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# Portugal in the European Network of Marine Science Heritage and Outreach (19th–20th Centuries)

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**Abstract:** The gradual consciousness of the scientific and economic riches of marine life is rooted in the legacy of some pillars of scientific production and dissemination in institutions such as natural history museums, aquariums, and maritime stations. Nowadays, one of the biggest issues of these scientific collections of species (marine or others) is their contextual interpretation which demands its original collection point, collectors, and original aims. The current research focuses on the origin of collections of marine specimens in Portugal as well as their historical evolution. In this particular approach, we assess the connection of the Portuguese natural history museums, universities and aquariums to similar European institutions since the mid-19th century, crossing primary sources from different archives. It was possible to reconstruct connections with the Zoological Station of the bay of Naples (Italy), the Maritime Museum of Monaco, and Aquariums of Monaco, France, and England. We identify both informers and the circulation of zoological specimens that underpin Museums and Aquariums collections that are today important scientific heritage repositories for a larger understanding of marine biodiversity and its threats, and core places of aesthetic contemplation and of philosophical discussion about the evolution of scientific knowledge.

**Keywords:** marine life; natural history museums; aquariums; Portugal; Naples

## 1. Introduction

One of the biggest challenges for natural history curators today is to create ‘comprehensive’ museums which invite the visitors to go back to the 19th and early 20th centuries (or even earlier) and understand the origin and history of their zoological collections following the ‘pioneers’ that promoted Science. If these collections had their beginning with pedagogic and research purposes and acquired and donated materials serving different fields of research (Carnall et al. 2013), the future of this legacy is an ambitious program of using the past for new purposes—the legacy of a comprehensive biodiversity evolution on its context (space, time, and environment).

Nowadays, Marine Institutes and Maritime Stations (MARS 2017) and University Museums and Natural History Museum of Science Heritage (UNIVERSEUM 2000) are designations that represented the oldest synergies between teaching and research, and Portugal is not an exception (Gil 2002). Therefore, it is important to research about the origin of collections of specimens from natural history museums, considering their diversity, and the probabilistic connections with two other pillars of scientific and outreach institutions: labs/maritime stations and aquariums, both characterized by an ambivalent role regarding their historical evolution. The aquarium evolved from single ‘tanks of fish’ to a place of exhibition and research, in some cases financing Maritime Stations, conducting research on marine biology evolution, thus promoting the development of both science and economy.

More recently, some of these sites are redirecting their goals to science communication and education, promoting activities to several age groups (especially young students). Indeed, these institutions provide an opportunity for a better understanding of the ecological aspects of the shore, the pelagic environment, and the deep sea.

This cultural and scientific perspective encourages pilot projects of research to adduce the need to recognize quantities of unprocessed and underused collections, giving rise to a “new hybrid research culture which is essential to the contemporary life science” (Strasser 2010). Moreover, those collections are in a process of revalorization by their reuse to scientific purposes as is the case of the World Register of Marine Species. This is an example of an open-access inventory of all marine species that provides a comprehensive list of names of marine organisms, comparing their taxonomy to current biological diversity, the process of appearance or disappearance of species which involves the study of museum’s collections (Costello et al. 2013; The Society for the Preservation of Natural History Collections (SPNHC 1985)). The same discussion started in Portugal (Saldanha et al. 2015; Gavroglu et al. 2018; Science and Technology in the European Periphery (STEP 1999)), a country that frequently has been seen in a peripheral position in the context of the European Marine Science, in particular if we take into account the absence of mentions to Portuguese labs and aquariums in the famous report about the European Maritime Stations wrote at the beginning of the 20th century (Kofoid 1910). Furthermore, the international debate about “museum taphonomy: the process by which collections disappear” is an important scientific contribution for identifying “objects [ . . . ] separated from the information about them—their stories, their metadata” (Lubar et al. 2017). This led to the growing disruption of the management of these secular spaces, as well as the identification of the origin of their collections and their historical role as spaces for teaching, research, and dissemination (Delicado 2010). This was already studied for the Portuguese case, pointing to connections and networks between Portuguese scientists and international research institutions (Amorim 2009; Pinto 2017; Saldanha 1997). In particular, the Natural History Museums of the University of Porto, Coimbra, and Lisbon seem to have been influenced by European models such as the Maritime Station of Naples (Italy) as well as other European maritime stations and Natural Museums and aquariums in the context of the scientific and economic riches of marine life. As a follow-up to these previous studies, we aim to reconstruct the information channels and circuits, the established contacts, projects, and achievements in the 19th and 20th centuries, using information from Portuguese, French, and Italian archives as well as several published reports, thus contributing to an increasing proficiency of the Portuguese Research Infrastructure of Scientific Collections (RISC 2014).

