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For scientists, for students or for the public?

THE SHIFTING ROLES OF NATURAL HISTORY MUSEUMS

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ABSTRACT

This article aims to discuss the main roles of natural history museums and to show how these purposes have evolved and adapted throughout the museums' history, as a response to the development of natural sciences and societal change, from their creation in the 18th century to the present. It strives to demonstrate how the balance between research, teaching and disseminating knowledge to the public has successively shifted, without ever forsaking any of these functions. It is focused on Portuguese museums, but examining their place within international trends.

Keywords: museums, natural history, Portugal, public dissemination, natural sciences

Museums are crucial institutions for the study of the history of natural sciences. Natural history museums are among the oldest types of museums and they have been close companions to the emergence and development of the study of nature within modern science.

According to Jan Golinski, 'although its history in relation to the construction of scientific knowledge is only beginning to be written, it is apparent that the museum can claim a significant place on the map of locations in which science has been made. The museum comprises an enclosed setting, but one that can be open up in various ways to the world beyond. It can be adapted to the tasks of education or popularization, but it can also serve as a site of research activity. Arrangement of its contents can signal various conceptions of the order that is believed to exist in the natural world and of the human relationship to it. Museums thus encode and shape particular configurations of knowledge; they display objects but they are never simple windows to the world beyond'.¹

From its inception, this kind of museum has played three main roles: to host scientific research on the natural phenomena, both by providing material evidence (natural history collections) and institutional sustenance to researchers; to provide support to the training of new professionals; to disseminate scientific knowledge to the wider public. Often, these three roles have coincided and overlapped, but over the history of natural history museums it is

noticeable how each has gained and then lost prominence over the others. The mutations of natural sciences but also of society itself have dictated the transformations in the functions of museums.

This article aims to show how the purposes of natural history museums have evolved and adapted throughout their history, as a response to the development of natural sciences and societal change. Museum activities and statements concerning their mission are used to document these transformations. A particular attention to Portuguese museums is paid, although their connection to international trends cannot be overlooked. The article is divided into loose chronological periods, corresponding to the eighteenth, nineteenth and twentieth centuries.

NATURAL HISTORY, SCIENCE AND MUSEUMS

More so than in any other scientific field, the history of natural sciences and of its museums is closely intertwined. Museums were the core location for scientific research on nature: 'the biological collections of museums and the science that developed from them are the foundation of our understanding of life on Earth'.² According to Goodman, 'the natural history museum (...) is and was even more, especially in the nineteenth century, a privileged, legitimated constructor of the natural world. Those within the museum were licensed to speak of the nature - to name it, classify it, construct it - they produced as valorised discourse'.³

Although preceded by Van Leeuwenhoek's microscope observations, R. Hooke's 'Micrographia' or John Ray, Willoughby and Skippon's naturalist fieldwork, it is Linnaeus's eighteenth century research that is considered the landmark of natural history. His binary and hierarchical system of classification follows a systematic method of precise rules that provided an efficient and universal basis for botany and a necessary preliminary for the theory of evolution.⁴

Foucault's ground-breaking work on the epistemology of the early natural sciences proposes that what distinguishes natural history from former studies and descriptions of plants and animals is a new way of naming things with regard to observation and discourse, documented by 'spaces where things are juxtaposed: herbariums, collections, gardens; the place of this history is an atemporal rectangle, where, devoid of any comment, of all surrounding language, beings are presented next to each other, with their visible surfaces, coming together according to their common traits and by them already virtually analysed and bearers of a single name (...) natural history is nothing more than naming the visible'.⁵ Classification is thus central to natural history, based on systematic observation, on descriptions of the beings according to set criteria, on the verification of likenesses and differences.⁶ In order to accomplish this, it is crucial to form series, systematic and comprehensive collections, that gather together specimens that represent what is typical (conformity to norm, representativeness) but also what is 'deviant' (abnormalities, pathological variations).⁷ Natural history museums and botanical gardens are thus central to the production of knowledge.

Discovering, describing, classifying and naming unknown species becomes the main activity of naturalists,⁸ many of whom are attached to museums. But collecting natural history is also an activity for amateurs. Pomian registers the significant increase in private natural history collections in Paris and Venice between the seventeenth and eighteenth centuries, signalling a 'natural history fashion trend'. Knowledge of natural sciences is disseminated to the general public via books, journals and teaching.

The way objects are disposed in museums reflects dominant theories.⁹ Early exhibitions follow closely classification principles, reconstitute the general inventory of living beings, and reproduce the order of books and treaties, functioning 'as a library of preserved specimens'.¹⁰ And although the main purpose of the early natural history museums is scientific research and there is a complete juxtaposition between the scientific object and the museum collection,¹¹ natural history museums are aimed not just at scientists and connoisseurs, but also to the general public. Museums aim to communicate and disseminate knowledge, by promoting an inteligibility that is accessible to all.

That is manifest in the labelling of specimens and in the promotion of other activities beyond exhibitions, such as lectures and guided visits.¹²

A brief analysis of the first natural history museums in Europe demonstrates the combination of these multiple purposes. The first university collections and botanical gardens date back to the sixteenth century in Italy and Holland, closely connected to the teaching of medicine and pharmacy.¹³ But it is the Ashmolean Museum that is considered as the first public museum, which opened in Oxford University in 1683, 'intended for "the knowledge of nature" acquired through the "inspection of particulars"'.¹⁴ Natural objects were displayed according to Payle's Natural Theology, with the aim of 'inducing the mental habit of associating the vision of natural phenomena to the conviction that they are the means of divine manifestation'.¹⁵ Lourenço considers this museum different from pre-existing university collections and teaching museums, since it is aimed at a wider audience and it is truly institutionalised as a museum, with its own structure and personnel.¹⁶ It was located in purpose built facilities and was associated to a Natural History School and a Chemistry Laboratory, and it provided science teaching until 1860.¹⁷

The Natural History Museum of Paris stems from the *Jardin Royal des Plantes Medicinales*, created in 1635 as a rival to Sorbonne's power and to promote the teaching of medicine in French and based on chemical medicine. Essentially a botanical garden, it also held collections of preserved botanical specimens, minerals and 'rare things in nature'.¹⁸ Its main purpose was training, but it was also open to amateurs and to the general public.¹⁹ This orientation was strengthened in the eighteenth century, when it loses its medical specificity, becoming focused on natural history, under the name of *Jardin des Plantes* and the direction of Buffon, who enlarges the garden and makes public access more regular. The turnout in lectures is so high that a new amphitheatre has to be built.²⁰ After the French Revolution it becomes a public museum, under the designation *Muséum National d'Histoire Naturelle*. It is no longer connected to the university and has no formal teaching duties. The government awards it the attributions of conservation, diffusion and research of the collections of the three natural kingdoms.

The British Museum, the first national museum in the world, opened in 1753 with the purpose of promoting 'the manifestation of the glory of God, the confutation of atheism and its consequences, the use and improvement of physic, and other arts and sciences, and benefit of mankind'.²¹ Its mixed collections included natural history specimens, some originating from the collections of the Royal Society and overseas expeditions of eminent travellers, such as Captain Cook.

THE FIRST NATURAL HISTORY MUSEUMS IN PORTUGAL

Rómulo de Carvalho²² attributes the development of natural history in Portugal in the final decades of the eighteenth century both to international influences of naturalists and to the contact with the African, Asian and South American colonies²³. Portugal is visited by several foreign scientists who publish descriptions of local fauna, such as J. Vigier, Merveilleux and Link, and a few Portuguese collectors assemble natural history cabinets.²⁴

The first natural history museum and botanical garden in the country is created by the Royal Household in 1768, with the main purpose of promoting the princes' education.²⁵ Its first director was the Italian botanist D. Vandelli and the Royal Cabinet of Natural History, later Ajuda Royal Museum, was meant to 'preserve the samples of natural productions from the colonies and the results of their analysis',²⁶ and it hosted the collections gathered through 'philosophical voyages' to the colonies of Brazil, Goa, Angola, Mozambique and Cape Verde in 1783, as well as through expeditions in mainland Portugal and the Atlantic islands.²⁷ According to Brigola, the Museum had 'a strong experimental element connected to the King's overseas strategy', being a 'scientific tool at the service of a strategy for economic development'.²⁸ Besides scientific and economic functions, the museum and botanical garden also had public

enlightenment purposes: from the last decade of the century onwards, it was open to the public once a week and visits by request from aristocrats, natural history enthusiasts, diplomats and foreign travellers were allowed on other days.

