCR), thus named in honour of the metropolitan astronomer, was inaugurated in 1908 (Fig. 5). It comprised a building for meteorology and a shed for astronomy, where star transits were observed for timekeeping purposes.¹²⁷ Time signals were regularly sent from the OCR to a clock installed in the boarding area of the port, and to a system of luminous semaphores that displayed the time for navigation. Lacerda learnt about Vasconcelos’s plans only in 1907, during a visit to Lisbon (when he spoke to the SGL). Lacerda’s original intention was mainly to develop scientific liaisons with South Africa, involving Mozambique in a trans-colonial meteorological network. But he was keen to maintain good relations with the metropolis. Thus he made sure that the OCR also met the plans developed by Vasconcelos.

¹²⁴ See S. Halliday, “Death and miasma in Victorian London: an obstinate belief”, *British Medical Journal* 323, 2001: 1469–1471.

¹²⁵ On the Portuguese religious missions and their role in African colonialism see Miguel Bandeira Jerónimo, Hugo Gonçalves Soares, “As Missões do Império: Política e Religião no Império Colonial Português”, in Miguel Bandeira Jerónimo (ed.), *O Império Colonial em Questão (sécs. XIX–XX). Poderes, saberes e instituições* (Lisboa: Edições 70, 2012), pp. 119–156.

¹²⁶ The Luanda Observatory was founded in 1879. It was installed in the old tower of Luanda’s cathedral and functioned mainly as a meteorological observatory, to which a time service comprising a time-ball was eventually appended (“Observatório Meteorológico de Loanda”, *Boletim da Sociedade de Geografia de Lisboa* 8, 1882: 296–310, 370–379, esp. pp. 296–299).

¹²⁷ See Pedro M. P. Raposo, “O Império e o Tempo: Notas Para uma Abordagem à História dos Observatórios Coloniais Portugueses”, in Maria Paula Diogo, Isabel Maria Amaral (eds.), *A Outra Face do Império: ciência, tecnologia e medicina (sécs. XIX–XX)* (Lisboa: Edições Colibri, 2012), pp. 17–29, esp. pp. 23–28.



Fig. 5 – The main building of the Campos Rodrigues Observatory c. 1908 (MUHNAC – Historical Archive of the Astronomical Observatory of Lisbon)

In 1914, Vasconcelos established a meteorological service, appended to the Cartographic Board of the Ministry of the Navy. Assisted by a fellow naval officer, he started to gather meteorological data from a significant number of observatories and outstations spread all over the empire. The data were summarized in an annual publication entitled *Anais Meteorológicos das Colónias* (Meteorological Annals of the Colonies).¹²⁸ The imperial observatory envisioned by Vasconcelos never came into existence; this was the feasible substitute.¹²⁹ The OCR was a regular contributor. By the early 1920s, it controlled a wide network of subsidiary stations in the Mozambican territory. Vasconcelos was not completely pleased with it though. In 1918 he underlined the importance of the observatory for “a better knowledge of the climate, with advantage for colonization and agriculture.”¹³⁰ But three years later, in the third edition of *As Colónias Portuguesas*, he regretted that, in spite of a considerable expenditure, the OCR was still performing below expectations.¹³¹ In fact the OCR faced persisting difficulties in obtaining data from the hinterland and generally in engaging reliable observers. It was, nonetheless, the most successful observatory in the Portuguese overseas empire. Vasconcelos probably never reconciled

¹²⁸ Ernesto de Vasconcelos, *Anais meteorológicos das colónias relativos a 1910, 1911, 1912, 1913 e 1914* (Lisboa: Centro Tipográfico Colonial, 1915).

¹²⁹ It must be noted that, after the death of João Capelo, the OMIDL had started to lose prominence.

¹³⁰ “(...) o melhor conhecimento do clima, com vantagem para a colonização e para a agricultura”, Ernesto de Vasconcelos, *Portugal Colonial* (Lisboa: Livraria Colonial, 1918), p. 123.

¹³¹ Ernesto de Vasconcelos, *As Colónias Portuguesas. Geografia Física, Económica e Política*, p. 455.

with the fact that Lacerda, notwithstanding the latter's collaborative attitude, had founded the OCR outside his meteorological master plan.