## 2. Methods

### 2.1. Study Area

The study area is Portugal with approximately 88,500 km<sup>2</sup> in the European Continent, only 16 percent of the Iberian Peninsula and with more than 800 km of coastline. In addition, there are also two archipelagos, Azores (with nine islands) of about 2400 km<sup>2</sup>, and Madeira (two islands) of around 800 km<sup>2</sup>, both in the Atlantic Ocean. The geographic position of the country explains the simultaneous proximity of the Atlantic and Mediterranean, characterizing the climate, vegetation, and agricultural system. In the 19th century, Portugal was the center of a larger Empire in Africa, South America, and Asia that was disputed by international interests (resources dispute) and political conflicts (nationalisms construction). Portugal diminished its colonial area (Brazil, in South America, at the beginning of the 19th century, and the areas between Angola and Mozambique in Africa in 1890) and the internal political turbulence (from monarchy to republic regime, in 1910) and economic crises explained a national feeling of peripheral position in an international frame of the great colonial powers.

The idea of a center-periphery dichotomy of Portugal in the European and global contexts was extensive to scientific areas that even nowadays dominate a speech of the Portuguese in international centers of innovation and scientific research. This perspective must be proved and this is a reason

for the path of this article, aiming to understand the past connections of Portugal research with international marine science, its nature, limits, and potential, adding new visions, new analyses in the international and national agendas.

## 2.2. *New Approaches to Issues, Sources, and Methodology*

In the context of the history of science, a new research perspective emphasizes the fruitful study of the relationship between center and periphery as complementary forces in the production of shared knowledge (Vanpaemel 2010). This perspective involves individuals, personal and institutional paths, and the construction of networks about which little is known. Nevertheless, there is enough information to realize that this formed national and international knowledge transfer. These kinds of studies will allow the recognition of processes of circulation of science around people, objects, and pathways, accumulators of genetic history, unrepeatable, underlining because they correspond to the evolution of Humanity as a whole. Besides, as recent research justifies and it is our perspective, it considers “the provenance of specimens in a supply chain may be a more productive approach than attempting to categorize actors in that chain” (Lucas and Lucas 2014).

In this context, our research route began with the identification of some of the main institutions related to the marine sciences, as well as scientists and collections of Portuguese institutions. Afterward, our research used primary sources from Portuguese Archives and some secondary sources as institutional reports, following their connections with foreign partners, mapping their connections with some European institutions. The report (1910) of Charles Atwood Kofoid (zoologist and plankton studies expert, 1865–1947, from the United States Bureau of Education) about existing European maritime stations was a starting point to understand its geographical distribution and historical foundation as well as their role as international experimental labs’ benches for the circulation of scientists.

Other studies added information to this picture of maritime stations institutions (Geistdoerfer 2015) and allowed an understanding of the existence of networks of distribution of marine species as well as how scientists were instrumental in bringing animals to Portugal and across Europe. The perception of these international transactions led us to visit and use information from the Maritime Station of Naples archive (manuscripts) and Monaco archive (sources already published). It was possible to locate invoice payments to the Naples Station regarding Naples Bay species catch and some laboratory supplies that were sent to Portuguese Universities and Museums’ labs. Letters were written from Naples and Monaco by their main scientists with Portuguese members of Academic Institutions (Universities of Porto, Coimbra, and Lisbon), and the Portuguese king and their advisors were localized in those archives and were analyzed in order to evaluate and establish the chronology and the nature of these relations (see a more detailed context below—Section 4).

The results of our research are structured in some points. In a preliminary summary, the exploratory readings allow us to assess the process of construction of European natural museums, marine stations, labs, aquariums, and to point to hypothetical connections with Portuguese history of marine science (point 3.1). Taking into account the dominant role of the Stazione Zoologica of Naples as an international model of aquariums and maritime labs, despite the fact that the station at Concarneau (France) was the first permanent marine laboratory (1859) (Geistdoerfer 2015), we evaluate its creation, evolution, action, international connections, and leaders (Section 3.2). Furthermore, we evaluate the Portuguese relationship with all those institutions by summarising the internal scientific environment, pointing drivers of change and the academia evolution (Section 4). Crossing several sources of information (see Appendices A and B), we focused on three main points: the relation of Portuguese Academia with the Naples Station (Section 4.1), then with England and other countries between traditional and new scientific relations (Section 4.2), and finally the relations that were behind the creation of the Aquarium of Lisbon as an example of a connection between scientific and political marine research (Section 4.3).