Brigola assesses that, although the economic purpose was fairly accomplished, through forestation activities in public gardens, acclimation of valuable species (such as tobacco), medicinal products to the colonies and chemical tests on raw materials for manufacturing companies, the scientific aims fell short of expectations. Vandelli's prolonged absences, an inefficient administrative model, the sheer volume of received products, lack of funds and personnel and the excessive bureaucratic burden imposed on the chief naturalist Alexandre Rodrigues Ferreira determined that few resources were diverted towards scientific work and dissemination. Many collections were left packed in boxes, unstudied and unclassified, 'whose description in scientific publications might have allowed our naturalists to become naming authors'.²⁹ The educational functions were also compromised: 'the sheer lack of physical space made impossible (or at least difficult) to follow a criterion of systematic display of specimens based on its methodical identification and taxonomical classification'.³⁰

The first natural history museum connected to a university was created in 1772 in Coimbra³¹, with the constitution of a Faculty 'expressively devoted to the teaching of natural sciences and physical and chemical sciences. It was named Faculty of Philosophy since the subjects taught in those disciplines were considered to belong to the Natural Philosophy, that is to say, the knowledge of science in its diverse aspects'.³² The statutes of the university prescribed the creation of annex institutions for providing support to teaching, among which a Natural History Museum and a Botanical Garden: 'Being manifest that nothing can contribute more to the advancement of Natural History than the continuous viewing of the objects it comprises, which produces ideas more filled with strength and truth than all descriptions, even the most exact, and figures, even the most perfect, it is necessary, in order to grip, in a dignified way, the study of Nature at the core of the University, to create a collection of the products that belong to the three kingdoms of the same nature (...) we must take care to seek to make the said collection in the most comprehensive way possible and to enrich it with the new products of Nature that can be found both in its regular functioning and in its monstrous one'.³³

The University Statutes also prescribed the physical requirements for displaying the museum collection (three rooms devoted to the three kingdoms) and to organise the botanical garden, making mandatory to give prominence to medicinal plants (the garden was shared with the Faculty of Medicine) and plants from overseas dominions. There was to be a detailed catalogue of the collection and the Natural History Professor was to be also in charge of the museum and garden.³⁴ This position was filled by D. Vandelli, who also sold his private collection to the university. The museum would also receive the legacy of José Roleen Van-Deck, remittances from the Ajuda Museum and colonial authorities, purchases from collectors and commercial houses, assortments gathered by University naturalists.³⁵ The collections were inventoried, classified and displayed in order in the rooms allocated to the museum in 1775.³⁶ However, the number of students in the Philosophical course was low and their professional careers thwarted: 'the fashion for amateur collecting among the elites, the social interest in the study of nature (...) and the acceptance of its economic usefulness by rulers did not have the proportional correspondence in the professional careers and the filling of administrative positions for which the naturalists would be disciplinary suited'.³⁷

The last of the eighteenth century museums was created within the Academy of Sciences with the justification that a collection of natural specimens, 'as long as well ordered, can result in the advancement of the arts, commerce, manufacture and all branches of economy',³⁸ but also to provide support to the lessons in natural history.³⁹ In 1781 the Academy publishes a leaflet entitled 'Brief instructions to the correspondents of the Academy of Sciences of Lisbon on the remittances of products and news pertaining the History of Nature in order to form a national Museum', a list of rules for collecting, preparing and transporting specimens for the museum and the information required for each object.⁴⁰ In 1792 the Academy receives the natural history collection of the priest José Mayne. However, the museum is only formally constituted in 1834, delayed by foreign invasions and civil war in the first decades of the nineteenth

century.⁴¹ It lasts only two decades and in 1858 is terminated and its collections transferred to the Polytechnic School.⁴²

THE TWIN IMPACTS OF THE THEORY OF EVOLUTION AND COLONIALISM

Natural sciences underwent significant transformations in the nineteenth century. Generalist natural history gives way to disciplinary (botany, zoology, geology, mineralogy) and sub-disciplinary (mammalogy, herpetology, ornithology, malacology) specialisation. The concept of life becomes central to biology, a new discipline concerned with the internal morphology of living beings.⁴³ Darwin's theory of evolution is perhaps the most noteworthy development of this period, but, advances in cellular biology by Schleiden, Schwann and Virchow, and the creation of the term ecology to label the study of environmental conditions are also relevant.⁴⁴ In geology, Cuvier's stratigraphy, the glaciation theory of Charpentier and Agassiz and Lyell's *Principles of Geology* also bring major changes in the way geological time and dynamics are perceived.⁴⁵ Geology itself becomes increasingly professional, with its own specialized publications and state institutions (such as the Geological Survey in the UK).

These transformations had profound impact on natural history museums. Museum exhibitions were changed to reflect evolution theories, by ordering specimens by chronological series and evolution schemes, from inanimate materials to more complex living organisms:⁴⁶ 'the visitor's pathway through most museums came to be governed by the irreversible succession of evolutionary series. If the essential methodological innovations in nineteenth century geology, biology and anthropology consisted in their temporalisation of spatial differences, the museum's accomplishment was to convert this temporalisation into a spatial arrangement. (...) The museum as "backteller" was characterized by its capacity to bring together, within the same space, a number of different times and to arrange them in the form of a path whose direction might be traversed in the course of an afternoon. The museum visit thus functioned and was experienced as a form of organized walking through evolutionary time'.⁴⁷ Such is the case of the palaeontology and compared anatomy gallery of the *Muséum National d'Histoire Naturelle*, 'one of the first exhibitions structured by a narrative plot (...) that popularizes biological evolution'.⁴⁸

Later on, in the early 20th century, research on ecology and the improvement in taxidermy techniques leads to a new approach to museum display, of a contextual nature: the diorama. This consists of a reconstitution of ecological environments through the use of preserved specimens in dramatic postures, integrated in detail rich scenarios, symbolizing reproduction, behaviour or feeding patterns, 'a figurative imitation of nature through abstract theoretical interpretations'.⁴⁹ This kind of display required intensive research and fieldwork and became predominant in European and North American museums.⁵⁰

These transformations reflect not only the close proximity between science and museums, but also a growing concern with the dissemination role of museums, namely with the importance of conveying scientific information to the public via the museum. This is also manifest in the separation between research collections (systematic, comprehensive, all-encompassing) and the exhibition collection (selective, following epistemological and aesthetic options).⁵¹

Nevertheless, the role museums played in the training of professionals remained central. That explains the creation of new museums within universities, such as Berlin (1810).⁵²

Besides this educational aim, in this period natural history museums also take part in the political construction of Nation States. By promoting the systematic collection and exhibition of natural specimens in the geographical area corresponding to the country, they reinforce the sense of belonging to an 'imagined community'.⁵³ Museums also became a tool for colonial domination, geared towards the economic exploration of natural resources in colonies and to the ideological promotion of an idea of empire.⁵⁴

In the early decades of the nineteenth century the *Muséum National d'Histoire Naturelle*, with such eminent figures as Geoffroy Saint-Hilaire and Georges Cuvier, led the field of natural sciences in France, promoting scientific expeditions and extending its collections. Later the University of Paris gains prominence in research and the Museum increasingly redirects its efforts to science dissemination, by opening to the public its galleries: mineralogy in 1841, zoology in 1889, palaeontology and compared anatomy in 1898. The museum also takes part in colonial policy, by offering courses for travellers and a chair in colonial agronomy.⁵⁵

In London, the natural history collections are removed from the British Museum and placed in purpose-built facilities in South Kensington, inaugurated in 1881. The collections are displayed by taxonomic groups and the museum receives the legacy of Darwin's expeditions.⁵⁶

Specialized museums, namely in the field of geology, are also created throughout Europe. Their main function was to promote research activities, but they were also geared towards the economic use of mining resources. Such is the case of the *Museum of Practical Geology* that opened in London in 1851.⁵⁷

THE GROWING FIELD OF NATURAL HISTORY MUSEUMS IN NINETEENTH CENTURY PORTUGAL

Under the influence of international trends but also of national events, the nineteenth century is a thriving period for natural sciences and their museums in Portugal.⁵⁸ Pre-existing museums continue to grow and new museums are created, but some also decline and are closed down.