Ramos da Costa also fostered his own observatory projects. In 1905 he published an article in the *Revista Militar* (Military Review) entitled “The need to create a new observatory for the Navy.”¹³² Costa wanted a replacement for the defunct Royal Observatory of the Navy, covering a wide range of subjects: magnetism, atmospheric electricity, nautical meteorology, seismology, oceanography and timekeeping. He was already setting the scenes for his astro-meteorological project, suggesting collaboration with the OMIDL in higher meteorological investigations.¹³³ But by then timekeeping was at the top of his concerns. Notwithstanding the OAL's prowess in timekeeping, Ramos da Costa defended the installation of a new time-ball in the southern bank of the Tejo, under the control of the new observatory. He also endorsed the adoption of the Greenwich meridian in replacement of the OAL's.¹³⁴ Costa's observatory never came into existence, but the Greenwich meridian was in fact adopted in Portugal in 1911. Five years later, a new system of time signals, replicating Lourenço Marques's public clock and luminous semaphores, was installed in the port of Lisbon. These works were coordinated by a commission constituted by Hugo de Lacerda, Frederico Oom (by then the sub-director of the OAL),¹³⁵ and Ramos da Costa.¹³⁶ Costa took the lead, gaining a prominent position in timekeeping affairs but he did not withdraw the idea of founding a new observatory. In 1914, addressing the Navy, he wrote that an observatory suited to investigate the connections between meteorological and astronomical phenomena was “indispensable” for every country wanting to partake in the progress of meteorology.¹³⁷ Neither the Navy and nor the civil authorities were sensitive to such appeals, but the Academy of Sciences of Portugal quickly accommodated Costa's project. Regulations issued in 1915 mentioned a museum, a library, and an astrophysical

¹³² Augusto Ramos da Costa, “Necessidade de crear um observatório para a Marinha”, *Revista Militar* LVII, 1905: 285–291. Costa had already proposed the foundation of such an observatory in a report of magnetic observations carried out during the solar eclipse of 28 May 1900. See A. Ramos da Costa, *Algumas palavras sobre o eclipse do Sol de 1900* (Lisboa: Manoel Gomes, 1900).

¹³³ “(...) o conhecimento e investigação dos fenómenos para a dedução das leis que os regem e todas as demais questões que se relacionam directamente com a astrofísica”, A. Ramos da Costa, “Necessidade de crear um observatório para a Marinha”, p. 289.

¹³⁴ Between 1885 and 1911, the meridian of the OAL was the main meridian in Portugal, at least for timekeeping purposes.

¹³⁵ Frederico Tomás Oom (1864–1930) was appointed sub-director in 1897. He must not be confounded with his father, Frederico Augusto Oom, mentioned earlier in this paper.

¹³⁶ A. Ramos da Costa, Frederico Oom, *Relatório da comissão do novo sinal horário do porto de Lisboa* (Lisboa: Imprensa Nacional, 1915).

¹³⁷ A. Ramos da Costa, *O Serviço Meteorológico e a Sciencia da Meteorologia* (Lisboa: Oficina Tipográfica, 1914), p. 13.

observatory, eventually to be appended to the Academy's building.¹³⁸ The observatory would comprise two sections, one for geophysics and the other for "heliophysics" (i.e., solar observations), to investigate the relationships between solar activity and electrical and magnetic phenomena.¹³⁹ In 1918, whilst celebrating the first decade of the ACP, António Cabreira extolled the observatory as one of the Academy's highlights, remarking that the respective project was just waiting governmental approval.¹⁴⁰ But the Republic was living through particularly tense times. In December that year President Sidónio Pais (1872–1919) was murdered in Lisbon's main railway station; in January 1919 a monarchic sect attempted to restore the old regime with a coup d'état. Most likely the observatory project was left into oblivion amidst these events, and the ACP itself started to lose momentum. In 1921, Ramos da Costa called again for the foundation of an astro-meteorological observatory, in a short publication dedicated to the subject.¹⁴¹ But such appeals were definitely bound to become historical testimonies of an unaccomplished endeavour.¹⁴²

Overall, the meaning of the observatory projects fostered by Vasconcelos, Lacerda and Ramos da Costa, regardless of particular successes and shortcomings, dwells in evincing the importance of observatory sciences and techniques in their agendas and careers, and in their interventions towards the resurgence of the nation and the empire.

9. Conclusion

Hydrography belongs to a constellation of sciences (astronomy, geodesy, topography) in which the development of military values, practices and codes played a central role. This has been demonstrated for countries such as France and Sweden,¹⁴³ and applies to Portugal too. But the

¹³⁸ The ACP was installed in the former Convent of Sacramento, located in Alcântara, a western neighbourhood of Lisbon.

¹³⁹ *Documentos oficiais organizando, privilegiando e enaltecendo a Academia de Ciências de Portugal* (Coimbra: Imprensa da Universidade, 1916).

¹⁴⁰ António Cabreira, *A obra da Academia de Ciências de Portugal no seu 1º Decénio (16 de Abril de 1907–16 de Abril de 1917)* (Coimbra: Imprensa da Universidade, 1918), p. 13.

¹⁴¹ A. Ramos da Costa, *Duas palavras sobre Astrometeorologia* (Coimbra: Imprensa da Universidade, 1921).