### 3. Possessing Nature: Natural Museums and Marine Labs, from Private to Public Spaces

Most of the current natural museum collections are the result of private or public initiatives, individual or institutional, above national boundaries, tying transnational research, interchanging ideas, methods, and people. This process had its roots in antiquaries and local erudite elite's discourses since the 17th century (Cabinet of Curiosities) that evolved to 18th-century royal academies (Goldgar 2007), the famous "Mirabilia" collections (of archeological, zoological, botanic, etc. objects and species), with pedagogical aims. In the transition from the 18th to 19th centuries, those collections gained larger visibility with their exhibition in new buildings under the royal or governmental protection. Moreover, they were connected with universities' curricular reforms, in particular with the introduction of new teaching methods and themes, stimulating intellectual curiosity, applied research and searching for new platforms of scientific research and its outreach.

#### 3.1. *The Dissemination of Science—From Academia to Common People*

Natural museums, aquariums, and maritime stations reinforced their roles in the early years of the 19th century under several conditions: firstly, the evolution of the concept of knowledge construction based on practical observation and experimentation; secondly, by the growing importance of the role of scientist as a professional with capacities for training, research, speak, and write (Meadows 2004); thirdly, by the ideological and political power of science constructed under the protection of princes, kings, and states that finance naturalists' expeditions in Europe and overseas, and universities, royal academies, and scientific societies, which were the guardians of all kinds of received materials, collecting, inventorying, studying, and publishing results in scientific journals (Bourguinat and Venayre 2007); finally, as happens in the 19th century by a growing improvement in the dissemination of "popular science" in which books those collections' images and photos were directed to common people (Moore 2014; Canadelli 2013).

The aquariums were part of this process of visibility and popularization of science as well as maritime labs. The concept of the modern aquarium can be traced back to the 1850s when it became fashionable for middle and upper classes in England to own private aquaria (Kisling 2001; Rehbock 1980). The "Fish House" construction at the London Zoo (1853), an initiative of the Zoological Society of London, as the world's first public aquarium, was followed throughout Europe and the United States of America by new public aquariums in Paris, London, Berlin, New York, Boston, etc. (Kisling 2001; Rehbock 1980; Dean 1897; Egerton 2014).

International exhibitions had the same purpose of scientific dissemination and it was the first step to creating a maritime station, as was the case of London International Fisheries Exhibition in 1883, under the auspices of the Marine Biological Association of the United Kingdom (Egerton 2014). Indeed, from the 19th to the 20th centuries, the growing number of marine stations in Europe had a close relationship with exhibitions and public aquariums (Kofoid 1910; Egerton 2014). One of the most famous examples was the establishment of the Naples Zoological Station and its Aquarium by Anton Dohrn in 1873–1874, thus combining "the idea of founding a scientific station with the plan of building a great public aquarium" (Dohrn 1872). The Station, known by the great public as *l'Acquario* (1872), was conceived to finance future management decisions (Dohrn 1872; Kirby 1947; Goldschmidt 1951). It was an example adopted by some research centers such as the Woods Hole Oceanographic Institution in the USA (Kofoid 1910; Canadelli 2015).

#### 3.2. *The Aquarium, Museum and Maritime Station of Naples as an International Model*

The influence of Darwinism in the creation of the Aquarium and Laboratory Station of Napoli by Anton Dohrn is well documented (e.g., Heuss 1991; Groeben 2000; Fantini 2000, 2006; Browne 2015). Moreover, Dohrn's field trips inspired him to establish this pioneering facility. At the Hamburg Zoological Garden and the bay of Kiel (1866), he met the English technician William Alford Lloyd (1815–1880) who was responsible for the Aquarium built in 1865, thus combining lab space with

seawater and animal supply (Groeben 2006). Dohrn spent two summers (1867, 1868) in Scotland at Millport, near Glasgow. Working in partnership with David Robertson (1806–1896) they constructed a portable and experimental aquarium of three tanks. He arrived in Messina, considered by some as “the Mecca of German private professors” (Heuss 1991), in October 1868, where he met Nikolai Micloucho Maclay (1846–1888). Both, the “Prussian and the Russian”, as they were called by the local fishermen, put up a makeshift lab evaluating the few results. They searched for a future solution, maybe inspired by letters received from Charles Darwin, enlarging “the idea of not only founding Aquariums, but also Zoological Stations or Laboratories in different parts of our European coasts”, such as Venice, Gibraltar, the Cape Verde Islands, Nice, Ceylon, Australia, the Cape of Good Hope and Suez, easily connected by railway stations (Groeben 2006).