The Royal Museum of Ajuda loses a substantial part of its collections due to the French invasions⁵⁹. First some of them are transferred to Brazil, where they become part of the Rio de Janeiro Museum, then other objects are confiscated and sent to France by Geoffroy Saint-Hilaire in 1808. Some of these specimens were recovered by the King Peter V in 1854 and by Barbosa du Bocage in 1859, who would write later that 'G. Saint Hilaire, who was intelligent, learned and animated by a burning zeal for zoology, used those specimens for the benefit of science, by describing them, whereas before they were laying ignored in the cabinets of the Museum of Ajuda, maybe destined, if they had remained there, to disappear, like so many others, eaten by moths'.⁶⁰ In 1835 the Museum is closed down and its collections are transferred to the Museum of the Academy of Sciences (officially created in 1834). This museum also receives the mineral collection of the Mining and Metal Intendancy of the Kingdom, as well as private donations from members and friends.⁶¹

In Coimbra, in 1885, the Museum of Natural History is divided in four sections led by the professors of each class: botany, zoology, mineralogy and geology and anthropology. It remains solely a teaching and research museum, with no public oriented activities. Fieldwork missions in Portugal and in the colonies are conducted to expand its collections.⁶²

Several new museums are created throughout the nineteenth century. The Lisbon Polytechnic School is founded in 1837, the first higher education institution in the capital city to teach natural sciences. The statutes foresaw the creation of a natural history cabinet and a botanical garden. For that reason, the following year, the School Council filled a petition for receiving the Royal Museum of Ajuda collections that were allocated to the Academy of Sciences, justifying this petition with 'the need for natural sciences professors to have at their disposal the means to impart theoretical and practical teaching, since that is the only way to achieve its perfecting and to raise and develop the taste, among masters and disciples, for the study of the said sciences'.⁶³ The Academy of Sciences lacked the conditions for exhibiting the collections, which 'impaired the progression of natural sciences in Portugal, stressing the need for their transfer',⁶⁴ as well as the funds for purchasing and preserving specimens, 'a waste and loss that that inexcusable neglect caused, not only from an academic point of view but also for industrial progress'.⁶⁵ This petition was approved only in 1858.⁶⁶ The

Museum regulations were published in 1861, under the official designation of National Museum of Lisbon, and although they stated that the primal aim of the collections was to support teaching, it ought to be open to the public 'as soon as it was properly displayed'.⁶⁷ The museum was divided in three sections – botany, zoology, mineralogy and geology – and received funding for scientific missions in the country for collecting zoological and botanical specimens. The activities of the museum naturalists focused on increasing, studying and classifying the collections, as well as publishing scientific papers.⁶⁸ The director of the zoological section, Barbosa du Bocage, publishes in 1862 'Practical instructions for collecting, preparing and sending zoological products for the Museum of Lisbon', aimed at colonial authorities, physicians and pharmacists, as well as colonists and inhabitants of mainland Portugal, since 'for collecting the natural products of the locality where one resides, for occupying the leisure of living in the countryside with chores that make the hours fly by and raise the intelligence, for studying nature and seeking to understand the great work of Creation by spelling some of the pages of its history, it is not necessary to be a naturalist by profession nor a university or academy diploma bearing sage'.⁶⁹

Despite receiving numerous donations and materials from fieldwork, the zoological section was never able to obtain complete collections of typical series.⁷⁰ Even its director had no illusions regarding the limitations of the museum: 'with the organisation allowed by its means, our institution cannot aspire to assume the importance of the great European museums (...) it is our task to endeavour to make it interesting and worthy to be visited by true lovers of science; it is more important to confer it the special features and its own and exclusive character, to recommend and to ennoble it. In order to achieve this, it requires no more than to gather within it the zoological productions of our country and our overseas possessions and to offer them, well-coordinated, to the examination and study of naturalists'.⁷¹

The Polytechnic Academy of Porto, created in 1837, was also intended to have natural history cabinets and a botanical garden. However, the natural history collections remained small and disorganized until the final decades of the century, when, partly as a result from pressure from a scientific society,⁷² they were taken in charge by the professors of each area, who produced catalogues and a scientific display of the specimens.⁷³ Thus, the mineralogy, stratigraphy and palaeontology collections were organized by Wenceslau de Lima in 1885, the zoology museum by Augusto Nobre in 1890, and the Anthropology Museum in 1926 by Mendes Correa.

Another nineteenth century natural history museum was created in the Azores in 1880, the Museu Açoreano, by a local school teacher, Carlos Machado. A few years later, ownership of the museum was transferred to the municipal authorities. Besides holding exhibitions, the museum also carried out research on natural history, meteorology and ethnography.⁷⁴

Similar to other countries, a specialized geology museum was also created in Portugal in 1855, under the administration of the governmental body in charge of this field and with a mainly economic role: the management of natural mineralogical resources⁷⁵. The Geological Museum exhibition was displayed in 1859, but a decade later part of its collections were transferred to the National Museum of Lisbon.⁷⁶ In 1901, Nery Delgado described the conditions of the exhibition: 'only a small part is displayed in glass cabinets (...) since there never was the furniture nor the personnel to give it the shape of a real museum. What was done as display, was done by the geologists of the Geological Service, sacrificing precious time of their own studies'.⁷⁷

DECLINE AND REVIVAL OF NATURAL HISTORY MUSEUMS

The early twentieth century was marked by a divorce between natural sciences and its museums. The rise of genetics, micro and molecular biology, which became dominant sub-areas in the field, dictated that these sciences no longer needed extensive museum collections. Universities became the predominant location for scientific research and experimentation came to be the core activity in science:⁷⁸ 'having occupied a spot near the centre of scientific stage,

museums were primarily displaced by laboratories. It was the later that came to define an experimental ideology of command, control and manipulation which consequently left in the shadows the knowledge based on classification that had been produced by studying museum collections'.⁷⁹

The museums became 'scientific mausoleums' and even lost their role in higher education, since new teaching technologies (experimentation, audio-visual devices) gradually replaced the use of collections. Scientific dissemination to the wider public also suffered with the competition from other museum institutions (such as zoos and natural parks, with live specimens instead of taxidermised ones) and other media, such as cinema and television.⁸⁰

However, the second half of the twentieth century brings on a change in natural history museums' fortunes. On the one hand, growing environmental concerns, coupled with the urgency of informing and engaging the public, create a new role for these museums. Environmental protection can be conveyed not only in exhibitions and educational activities, but also in research and conservation programmes run by museums: 'When exhibits are presented in a meaningful context, and with an appropriate message, they can educate visitors about important conservation issues. About 50 per cent of the world's people live in cities, and that proportion will continue to grow. Because urban life is so disconnected from nature, collection-based institutions have the potential to stimulate curiosity about wildlife, offer educational opportunities about nature, and improve the chances of winning support for its preservation'.⁸¹

Museum exhibitions have thus started to deal with new subjects, such as environment, nature preservation, interdependency between living organisms, the consequences of human intervention over ecosystems, necessary behavioural changes.⁸² International bodies reflect also this new orientation. The ICOM held an international conference on museums and environment in 1972 and the Natural History Museums and Collections International Committee adopted in the 90's as its mission statement that 'Natural history museums (...) must effectively fulfil their vital and unique role in the study of biodiversity, global change, conservation and environmental education. Their collections and associated data are recognised as being essential in fulfilling this function'.⁸³

On the other hand, natural history museums have also been influenced by the public understanding of science trend that developed from the 80's onwards. The relation between science and the public became a cause for concern for scientists and policy-makers, since supposedly low levels of scientific literacy, of enrolment in science-based secondary and upper education courses, and of public trust in science were diagnosed as a social problem requiring the public's attention, scientific analysis and political intervention.⁸⁴ The 'public understanding of science' movement consisted of an array of initiatives that 'amount almost to a public understanding of science industry, which is colonising small corners of academia, commerce and politics and generating its own momentum', producing 'clearer perspectives on previously ill-defined or even undetected problems; policies and activities designed to deal with these problems; and manifestos and protocols designed to redesign professional and educational practices'.⁸⁵ In addition to the economical (to train a sufficient number of both scientists and engineers, but also industrial workers) and the professional (to generate support for scientists) motivations, the dissemination of scientific knowledge among the population was justified also by the need to empower citizens: 'democratic citizenship in a modern society depends, among other things, on the ability of citizens to comprehend, criticise and use scientific ideas and claims'.⁸⁶ In contemporary societies, it is assumed that the public needs to possess some scientific information in order to function efficiently both in daily life (to deal with all the technological devices that surround them, to make informed consumer choices) and in political participation forums (to elect their representatives, to take part in public consultations in matters of risk, environmental assessment, consensus conferences, etc.).⁸⁷