¹⁴² In 1926, a spectro-heliograph was put to work at the Observatory of the University of Coimbra, but it had no relation with Ramos da Costa's "astro-meteorological" agenda. See Vítor Hugo da Rosa Bonifácio, *Da Astronomia à Astrofísica: a perspectiva portuguesa (1850–1940)*, unpublished doctoral thesis, Universidade de Aveiro, 2009, pp. 356–364.

¹⁴³ Sven Widmalm, "Astronomy as military science: the Case of Sweden", in David Aubin, Charlotte Bigg, H. Otto Sibum (eds.), *The heavens on Earth – Observatories and Astronomy in Nineteenth Century Science and Culture* (Durham and London: Duke

frequent mobilization of Portuguese hydrographers for functions other than surveying gave them room to become privileged agents in the appropriation of the physical and mathematical sciences in a broader sense.

The formation of EHs produced more than hydrographic surveyors. It endowed them with techno-scientific knowledge and skills that could be deployed for several other purposes. In fact, Vasconcelos, Lacerda and Ramos da Costa assimilated and developed their common training in different guises. They build distinct personae upon it, exploring diverse ways of mobilizing what they studied and practised at the military schools, the observatories, and their hydrographic apprenticeships.

The undertakings embraced by the three hydrographers are illustrative of the importance of military engineers in nineteenth-century and early twentieth-century Portugal. However, the particular ways they paved their careers also suggest that, in order to fully grasp the scope and impact of their action, we must discard rigid divides between the civil and the military spheres, and pinpoint the idiosyncratic elements of their pursuits, whilst scrutinizing the networks and circuits in which they developed.

They did not leave their martial mind-set completely behind when they leapt out of their military sphere of action. As Vasconcelos put it, science and technology were weapons of a new kind of war. Embracing them was not a matter of seeking redemption from the primeval commitment of the military to warfare, but rather a way of partaking in the struggle for colonial domain, international respectability and economic prowess, in a time when imperial strength increasingly dwelt on techno-scientific acumen. But they could better contribute to this purpose if they crossed boundaries between military and civilian institutions, and if they canvassed public bases of support amidst civil society, capitalizing on collective feelings and aspirations. In this respect patriotism was more than a rhetorical device grounded on military pride. It was a valuable emotional resource, which Vasconcelos, Lacerda and Ramos da Costa used thoroughly to increase the resonance of their agendas with the downtrodden nation in search of imperial resurgence.

University Press, 2010), pp.174–198; in the same volume, Marta Schiavon, “Geodesy and Mapmaking in France and Algeria: Between Army Officers and Observatory Scientists”, 199–224. As far as hydrography is concerned, the U.S.A. constitutes a more subtle case, where the development of this discipline was particularly affected by tensions between military and civilian institutions. See Hugh Richard Sloten, “The Dilemmas of Science in the United States: Alexander Dallas Bache and the U. S. Coast Survey”, *Isis* 84, 1993: 26–49.

The controversial legacy of the Portuguese colonial empire,¹⁴⁴ which was dissolved in the sequence of the democratic revolution of 25 April 1974, bears witness to many aspects of Vasconcelos's imperial outlooks. Many of its elements can be found in the mystical aura of imperial bravado adopted by Salazar's dictatorship, as well as in the colonial policies of the Estado Novo.¹⁴⁵ Weather forecasts based on astronomical elements will most likely be filed today as bogus science, as they would be by most scientists during Ramos da Costa's lifetime. However, not all of his pursuits were doomed to oblivion. The relations of solar activity with magnetic phenomena on Earth, as well as the possible connections between solar cycles and long-term climatic patterns are still relevant themes in the Earth sciences. Furthermore, oceanography and fisheries remain a research topic of high economic importance, still pursued at the Portuguese Hydrographic Institute. For the first fifteen years of its existence, the IH acted as the hydrographic bureau of the Portuguese empire. Such an institution was a dream that Lacerda did not see come true in his lifetime, but to which his action at the Naval School and in the MHCP helped pave the way.

Regardless of how pure their intentions were, the three hydrographers doubtless left their mark, and that was because they were as efficient in surveying waterfronts as they were in promoting their agendas ashore.

¹⁴⁴ For a recent historiographic reappraisal of the late Portuguese empire in its political, economic, cultural and scientific dimensions, see Miguel Bandeira Jerónimo (ed.), *O Império Colonial em Questão (sécs. XIX–XX). Poderes, saberes e instituições* (Lisboa: Edições 70, 2012).

¹⁴⁵ See José Mattoso (ed.-in-chief), Fernando Rosas (vol. ed.), *História de Portugal*, vol. 7: *O Estado Novo (1926–1974)* (Lisboa. Editorial Estampa, 1998), pp. 252–262.