The transference of the laboratory from Messina to Naples was part of a wider plan defined after his visit to the Berlin Aquarium, opened in May 1869, leading him to a sustainable strategy of public entrance fees that could finance laboratory research. The first visiting scientists arrived in September 1873 and since then the rental of research space, named “table system” or “bench system” was an important way of financing the Station. In 1909, when A. Dohrn died, more than 2200 scientists had already worked in the Station on that system (Fantini 2006; Groeben and Fokin 2013). At the same time, this scientist created a specimen supply program as a source of income to the Station, which benefitted from the expertise and skills of the curator Salvatore Lo Bianco (1860–1910). His successful method for preserving marine organisms was well known, and specimens and collections were sold to museums, universities, schools, and private individuals (Fantini 2000; Liotto 2015). This paradigm combines laboratory and maritime station, as an experimental and regular research place, no longer depending upon the limited facilities of irregular access to marine species from a fisherman’s hut supply (J. S. K. 1911).

#### 4. Portugal in the European Network of Marine Science and Outreach

Portugal was not very far from this European frame. It is possible to name scientific institutions and personalities, organizing museums of natural history and botanic gardens in the nation’s main towns and universities settlements, as Coimbra (the University city), Lisbon (the capital), and Porto (the second town of the country) (Brigola 2003).

In Coimbra, serving the only existing Portuguese University until the beginning of the 20th century (founded in 1290), the Museum of Natural History and the Botanic Garden were created in 1772. Manuel Paulino de Oliveira (1837–18?) was one of its directors (1888–1898) and responsible for the organization of the Natural Museum as well as its zoological collection (Oliveira 1892–1893).

In Lisbon, the Royal Museum of Natural History and the Botanic Garden of Ajuda were settled in 1768, being later the National Museum of Lisbon which was attached to the Academic Polytechnic School (the future University of Lisbon since 1910), whose director was the naturalist and zoologist José Vicente Barbosa du Bocage (1823–1907). This naturalist had the main objective of developing the Portuguese zoological collections, in part, a consequence of relevant political services played as Minister of Navy and Overseas in 1883 and Minister for Foreign Affairs in 1883–1886, and again in 1890 (Madruga 2013). He can be considered as a “persona” due to a certain degree of cultural recognition (Daston and Sibum 2003), both inside and outside Portugal, regarding his connections and networks in different social levels, as we will observe. In 1898, Lisbon witnessed the opening of the Aquarium Vasco da Gama, in the context of an international exhibition to celebrate the 400 years of the voyage of the Portuguese Oceans Discoveries (Pinto 2017).

In the town of Porto, the Zoological Museum associated with the Academy Polytechnic was created only in 1837 (the future University of Porto, since 1911). Augusto Nobre (1865–1946) was the notorious assistant naturalist of the Zoology Office that idealized the establishment of a museum of Zoology as an indispensable education complement. He also assumed the position of Director of the Museum (opened to the public only in 1916). Nobre set up a small maritime laboratory, anticipating a modest Maritime Zoology Station which was created near the shore of Porto (1914).

Later, in the summer of 1927, this station would integrate an aquarium, which was opened to the public (Egerton 2014), even though there were difficulties in maintaining it opened until the mid-1950s (Júnior 1957). Besides this, he was Minister of Education (1920–1922), Dean of the University of Porto (1919–1926), and Member of the Portuguese Parliament (1913–1915) (Egerton 2014; Almaça 1997).

#### 4.1. *The Contacts of Portuguese Natural Museums with Naples Zoological Station*

In the Archives of the Naples Station, there is a small handwritten book with the title “Portogallo and America 1881” (ASZAD—Stazione Zoologica Anton Dohrn Napoli, 1881). The three pages mentioned a list of names as eventual future contacts with Portugal in the towns of Lisbon, Coimbra, and Porto where there were higher school levels. That proves how Anton Dohrn was well informed about the scientific elite of each country to whom he intended to make future and fruitful contacts.