It became widely expected that natural history museums would play a role in improving 'scientific and ecological literacy': 'Some of today's hottest political topics are deeply influenced by science, for instance, energy production, acid rain, biodiversity, gene technology and therapy, AIDS and legislation. Consequently both politicians and the electorate should have a working knowledge of science, not to become experts, but to be adequately informed, to be able to discriminate between fact and fiction and between a well-founded argument and mumbo-jumbo. In a democratic society

citizens should be able to analyse and see through expert reports and political arguments veiled behind a varnish of science'.⁸⁸

As a consequence, these issues became subjects for exhibitions and other museum activities. Natural history exhibitions also changed their display patterns, mimicking the practices of science centres, through the inclusion of interactive, hands-on devices, robotic models (often of dinosaurs), audio-visual displays and games, reconstitution of natural habitats through which visitors can walk, spaces with living animals (aquariums, terrariums, beehives, cages with birds), discovery rooms where visitors can manipulate specimens, see samples on a microscope or perform basic experiments.⁸⁹ Museums have also striven to function as meeting points between scientists and the public, conveying information between the two sides, which has been manifest in exhibitions that include references to the scientific work underlying the displays, in laboratories viewable by the public, in guided tours behind the scenes or in field expeditions.⁹⁰

This is also connected to the educational function of museums. Although their role in higher education remains limited, much investment has been made in non-formal education, both of adults and school children. Educational services have become increasingly important, promoting a wide range of activities, participating in the design of exhibitions, developing pedagogical materials, taking part in teacher training, carrying out research on pedagogy and learning through the museum medium.⁹¹ Again, the mission statement of NATHIST postulates that 'Natural history museums must vigorously promote educational programmes and exhibition themes of high quality (...) to create greater public awareness of environmental issues both in the life and earth sciences'.⁹²

Finally, the research function of museums has been partially bolstered, both by investing in areas that have been neglected by university departments (such as palaeontology, botany, zoology, entomology) in order to carry out preparatory work for exhibitions but also fieldwork and specimen collection,⁹³ and by discovering a new scientific role as 'observatories of nature and memory or its evolution'.⁹⁴ Collections function as archives, they 'document biodiversity and its distribution and to serve as a resource for research and education (...) each specimen is unique, providing multidimensional documentation in geographic space (locality), biodiversity space (taxonomy), and position in time (date)'.⁹⁵ Museum collections are one of the few places where specimens from extinct species can be found and samples can be used in new areas of biological and environmental research: the presence of environmental contaminants over time, the genetic diversity of populations, the workings of food chains, responses to climate change, population decline in certain species, biodiversity drop.⁹⁶

Again, these general trends can be illustrated by the cases of the two main natural history museums in Europe. After some decades of relative winding down of activities, the director of the *Museum National d'Histoire Naturelle* during the 50's, Heim writes an article in the UNESCO magazine, *Museum International*, proposing as a solution for this type of museums, namely a closer connection to more dynamic scientific domains such as ecology, biogeography, genetics and ethology, as well as the need to reintroduce nature in museums: to show the results of field studies and to raise awareness among visitors to the necessity of protecting nature. The Museum created in 1955 a chair in ecology and nature protection and in 1962 a service of nature preservation.⁹⁷

However, it is only in the eighties that major overhaul works begin in the zoological exhibition. In 1994 the Great Gallery of Evolution opens to the public, with a permanent exhibition dedicated to three main subjects (the diversity of living things, the evolution of life and man as a factor of evolution), coupled with a 'discovery room' with interactive devices and games.⁹⁸ The aim was to transform a centuries old museum into 'a true centre of scientific culture, a showcase for illustrating the concepts raised by a science on the making. The ambition was great, because we wanted to show visitors, through the concept of evolution, how scientists, through uncertainties, questionings, hypotheses that are verified or not, had built and modelled the theory of evolution throughout the past two centuries. And to make them understand that science does not provide definite answers but rather offers explanations that give rise to new

questions'.⁹⁹ The Museum continues to carry out research, some its centres are affiliated to CNRS, and it even grants doctoral degrees since 1989.¹⁰⁰

The *Natural History Museum* of London began its transformation process in the seventies. Gradually, systematic and taxonomic exhibitions have been replaced by thematic exhibitions, dealing with ecology, human biology, evolution and the origin of species, cosmology, volcanology, earthquakes, and climate change. Most of these displays have interactive and multimedia devices. In the beginning of the twenty-first century, an ambitious project named Darwin Centre opened to the public: the museum reserves and laboratories became accessible to visitors via information screens, guided tours, daily lectures and demonstrations and video-conferences with researchers both inside and outside of the museum.¹⁰¹

PROXIMITIES AND DISTANCES BETWEEN PORTUGUESE MUSEUMS AND CONTEMPORARY TRENDS

The reform of higher education in 1911 had implications over the natural history museums of Lisboa, Porto and Coimbra. All three became annex institutions to the Universities but the division into separate sections was kept. Teaching duties remained paramount, but a 1919 decree clarified that the National Museum of Natural History should retain its autonomy, since 'there should be conducted studies not only of taxonomy, but also experiments and research in all fields of the nature sciences, both basic and applied – to study, to guide and to exemplify, so to say, the direction of scientific research at its use. Such an end is completely different of the teaching function of courses, it can be its complement, but not its main element, to avoid the risk of neither the courses nor the National Museum accomplishing the objectives they should aim to'.¹⁰²

Throughout most of the century, these museums remained closed to the public and solely devoted to teaching and research: 'by using its laboratories, its technicians and auxiliaries, here the highest level of teaching in the three branches of the natural sciences was carried out and laboratory support to research was provided, often connected to PhD thesis and to publication in the museum's scientific journals'.¹⁰³ Scientific missions to the colonies were carried out and collections were added. The museum sections created their own scientific journals and took part in the foundation of the Portuguese Natural Sciences Society (1907) and the Portuguese Biological Society (1922).¹⁰⁴ However, changes in the dominant paradigms of the natural sciences progressively decreased the relevance of working with museum specimens.

The geological section of the National Museum of Natural History did manage to open one of its galleries to the public once a week, between 1934 and 1972, but the display was geared towards the needs of lecturers, students and researchers: 'the static nature and sheer volume of the collections that were displayed, as well as its overlong permanence, without any renewal for extended periods of time, made it unable to attract any other audiences besides the academic ones. Nothing in the analysis of its recent history leads us to believe that this museum was ever intended for disseminating geological culture among the wider public'.¹⁰⁵

A similar state of affairs was experienced at the zoological section: 'the museum has its collections piled inside ugly one kilometre long cupboards along its two thousand square metre rooms, without any glass cabinets, with the specimens all lined up inside old containers or on polished pedestals. As a scientific museum it is a huge deposit (...) of precious scientific material (...) as a public museum it satisfies none of the modern museological demands and as such it has remained closed'.¹⁰⁶ The director of the museum between 1925 and 1957, Artur Ricardo Jorge, defended the need for the museum to play both a scientific and a public dissemination function, this latter justified by the need to encourage vocations in natural sciences, and made a request to the Government to initiate the construction of the new building for the Faculty of Sciences that would include specialised facilities for the National Museum of Natural History,

in order of it to be 'at the same time a moment and indicator of the cultural degree, the imperial width and the spiritual greatness of the Portuguese People'.¹⁰⁷ Under his direction, the museum was modernised, the research and exhibition collections were separated, a new didactic collection was formed and the exhibition, displayed in taxonomic order, was open to the public in 1952, although only infrequently due to the lack of staff.¹⁰⁸ However, the following director disagreed with most of these options and considered that it no longer made sense to aggregate three diverse disciplines under the obsolete name of natural history and that there were no conditions in the museum to open a modern exhibition and that the research function had been unduly neglected.¹⁰⁹