In Lisbon, the first name was of Professor José Vicente Barbosa du Bocage, which was mentioned above (Daget and Saldanha 1989). He received a handwritten letter from A. Dohrn, in French, at the end of 1880 (of which only the draft is known), that was written by A. Dohrn’s wife (Marie Dohrn) and corrected by her husband. The subject was a presentation of the polyvalence of the Station (table system, library, publication, and preparation of species) as well as a justification of the value of the Station and its infrastructures regarding “le développement rapide et spontané de la Biologie” (the fast and spontaneous development of Biology). A. Dohrn appealed to the influence of Barbosa du Bocage on the Portuguese Academy of Sciences, as well as on the Portuguese government (see Appendix A).

The answer of Barbosa du Bocage arrived three months later with news about his efforts near the Portuguese Minister of Instruction. Unfortunately, the Portuguese government was not interested in booking a table at the Naples Station. A few days later, in a second letter, Barboza du Bocage received the volumes sent by A. Dohrn: the first volume of “Fauna e Flora del Golfo di Napoli” and the Station’s Journal “Mittheilungen aus der Zoologischen Station zu Neapel”. The last letter written in a Bocage stay in Roma created the suspicion that there had been a personal contact between the two men, a hypothesis based on the Bocage letter content.

As far as it can be found in the archives of Naples Station, no more letters were exchanged and it is possible that scientific interests, in a particular Portuguese political context, and the zoologist Bocage scientific profile, could explain this silence. Firstly, because Darwinism in Portugal was more accepted by Anthropology than by Natural History, Botany, and Zoology, interested in systematic inventories, descriptions, and classification of species, following the models of the classic Linnaeus and Cuvier, and uninterested in the genealogical system of Darwin (origin, affinities, affiliations of the evolutionist code (Pereira 2001)). Secondly, during the 19th century, the Portuguese government was more committed in a classification system of species due to a real interest in Portugal’s Overseas Territories. Barboza du Bocage was responsible for the inventory of wild species, not only in Portugal but also in the African colonies (e.g., Angola and Mozambique). Besides, Bocage was particularly interested in maintaining connections with European Natural Museums or even with local scientists in Madrid, Bordeaux, London, Brussels, Strasbourg, and Leiden, from whom he received materials in exchange for Portuguese and Overseas specimens. He was also involved in a process of recovering animal specimens from the French Museums, which were stolen from the Portuguese Museum during the French Invasion Campaigns (1807–1814) (Daget and Saldanha 1989).

Yet in June 1883, the Portuguese Prince Charles, the future king of Portugal, as the son of Maria Pia de Sabóia of Italy, visited the Naples Aquarium. He received an offer from A. Dohrn, the publication “Fauna e Flora del Golfo di Napoli”, and expressed his intention to write to the Portuguese Minister of Navy (who was Barboza du Bocage) about the scientific importance of the Station (ASZAD—Stazione Zoologica Anton Dohrn Napoli).

However, if the tables system was not a priority to the Portuguese government, much more important was the Zoological Naples Station as the supplier of species or materials. During successive directions (Fantini 2006), purchase orders were made from Portugal and correspondence exchanged in order to equip labs in Portuguese Natural Museums, Universities or high-level schools, as were

the Polytechnics of Lisbon and Porto, as well as Gymnasium schools and local curators of species (see Appendix B).

From the chronological point of view, we can identify two different periods of connections between the Naples Station and Portuguese Museums and Universities. The first one was under A. Dohrn's direction (1873–1909) and dominated by the contacts with Paulino de Oliveira (1837–18?), director of the Natural Museum of Coimbra. Another one-off purchase was made by Afonso Chaves (1857–1926), a military and naturalist of the Portuguese Azores islands and, since 1893, the director of the local Meteorologist center (Tavares 2007). Also in this first period, in 1905, the Porto Academy Polytechnic and its Zoological Museum directed by the mentioned Augusto Nobre (1865–1946), bought significant quantities of species and materials regarding the absence of Portuguese Researchers at the Naples Zoological Station as Nobre argued (Nobre 1894).

The second phase, which began in 1910, is characterized by a higher diversity of buyers of Naples specimens and reflects a pedagogical evolution of Portuguese universities. One of the explanations for this is that labs are definitively no more an exclusive means of practical education for universities but also used in secondary schools such as the case of two Gymnasiums at the city of Porto ("D. Manuel" and "Rodrigues de Freitas"). Besides, a private buyer named António Peão Lopes, someone unknown in the Portuguese records, represented a business associated to a community of sellers or of professionals that worked for educational institutions and whose curriculum and life are still unknown.

#### 4.2. The Strong Scientific Connections of Portugal with England, France, and Monaco

Several reasons could explain the links between the Portuguese, the French, and the English in the area of marine zoology. First, we can consider the dominance of the French language in the Portuguese cultural elite in international communication. For instance, in Portugal, the studies by Darwin were presented through a French translation (Pereira 2001). Also, as stated above, French was the language used in the letters exchanged between A. Dohrn and Portuguese correspondents. On the other hand, since the beginning of the 1880s, France invested in marine laboratories in Arcachon (laboratory–aquarium, 1866), Roscoff (1881), Wimereux (1873), Banyuls-sur-Mer (1881) (Canadelli 2015; Kofoed 1910). Hence, these French marine labs were seen as inspired models and experiences for marine stations and aquariums in Portugal (Amorim 2009; Pinto 2017).

A second reason is related to the friendly scientific relations with Great Britain (based on an old political alliance). For example, the expedition *H.M.S. Challenger's* 3.5-year voyage (1872–1876) started from Lisbon. In this and other instances, a significant number of British scientists visited Portugal and dredged in the Portuguese seas, collaborating with the mentioned Portuguese zoologist Barboza du Bocage in a long tradition of scientific cooperation (Deacon 1997).

Thirdly, there was a strong connection between the Portuguese King Charles (1863–1908) and Prince Albert of Monaco (1848–1922) who visited Lisbon in his first yacht, the *Hirondelle*, following then to Canaries, Madeira, and in particular to the Azores islands (1885, 1887, and 1888). In the Azores, Prince Albert met Afonso Chaves (1857–1926), already mentioned above, with whom he developed a strong connection since 1897.

These islands are mentioned in the publication *On the Origins of Species by Means of Natural Selection*, in 1859, by Darwin, who visited this archipelago for the first time in 1836, after five years of a trip in the ship *Beagle*. After this, they become more and more the object of systematic investigation (Tavares 2007). In his oceanographic voyages, Prince Albert adapted his boat to the collection of specimens and the invention and improvement of instruments, in order to conserve alive or fresh specimens in the best conditions. Albert encouraged the Portuguese King Charles to carry out his own expedition that began in 1896 (Carpine 2002). On board his "Amelia boats" (I, II, III, IV) 1896–1907, he expanded his observations to the southernmost coast of Portugal, carrying out studies about tuna, sharks, marine currents, etc. (Saldanha 1997). Moreover, he established for the first time the relationship between tuna fish migrations and thermal variations in the marine environment, between

pelagic fauna and plankton (Jardim et al. 2014; Saldanha 1997). The materials of his campaigns were photographed as documental proof, in particular, plankton images showed in several national and international exhibitions. The relations with France were reinforced with the gift of a collection of marine species to the National Museum of Natural History in Paris, where King Charles was later received as a scientist among his peers (Jardim et al. 2014).

#### 4.3. *The Aquarium “Vasco da Gama” in Lisbon—An Exhibition*

Part of the materials collected by King Charles are nowadays at the Aquarium Vasco da Gama in Lisbon. Another part was integrated into the mentioned Portuguese Royal Museum, created in 1768 as a private royal collection, and transferred in 1861 to the Academy Polytechnic of Lisbon. This second part is currently under the direction of the Museum of Natural History and Science (in Lisbon) (Felismino 2015).

The aquarium Vasco da Gama was opened in 1898 on the outskirts of Lisbon as the first public aquarium in the country. It was part of an international exhibition to celebrate the 400 years of the Portuguese Discoveries (Saldanha 1997). This initiative was led by the Society of Geography and the naturalist and civil engineer Albert Girard (1860–1914), who coordinated the oceanographic expeditions and royal natural collections with King Charles (Jardim et al. 2014; Saldanha 1997). With his experience, Girard was in charge of this project. At the request of the Society, he visited other European aquariums and marine research stations in countries such as France, England, and Holland, which served as the initial basis for the creation of the aquarium (Pinto 2017). But the political context transformed a scientific exhibition into a political measure as a way to promote the Glorious Memory of Overseas Discoveries in a particular occasion, when Portugal was menaced by England (the Ultimatum) contesting the Portuguese Colonial Empire. Moreover, the construction of this aquarium was a way to gather Portuguese public pride in an emergent movement against the monarchy system (the King would be killed in 1908) and the implantation of the Republic in 1910 (Ramos 2007).