The seventies are characterised by substantial transformations in the strategy of the museum, if not its actual activities. The Faculty of Sciences is transferred to new buildings in the university campus and the museum departments are left behind in the Polytechnic School, which signifies a spatial divorce between the museum and teaching and research that had already been happening in practice.¹¹⁰ The geological section shows a new 'awareness of the educational and cultural roles of the museum'.¹¹¹ It undergoes an internal reorganisation, new laboratories and archives are built, and a temporary exhibition is planned, 'scientifically up to date and following the rules of the new museology (...) showing the materials in an attractive way, connecting them with geological phenomena, offering a simple, clear and accessible reading, of a high scientific level'.¹¹² A museological plan is designed and sent to the Ministry of Education, together with a request for funding.¹¹³ The zoological section is in a worse state of disrepair but plans are also drawn to restructure it and 'make it suitable for fulfilling the functions for which it was created, with regard to popular education and culture'.¹¹⁴ It also dates from this period a proposal to develop the whole National Museum of Natural History, 'as a means to disseminate culture, to develop and publicise scientific knowledge, to provide populations with an pleasant way of improving their knowledge of their own country, to offer young natural science students a way of grounding and developing the bookish teachings they received'.¹¹⁵

However, all these intentions suffer a major setback with the catastrophic fire that severely damaged the Polytechnic School in 1978, destroying much of the museum collections (especially the zoological ones). Over the next three decades, the museum embarks on a slow and painstaking process of renewal, now almost completely geared towards a public role. Although research activities are still pursued (the museum still has researchers in its staff and publishes scientific journals)¹¹⁶ much of the resources are channelled to exhibitions and events for school children and the general public.

This renovation was carried out more swiftly in the geological section, which in the eighties created an educational service and started promoting temporary exhibitions, holding lectures (in a makeshift auditorium made of scaffolding), publishing a newsletter: 'The museum didn't want to die and we started with a very small exhibition in the basement, with only one glass cabinet (...). Dinosaurs was an appealing subject, that brought children into the museum to see what little we had, so we organised pedagogical workshops to have students come over. Since we didn't have a museum in the traditional sense, an open doors museum, open to tourists, open to the population, we had huge gutted salons, we had to have some activity, conferences debates, symposiums'.¹¹⁷ The key turnaround moment is the astonishingly popular 1993 exhibition on dinosaurs, with robotic models rented from the Natural History Museum in London, which set the standard for a regular programme of exhibitions that were held in the following decade and a half. Educational and public understanding of science concerns have become paramount in the content and form of these exhibitions: see for instance the latest exhibition, 'Allosaurus, a dinosaur, two continents', which is the result of a research project and aims to show the scientific process underlying new knowledge on a particular species, drawing on not just preserved or replica skeletons, but also on reconstructions of diggings and pieces that can be touched by the visitors.

Conversely, during this period the zoological section invests mainly on research and on recovering its national collection through new scientific missions. The then director opted out of holding exhibitions in 'unplastered rooms' and a permanent exhibition on ecosystems only opened in the nineties due to the inflow of funding from European programmes (CIENCIA). This orientation changed in the first decade of the 21st century, when a new board of directors

began promoting temporary exhibitions and opened a new permanent exhibition about nineteenth century zoological cabinets. A new team of young researchers is also behind some very innovative exhibitions on butterflies (2006)¹¹⁸ and insects (2010). This may signal a shift towards environmental issues, in tune with the trend in major European museums.

Although formally under a common structure, successively reaffirmed in statutes and regulations, the National Museum of Natural History functioned for most of its history as three separate departments, with separate staff, governing bodies and activities. This has changed slightly in the last few years, with the organisation of joint exhibitions and events. The latest version of the statutes (2003) places the museum under the direct responsibility of the Rectorate and assigns it the mission of 'the development of museology based on the scientific and cultural collection accrued and the results of scientific research that is carried out'.¹¹⁹

In Coimbra, it is also noticeable a change in direction of the university natural history museum towards a more significant public role. The publication of new museum statutes in 1996 signals a renewed interest by university authorities, as well as a redefinition of aims: 'The Museum of Natural History is a scientific museum, in which research and dissemination of scientific knowledge ought to be primordial in the dynamics of its activity. (...) The specific aims of the museum are: a) To promote and develop scientific and cultural actions within the sciences related to the four sections; b) To promote and carry out basic research and experimental development (...); c) To preserve its collections; d) To enlarge its collections (...); e) To publish the results of its activity...'.¹²⁰ However, each section retained a high degree of autonomy and all except the anthropological section opened to the public permanent exhibitions, with fairly modern museological concepts: Mineralogy and Geology in 1995, Botany in 1998, Zoology in 2000 and 2004. However, a project for gathering together all the university collections in a single Museum of the Sciences was unveiled in 2004, which faced some resistance, since it meant to dismantle the hard-won exhibitions. A first common exhibition, with objects from all the sections was inaugurated in 2006, on the theme of light and matter, and work is under way to transform the main building of the museum.

In Porto, a much similar process occurred. New legislation was published in the nineties, also with the aim to revitalise the Natural History Museum, and gradually all the sections renovated their exhibitions, although they have been infrequently open to the public. Some fairly successful temporary exhibitions have been held and there is also an ambitious plan to gather together all the university collections in the historical building of the Rectorate, but so far this has failed to materialise.

Accompanying the constitution of new universities and polytechnics, a few new natural history museums opened in the final decades of the twentieth century. Such is the case of the geological museum of the University of Trás-os-Montes e Alto Douro (1985) and the Botanic Museum of the Polytechnic of Beja (2002). They combine both scientific functions (to support research and training) and public dissemination functions.

As to the Geological Museum, it followed the fluctuating fortunes of the Geological Services. After a period of neglect in the first decades of the century, from the forties on its activities were revitalised, benefiting from an inflow of funding, the work of renowned researchers (such as Georges Zbyszewski, Henri Breuil, Orlando Ribeiro, Carrington da Costa, O. da Veiga Ferreira, Afonso do Paço and Abel Viana) and ambitious tasks such as the systematic cartography of the country (with greatly expanded the collections). Although the museum retained a primarily scientific role, some activities with schools were carried out.¹²¹

Nevertheless, in the seventies the museum remained a scientific deposit of specimens, even though the archaeology room was given a more visitor friendly makeover and there were plans to extend this renovation to the other rooms: 'we are the first to acknowledge that this museum could and should be more attractive and educational to the public. Although such a transformation is expensive, we are doing our best efforts to achieve this aim'.¹²² A new effort of modernization was done in the nineties, triggered by the awareness of the dwindling role of support to research. Part

of the exhibition was renovated, temporary exhibitions and other activities were organized, and a newsletter was published. Some rooms were preserved in their original forms, as “museums of the museum”¹²³. The museum objectives were defined as such: ‘1. To collect, preserve, study and publicise the evidences of the Portuguese geological, mining and archaeological heritage; 2. To provide support to the research works of the Geological Institute and the national and international scientific community, by improving access to the reference collections; 3. To promote dissemination and cultural activities, in an open and multicultural perspective; 4. To sponsor and support the study, preservation and safeguard of the Portuguese geological, mining and archaeological heritage’.¹²⁴ But a lack of human and material resources, as well as institutional upheaval (the Geological Institute to which the museum belongs was successively extinguished and reinstated) put much of these endeavours on hold.

In Ponta Delgada, Azores, the natural history section of the municipal museum gradually lost relevance to the artistic and ethnographic collections. But in 1933 a new museum of natural history is created in Funchal, based on zoological and botanical collections gathered by several priests, that to this day retains its scientific nature.

The final tier of the twentieth century is marked also by the opening of local museums devoted to natural history, attached to municipal authorities or associations. Such is the case of the Museum of the Sea in Cascais (1976), the Luís Saldanha Oceanography and Fishing Museum (1978), the Lourinhã Museum (1984), the Natural History Museum of Sintra (2009), as well as of several museums in project (Batalha, Viseu). This is part of a wider trend of growth in local museums but is also shows a renewed interest in natural sciences and a new way of conceiving local heritage, no longer confined to archaeology and ethnography. Many of these museums even develop research activities, such as paleontological diggings, although their main aim is to promote local identity and tourism, by carrying out exhibitions and events aimed at the general public.