Since Girard thought that the construction of the aquarium did not follow his plans, he quit the position of director in the same year of its opening (Choffat 1916; Girard 1907). After the mentioned international exhibition ended in December 1899, the Society of Geography and the Government negotiated about the future management of the Aquarium. Since the Government refused to pay the fee requested by this scientific society to run this infrastructure, there was no agreement and the aquarium entered a period of degradation and scarce management. There were also technical problems such as several broken glasses in the aquariums, which can be explained by the lack of expertise in assembling them and also the shortage of time for its construction (Silva 1901; Girard 1907). Therefore, the Government took over in February 1901 and the Navy became responsible for its management (Silva 1901). However, considering the scarcity of experts about aquariums in the country, difficulties in addressing these and other technical issues persisted for several years.

It was the Portuguese Society of Natural Sciences, established in 1906, with the main purpose of creating a marine biological station in the country that decided to transform the aquarium Vasco da Gama to this function (Athias 1942). Therefore, this scientific society took charge of the management of this Aquarium in 1909 and was able to gradually solve its technical problems and made changes so that it could become a marine biological station. Although there were no formal connections to the Anton Dohrn Zoological Station (Naples), this was assumed as the model for the marine station/aquarium in technical reports of that time (e.g., Costa 1918; Athias 1942).

Therefore, marine research became the priority, whereas science dissemination became a secondary objective. This also marks a transition between two different models of public aquariums, which already existed in other European countries: a model of aquarium fully dedicated to inform and educate lay audiences usually located in big cities such as Paris or London; and an alternative model of aquarium, largely promoted by the Anton Dohrn Zoological Station, which was seen as an additional element to a marine laboratory (Pinto 2017).

This Society also proposed a draft law-decree to connect the Aquarium to the University of Lisbon. However, due to the strong opposition of the Navy, this initiative was not accomplished (Costa 1918). Nevertheless, the Aquarium legally became a marine biological station in 1919 (Law-Decree No. 5615, 10/05/1919) and the marine scientific research at the national level benefitted from the existence of this infrastructure and its connection to the Navy. More specifically, under the management of the director Magalhães Ramalho since 1924, the Aquarium promoted research in regions of Portugal and the Mediterranean (Serviços Municipalizados Água e Saneamento 2002). The large diversity of issues explored during these missions include the fluctuation of sardine stocks in national waters, overfishing, plankton, marine currents and topography, water quality, etc. (Serviços Municipalizados Água e Saneamento 2002). Another important event during this period was the entrance in the early 1920s of Portugal in the International Council for the Exploration of the Sea (ICES), which brought research programs and other possibilities to fund research in national waters (Went 1972; Costa 1922; Ramalho 1930). In 1950, the difficulty in maintaining both functions of marine investigation and outreach would dictate the separation of the aquarium from the marine research station (Pinto 2017). In hindsight, it is also interesting to notice the establishment of the date of 1898 to celebrate the trip of Vasco da Gama to India, that was also used later for the World Exhibition of Expo'98 (Pinto 2018). Moreover, this important event which happened in Lisbon in 1998 also implied the construction of an aquarium—the Lisbon Oceanarium—inaugurated 100 years after the historical aquarium Vasco da Gama (more details in Pinto 2017, 2018).

## 5. Conclusions

Along these pages, which followed people, pathways, and collections, we recognize the process of circulation of science. Our purpose was to observe the inclusion of the Portuguese scientific experts in international networks, discovering the several directions of Portuguese centers of science and their specimens' collections, which gained an interpretative light and identity.

Indeed, we have illustrated the path of marine natural collections, thus showing the various connections between the aquariums, natural museums, and maritime stations in Portugal with other European countries. More specifically (and never mentioned before in any research study), a strong connection was identified between Portugal and the Naples Station due to the initiative of Anton Dohrn, who wrote to naturalists working in the main cities of Portugal. This is a process with a particular interest of reconstructing the unknown process of the origin of current collections, localizing the correspondence between some Portuguese elites and A. Dohrn. Definitively, we proved that there were contacts, with the personal visit of Royal Prince Charles, future King of Portugal, to the Naples Station. Although there are no records of Portuguese researchers renting space in this Station, there was nevertheless a flow of specimens, books, and laboratory materials along the years from this maritime station to several universities, museums, and high schools in mainland Portugal and the Azores archipelago. This commercial and cultural connection was established by A. Dohrn himself and followed by further directors. During all this period, we also acknowledged the growth of High Academic Portuguese Institutions. In the cases of the University of Porto or Coimbra, which did not have a museum at that time, the purchases in Naples were one of its pillars of today's Zoological Collection, named the Naples Collection, until now a mystery of its history of incorporation of specimens.

We also searched for the reasons that pushed the Portuguese organizations of the Zoological and Biological Museums and Aquarium to an English and then French influence. In the first case, the relationship with English scientists was often signalized even if Darwinism had a scarce impact in the country in the first moment (on an initial stage). Also, the departure of the Challenger voyage from Lisbon in early 1873, as testified in a picture that includes the Portuguese King Louis, indicates that Portugal was not a peripheral country in the marine sciences.

His son, King Charles, was indeed a pioneer in oceanography at the national level, but also had close contact with Prince Albert of Monaco, in an intensive history of cooperation and friendship

which benefitted both countries. As it was recognized, he contributed to interpreting and improving knowledge about the connections between tuna fish migrations and thermal variations in the marine environment, in particular, pelagic fauna and plankton variation. Moreover, he also promoted exhibitions outside Portugal with the materials of his oceanographic expeditions (for example, in Milan, Italy), offering specimens to the Natural History Museums of Paris and London, and gaining European recognition as a marine scientist.

Although it was not a project of King Charles, this sovereign also supported the creation of the first Portuguese public aquarium (Vasco da Gama in Lisbon), which opened its doors in 1898. The conception of the infrastructure was done by Albert Girard, his assistant naturalist, which visited several Aquariums and maritime stations in France, but also England and Holland (Pinto 2017). Once more, clearly visible is an importation of technical and scientific knowledge from other countries, even though these contacts did not evolve into regular cooperation between aquarium Vasco da Gama and other European institutions. Since this aquarium later became one of the first maritime stations of the country, together with a small station established in the outskirts of Porto by Augusto Nobre in 1914, its historical importance extends beyond the popularization of science and included scientific research itself.

Finally, it was possible to signal a paradigm shift in the beginning of the 20th century, a transition between two different models of public aquariums, a model of Aquarium fully dedicated to informing and educating lay audiences and an alternative model of an aquarium, largely promoting scientific research. Indeed, the initial mission of aquarium Vasco da Gama (Lisbon) changed at the beginning of that century due to the desire to transform into a “Veritas” lab. What happened in Lisbon was the same challenge that crossed the different Laboratory Stations, as it happened in Italy (Canadelli 2015), or in Spain, even though in the latter example it was interrupted by the Civil War (Pérez-Rubin 2013). A new path will come on the 1930s (Groeben 2013), toward an evaluation of how zoological station, natural museums, and aquariums will benefit the biology of the sea and the pathology of species’ research, which opens a new chapter for a future historical approach.

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## Appendix A. Correspondance between Anton Dohrn and J.V. Barbosa du Bocage (1880–1881)

Archive of Naples Station	Date	From	To
Serie 7 GLXI Spain and Portugal (1880–1897) 1	19 October 1880	Draft letter handwritten by Marie Dohrn and corrected by A. Dohrn	J.V. Barboza du Bocage
Serie 7 GLXI Spain and Portugal (1880–1897) n° 1 (443)	14 January 1881	J.V. Barboza du Bocage	A. Dohrn
146	2 March 1881	J.V. Barboza du Bocage	A. Dohrn
443	17 October 1881	J.V. Barboza du Bocage	A. Dohrn

Sources: Archives of the Stazione Zoologica Anton Dohrn Napoli.

## Appendix B. Zoological Naples Station Species Supplies to Portuguese Institutions (1887–1928)

Director of the Zoological Station of Naples	Date	Number of Requests	Person/Institution	Town
Anton Dohrn (1873–1909)	1887 to 1894	18	Paulino de Oliveira, University of Coimbra	Coimbra
	1890–1891	3	Afonso Chaves, Municipal Museum of Ponta Delgada, S. Miguel	Açores (Azores)
	1905	1	Augusto Nobre, Academy Polytechnic of Porto, Museum of Zoology	Porto
Rinaldo Dohrn (1909–1915)	1910	3	Museum Bocage, Zoology, Academy Polytechnic	Lisbon
	1910	1	Gymnasium Alexandre Herculano	Porto
	1910	1	Gymnasium D. Manuel	Porto
	1914	3	Alberto Peão Lopes, curator, and seller	Porto
Francesco Saverio Monticelli (1915–1924)	1922	2	Faculty of Sciences, University of Porto (former Academy Polytechnic)	Porto
Reinhard Dohrn (1924–1954)	1928	1	Alberto Peão Lopes, curator, and seller	Porto

Sources: Archives of the Stazione Zoologica Anton Dohrn Napoli.

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