CONCLUSION

Throughout their two and a half centuries old history, natural history museums have changed. Missions, activities and display practices have been transformed in response to the mutations of the natural sciences but also of societal challenges. The rise and fall of theoretical paradigms and changes in empirical methods dictated the fluctuating relevance of museum collections. The development of higher education and the training needs of natural sciences practitioners have also mutated over time, first promoting, then demoting the use of museums. Changing social conceptions of nature, from a resource to be exploited to an endangered good to be protected, transmuted also the role of museums. National, colonial or local ideologies have likewise been served by museums at different stages. Under different guises, the effort to bring science to the public has always been one of the purposes of these institutions. The functions of natural history museums and the three main audiences they serve – researchers, students and the public – have remained constant. It is their relative importance that has varied over time.

These trends are noticeable on general terms all over the western world and Portugal is no exception. Even though influenced by particular national events and with the usual time delay (and financial constraints) from tendencies in the core countries, Portuguese natural history museums lived through most of the expected stages and evolved in line with their social and scientific environment. Although this article has left out a few other museum types that played significant roles in the relationships between the natural sciences and their publics, such as botanical gardens, zoos or aquariums, it has striven to illustrate the shifting purposes that steer museums’ activities and displays.

Museums have changed and evolved, but an acknowledgement of their history has always been present in these transformations. Although modern and interactive exhibitions abound, most of these centuries-old museums, both in Portugal and abroad, take pains to preserve and show visitors a glimpse of past collection and exhibition practices, usually through recreations of natural history cabinets. And when what is at stake is deciding on the future of these

museums, such as the 2010's public consultation on the National Museum of Natural History, promoted by the Rector of the University of Lisbon, a historical and comparative perspective is indispensable to make informed judgments.

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1 JAN GOLINSKI, *MAKING NATURAL KNOWLEDGE: CONSTRUCTIVISM AND THE HISTORY OF SCIENCE* (CAMBRIDGE, CAMBRIDGE UNIVERSITY PRESS, 1998), 97-98

2 KEVIN WINKER, (2004) "NATURAL HISTORY MUSEUMS IN A POSTBIODIVERSITY ERA", *BIOSCIENCE*, VOL. 54, N° 3, 455

3 DAVID GOODMAN, "FEAR OF CIRCUSES: FOUNDING THE NATIONAL MUSEUM OF VICTORIA", IN *REPRESENTING THE NATION: A READER*, ED. BOSWELL AND EVANS, (LONDON: ROUTLEDGE, 2002), 259

4 SEE DONALD WORSTER, *NATURE'S ECONOMY: A HISTORY OF ECOLOGICAL IDEAS* (CAMBRIDGE: CAMBRIDGE UNIVERSITY PRESS, 1994); JOHN GRIBBIN, *SCIENCE: A HISTORY 1543-2001* (LONDON, PENGUIN BOOKS, 2002); ANA LUÍSA JANEIRA, *FAZER-VER PARA FAZER-SABER: OS MUSEUS DAS CIÊNCIAS*, (LISBOA, EDIÇÕES SALAMANDRA, 1995); SUSAN PEARCE (1992), *MUSEUM OBJECTS AND COLLECTIONS - A CULTURAL STUDY* (LEICESTER: LEICESTER UNIVERSITY PRESS, 1992)

5 FOUCAULT, *LES MOTS ET LES CHOSSES* (PARIS: GALLIMARD, 1999 (1966)), 143-144

6 SEE FOUCAULT, *LES MOTS*; KRYSZTOF POMIAN, *COLLECTIONNEURS, AMATEURS ET CURIEUX*, (PARIS, GALLIMARD, 1987); JANEIRA, *FAZER VER*; EILEAN HOOPER-GREENHILL, *MUSEUMS AND THE SHAPING OF KNOWLEDGE*, (LONDON: ROUTLEDGE, 1995); PEARSON, *MUSEUM OBJECTS*

7 PEARSON, *MUSEUM OBJECTS*; TONY BENNETT, *THE BIRTH OF THE MUSEUM - HISTORY, THEORY, POLITICS* (LONDON: ROUTLEDGE, 1995); FRANCESCO PANESE, "LES RÉGIMES MUSÉOLOGIQUES DANS LE DOMAINE DES SCIENCES", IN *SCIENCES AU MUSÉE. SCIENCES NOMADES*, ED. PELLEGRIN, (GENEVA : GEORG ÉDITEUR, 2003), 7-28.

8 POMIAN, *COLLECTIONNEURS*

- 9 SEE, FOR INSTANCE, ANTÓNIO LAFUENTE AND NURIA VALVERDE, "THE EMERGENCE OF EARLY MODERN COMMONS: TECHNOLOGY, HERITAGE AND ENLIGHTENMENT", *HOST JOURNAL OF HISTORY OF SCIENCE AND TECHNOLOGY*, VOL. 2, 2008; RICARDO ROQUE, "SKULLS WITHOUT WORDS", *HOST JOURNAL OF HISTORY OF SCIENCE AND TECHNOLOGY*, VOL.1, 2007.
- 10 PANESE, "LES RÉGIMES MUSÉOLOGIQUES", 16. SEE ALSO JANEIRA, FAZER VER AND GOODMAN, "FEAR OF CIRCUSES"
- 11 BERNARD SCHIELE, "LES SCIENCES DE LA MUSÉOLOGIE SCIENTIFIQUE?", IN *LA RÉVOLUTION DE LA MUSÉOLOGIE DES SCIENCES*, ED. SCHIELE, E KOSTER, (LYON : PRESSES UNIVERSITAIRES DE LYON, 1998) 353-378.
- 12 LEAH M MELBER AND LINDA M. ABRAHAM, "SCIENCE EDUCATION IN U. S. NATURAL HISTORY MUSEUMS: A HISTORICAL PERSPECTIVE", *SCIENCE & EDUCATION*, 11, 2002, 45-54.
- 13 EDWARD P. ALEXANDER, *MUSEUMS IN MOTION: AN INTRODUCTION TO THE HISTORY AND FUNCTIONS OF THE MUSEUM* (NASHVILLE, ASLH PRESS, 1979).
- 14 WILLEM HACKMAN, "WONDERS IN ONE CLOSET SHUT: THE EDUCATIONAL POTENTIAL OF HISTORY OF SCIENCE MUSEUMS", IN *MUSEUMS AND THE PUBLIC UNDERSTANDING OF SCIENCE*, ED. DURANT, (LONDON: SCIENCE MUSEUM, 1998), 65
- 15 ALAN MORTON, "TOMORROW'S YESTERDAYS: SCIENCE MUSEUMS AND THE FUTURE", IN *THE MUSEUM TIME-MACHINE*, ED. LUMLEY, (LONDRES, ROUTLEDGE, 1990), 131.
- 16 MARTA LOURENÇO, "CONTRIBUTIONS TO THE HISTORY OF UNIVERSITY MUSEUMS AND COLLECTIONS IN EUROPE", *MUSEOLOGIA*, VOL. 3, N.1-2 (2003), 17-26.
- 17 HACKMANN, "WONDERS IN ONE CLOSET", P. 65
- 18 MICHEL VAN PRAËT AND CÉCILE FROMONT,, "ÉLÉMENTS POUR UNE HISTOIRE DES MUSÉES D'HISTOIRE NATURELLE EN FRANCE" IN *MUSÉES ET RECHERCHÉ - ACTES DU COLLOQUE*, (PARIS : OCIM, 1995), P. 58. SEE ALSO YVES GIRAULT AND FRANÇOISE GUICHARD "DU JARDIN DES PLANTES À LA GRANDE GALERIE DE L'ÉVOLUTION: LA PRISE EN COMPTE DES PUBLICS", IN *MUSÉES ET MÉDIAS: POUR UNS CULTURE SCIENTIFIQUE ET TECHNIQUE DES CITOYENS*, ED. GIORDAN, (GENEVA : GEORG EDITEUR, 1997), 30-31; FRANCISCA HERNANDEZ-HERNANDEZ, *ÉL MUSEO COMO ESPACIO DE COMUNICACIÓN*, (GIJÓN: EDICIONES TREA S. L.1998), 93-94; ALEXANDER, *MUSEUMS IN MOTION*, 46; MICHEL VAN PRAËT, ET AL., "L'ESPRIT DU LIEU, UN CONCEPT MUSÉOLOGIQUE", IN *LA MUSÉOLOGIE DES SCIENCES ET SES PUBLICS: REGARDS CROISÉ SUR LA GRANDE GALERIE DE L'ÉVOLUTION DU MUSÉE NATIONAL D' HISTOIRE NATURELLE* , ED. EIDELMAN, E VAN PRAËT (PARIS : PUF, 2000), 15-29; LAISSUS, *LE MUSEUM NATIONAL*.
- 19 JACQUELINE EIDELMAN AND MICHEL VAN PRAET, *LA MUSÉOLOGIE DES SCIENCES ET SES PUBLICS. REGARDS CROISÉS SUR LA GRANDE GALERIE DE L'ÉVOLUTION DU MUSÉUM NATIONAL D'HISTOIRE NATURELLE*, (PARIS: PUF, 2000), 5
- 20 EIDELMAN E VAN PRAET, *LA MUSÉOLOGIE DES SCIENCES*, 5. ON THE LIFE AND WORK OF BUFFON, SEE JACQUES ROGER, *BUFFON: A LIFE IN NATURAL HISTORY* (ITHACA: CORNELL UNIVERSITY PRESS, 1997); ANTÓNIO LAFUENTE AND JAVIER MOSCOSO (EDS), *GEORGES-LOUIS LECLERC CONDE DE BUFFON (1707-1788)* (MADRID: CSIC, 1999).
- 21 THE WILL OF HANS SLOANE, QUOTED BY ALEXANDRE *MUSEUMS IN MOTION*, 45

22 RÓMULO DE CARVALHO (1906-1997) WAS A SCIENCE TEACHER AND DISSEMINATOR THAT TOOK A KEEN INTEREST IN THE HISTORY OF PORTUGUESE SCIENCE AND PUBLISHED SOME OF THE FIRST WORKS ON THIS MATTER, NAMELY ON 18TH CENTURY PHYSICS, ASTRONOMY AND NATURAL HISTORY, AND A COMPREHENSIVE HISTORY OF EDUCATION IN PORTUGAL.

23 RÓMULO DE CARVALHO, *A HISTÓRIA NATURAL EM PORTUGAL NO SÉCULO XVIII* (LISBOA: INSTITUTO DE CULTURA E LÍNGUA PORTUGUESA, 1987).

24 CARVALHO, *A HISTÓRIA NATURAL*; JOÃO CARLOS BRIGOLA, *COLECÇÕES, GABINETES E MUSEUS EM PORTUGAL NO SÉCULO XVIII* (LISBOA: FUNDAÇÃO CALOUSTE GULBENKIAN, 2003); MARIA DO MAR GAGO, “A HISTÓRIA DA BIOLOGIA EM PORTUGAL”, IN *BIOLOGIA E BIÓLOGOS EM PORTUGAL*, ED. M. E. GONAÇLVES AND J. FREIRE (LISBOA: ESFERA DO CAOS, 2009), 175.

25 BRIGOLA, *COLECÇÕES*, 99-101; CARVALHO, *A HISTÓRIA NATURAL*, P. 63; PAULO OLIVEIRA RAMOS, “BREVE HISTÓRIA DO MUSEU EM PORTUGAL”, IN *INICIAÇÃO À MUSEOLOGIA*, ED. ROCHA-TRINDADE (LISBOA, UNIVERSIDADE ABERTA, 1993), 22-23; MADALENA BRÁS TEIXEIRA, “OS PRIMEIROS MUSEUS CRIADOS EM PORTUGAL”, IN *BIBLIOTECAS, ARQUIVOS E MUSEUS*, Nº 1, 1984, 189-191; MADALENA BRÁS TEIXEIRA, *PRIMÓRDIOS DA INVESTIGAÇÃO E DA ACTIVIDADE MUSEOLÓGICA EM PORTUGAL*, SEPARATA DA REVISTA DE MUSEOLOGÍA MONOGRAFÍAS *MUSEOS Y MUSEOLOGÍA EN PORTUGAL - UNA RUTA IBÉRICA PARA EL FUTURO*, FEBRUARY 2000, 13; MARIA DA GRAÇA SALVADO CANELHAS, “MUSEUS PORTUGUESES DE HISTÓRIA NATURAL - PERSPECTIVA HISTÓRICA”, *CADERNOS DE MUSEOLOGIA* Nº 1, APOM, 1983, 12.

26 DOMINGOS VANDELLI (1795), “RELAÇÃO DA ORIGEM E ESTADO PRESENTE DO REAL JARDIM BOTÂNICO, LABORATÓRIO QUÍMICO, MUSEU DE HISTÓRIA NATURAL E CASA DO RISCO”, 1795, IN *MEMÓRIAS DE HISTÓRIA NATURAL*, ED. J. L. CARDOSO, (PORTO: PORTO EDITORA, 2003), 51-58.

27 BRIGOLA, *COLECÇÕES*, 194-200; CARVALHO, *A HISTÓRIA NATURAL*, 83; J. BETTENCOURT FERREIRA, “ENSINO POSITIVO E PRÁTICO. OS MUSEUS. O MUSEU DE HISTORIA NATURAL DE LISBOA”. *REVISTA DE EDUCAÇÃO E ENSINO*, ANNO VII (6): 261-272; (8): 342-351; (9): 420-427; (12): 561-564. MUSEUS. MUSEU BOCAGE. 1892, 268; GAGO, “A HISTÓRIA DA BIOLOGIA”, 180.

28 BRIGOLA, *COLECÇÕES*, 114-115

29 BRIGOLA, *COLECÇÕES*, 255; SEE ALSO FERREIRA “ENSINO POSITIVO”

30 BRIGOLA, *COLECÇÕES*, 305.

31 INTEGRATED IN THE REFORM OF THE UNIVERSITY OF COIMBRA, A POLITICAL DECISION INSPIRED BY THE ENLIGHTENMENT MOVEMENT THAT WOULD PROVIDE ‘AN INSTITUTIONAL FRAMEWORK WITHIN WHICH MEN OF SCIENCE COULD CARRY OUT THEIR ACTIVITIES ON A PROFESSIONAL BASIS’, ANA CARNEIRO AND ANA SIMÕES, “ELINGHTNMENT SCIENCE IN PORTUGAL: THE ESTRANGEIRADOS AND THEIR COMMUNICATION NETWORKS”, *SOCIAL STUDIES OF SCIENCE*, 30, 2000, 604. SEE ALSO MARIA EDUARDA CRUZEIRO, “A REFORMA POMBALINA NA HISTÓRIA DA UNIVERSIDADE”, *ANÁLISE SOCIAL*, 1000, 1988; ANA CRISTINA ARAÚJO (ED.), *O MARQUÊS DE POMBAL E A UNIVERSIDADE* (COIMBRA: IMPRENSA DA UNIVERSIDADE DE COIMBRA, 2000).

32 CARVALHO, *A HISTÓRIA NATURAL*, 40

33 STATUTES OF THE UNIVERSITY OF COIMBRA, 1773, VOL. III, PP. 388-390, IN CARVALHO, *A HISTÓRIA NATURAL*, 45, 57-58. SEE ALSO GAGO, “A HISTÓRIA DA BIOLOGIA”, 176-177.

34 CARVALHO, *A HISTÓRIA NATURAL*

- 35 CARVALHO, *A HISTÓRIA NATURAL*; TEIXEIRA, “OS PRIMEIROS MUSEUS”.
- 36 CANELHAS “MUSEUS PORTUGUESES DE HISTÓRIA NATURAL”
- 37 BRIGOLA *COLECCÕES*, 189.
- 38 RAMOS, “BREVE HISTÓRIA”, 27
- 39 CARVALHO, *A HISTÓRIA NATURAL*
- 40 CARVALHO, *A HISTÓRIA NATURAL*, 74; MANUELA CANTINHO PEREIRA, *O MUSEU ETNOGRÁFICO DA SOCIEDADE DE GEOGRAFIA DE LISBOA: MODERNIDADE, COLONIZAÇÃO E ALTERIDADE* (LISBOA: FUNDAÇÃO CALOUSTE GULBENKIAN, 2006), 18-22.
- 41 FERREIRA “ENSINO POSITIVO”; TEIXEIRA, “OS PRIMEIROS MUSEUS”, 198-199; TEIXEIRA, *PRIMÓRDIOS DA INVESTIGAÇÃO*, 16.; GAGO, “A HISTÓRIA DA BIOLOGIA”, 182-183.
- 42 GAGO, “A HISTÓRIA DA BIOLOGIA...”, 183.
- 43 JANEIRA FAZER VER; FOUCAULT, *LES MOTS*. PETER J. BOWLER AND JOHN V. PICKSTONE (EDS.), *THE MODERN BIOLOGICAL AND EARTH SCIENCES* (CAMBRIDGE: CAMBRIDGE UNIVERSITY PRESS, 2009).
- 44 WORSTER, *NATURE'S ECONOMY*, 117, 155; GRIBBIN, *SCIENCE: A HISTORY*, 349
- 45 WORSTER, *NATURE'S ECONOMY*, 138-140; GRIBBIN, *SCIENCE: A HISTORY*, 324
- 46 SCHIELE, “LES SCIENCES DE LA MUSEOLOGY”, 367; BENNETT, *THE BIRTH OF THE MUSEUM*, 43, 182; TONY BENNETT, “THE EXHIBITIONARY COMPLEX” IN *REPRESENTING THE NATION: A READER - HISTORIES HERITAGE AND MUSEUMS*, ED. BOSWEL, AND EVANS, (LONDON: ROUTLEDGE, 2002), 349; PEARSON, *MUSEUM OBJECTS*, P. 103
- 47 BENNETT, *THE BIRTH OF THE MUSEUM*, 186
- 48 EIDELMAN E VAN PRAET, *LA MUSÉOLOGIE DES SCIENCES*, 5
- 49 PANESE “LES REGIMES MUSEOLOGIQUES”, 17. SEE ALSO JANEIRA, *FAZER VER*, 40; PEARSON, *MUSEUM OBJECTS*; KAREN WONDERS, *HABITAT DIORAMAS* (UPPSALA: ALMQUIST AND WIKSELL, 1993).
- 50 VAN PRAET AND FROMONT, “ELEMENTS POUR UNE HISTOIRE”
- 51 HERNANDEZ-HERNANDEZ, *EL MUSEO COMO ESPACIO*, 98; JANEIRA, *FAZER VER*, 41; ALEXANDER, *MUSEUMS IN MOTION*, 57; BENNETT, *THE BIRTH OF THE MUSEUM*, 41; LOURENÇO, “CONTRIBUTIONS TO THE HISTORY”
- 52 LIBA TAUB, “THE CIRCULATION OF IDEAS” IN *THE UNIVERSEUM PROJECT*, [HTTP://WWW.UNIVERSEUM.DE/INTRO/INDEX.HTML](http://www.universeum.de/intro/index.html); CORNELIA WEBER, “FROM INDEPENDENT UNIVERSITY COLLECTIONS TO A WISSENTHEATER: AN AMBITIOUS PROJECT AT THE HUMBOLT UNIVERSITY OF BERLIN”, *MUSEOLOGIA*, V2 (1-2), 2002, 81-88
- 53 MARTIN PRÖSLER, “MUSEUMS AND GLOBALIZATION”, IN *THEORIZING MUSEUMS*, ED. MACDONALD AND FYFE (OXFORD: BLACKWELL, 1998), 31-32; FILIPA LOWNDES VICENTE, *VIAGENS E EXPOSIÇÕES - D. PEDRO NA EUROPA DO SEC. XIX*, (LISBOA: GÓTICA, 2003), 309

54 CHARLES SAUMAREZ SMITH, "MUSEUMS, ARTEFACTS AND MEANING" IN *THE NEW MUSEOLOGY*, ED. P. VERGO (LONDON: REAKTION BOOKS, 1989), 9; LUDMILLA JORDANOVA (1989), "OBJECTS OF KNOWLEDGE: A HISTORICAL PERSPECTIVE ON MUSEUMS", IN *THE NEW MUSEOLOGY*, ED. P. VERGO, (LONDON: REAKTION BOOKS, 1989), 32; VICENTE, *VIAGENS E EXPOSIÇÕES*, 312.

55 EIDELMAN E VAN PRAET, *LA MUSÉOLOGIE DES SCIENCES*

56 HERNANDEZ-HERNADEZ, *EL MUSEO COMO ESPACIO*, 97; ALEXANDER, *MUSEUMS IN MOTION*, 46; CHALMERS, "PUBLIC UNDERSTANDING OF RESEARCH", 280.

57 P. S. DOUGHTY, (1996), "MUSEUMS AND GEOLOGY", IN *EXPLORING SCIENCE IN MUSEUMS*, ED. S. PEARCE, (LONDON: THE ATHLON PRESS, 1996), 5-28; SIMON KNELL, "THE ROLLER-COASTER OF MUSEUM GEOLOGY", IN *EXPLORING SCIENCE IN MUSEUMS*, ED. S. PEARCE (LONDON: THE ATHLON PRESS, 1996), 29-56.

58 FOR A BRIEF HISTORY OF THE DEVELOPMENT OF BIOLOGY IN PORTUGAL, SEE GAGO, "A HISTÓRIA DA BIOLOGIA".

59 BRIGOLA *COLECÇÕES*, 200

60 JOSÉ MARIA BARBOSA DU BOCAGE "INSTRUÇÕES PRÁTICAS SOBRE O MODO DE COLLIGIR, PREPARAR E REMETTER PRODUCTOS ZOOLÓGICOS PARA O MUSEU DE LISBOA", 1862, 4

61 FERREIRA, "ENSINO POSITIVO"; ALFREDO AUGUSTO DE OLIVEIRA MACHADO E COSTA, (1937), *O MUSEU MINERALÓGICO E GEOLÓGICO*, SEPARATA DO Nº 3 DA REVISTA DA FCUL.

62 CANELHAS, "MUSEUS PORTUGUESES DE HISTÓRIA NATURAL".

63 A. M. GALOPIM DE CARVALHO E CÉSAR LINO LOPES, "GEOCIÊNCIAS NA UNIVERSIDADE DE LISBOA - INVESTIGAÇÃO CIENTÍFICA E MUSEOLOGIA", IN *CATÁLOGO DA EXPOSIÇÃO COMEMORATIVA DO 150º ANIVERSÁRIO DA ESCOLA POLITÉCNICA E 75º ANIVERSÁRIO DA FACULDADE DE CIÊNCIAS DA UNIVERSIDADE DE LISBOA*, 1987, 250; COSTA, *O MUSEU MINERALÓGICO*, 13

64 COSTA, *O MUSEU MINERALÓGICO*, 12

65 FERREIRA, "ENSINO POSITIVO", 350

66 COSTA, *O MUSEU MINERALÓGICO*, 15; FERREIRA, "ENSINO POSITIVO", 423

67 FERREIRA, "ENSINO POSITIVO", 562

68 CARVALHO E LOPES, "GEOCIÊNCIAS NA UNIVERSIDADE DE LISBOA", FERREIRA, "ENSINO POSITIVO"; CARLOS ALMAÇA, "A ZOOLOGIA E A ANTROPOLOGIA NA ESCOLA POLITÉCNICA E NA FCUL", *CATÁLOGO DA EXPOSIÇÃO COMEMORATIVA DO 150º ANIVERSÁRIO DA ESCOLA POLITÉCNICA E 75º ANIVERSÁRIO DA FACULDADE DE CIÊNCIAS DA UNIVERSIDADE DE LISBOA*, 1987, 293-312; CARLOS ALMAÇA, (1993), *BOSQUEJO HISTÓRICO DA ZOOLOGIA EM PORTUGAL*, (LISBOA: PUBLICAÇÕES DO MUSEU BOCAGE - MNHN), 1993; GAGO, "A HISTÓRIA DA BIOLOGIA", 185.

69 BOCAGE, "INSTRUÇÕES", 9

70 FERREIRA, "ENSINO POSITIVO", 268

- 71 BOCAGE, "INSTRUCCÖES", 7-8
- 72 SEE RICARDO ROQUE, *ANTROPOLOGIA E IMPÉRIO*, (LISBOA: INSTITUTO DE CIÊNCIAS SOCIAIS, 2001), 167
- 73 SEE TERESA PEREIRA VIANA, "A UNIVERSIDADE, OS MUSEUS E O PORTO", IN *BOLETIM DA UNIVERSIDADE DO PORTO*, ANO 2, Nº 14-15, 1992, 5-10
- 74 CANELHAS "MUSEUS PORTUGUESES DE HISTÓRIA NATURAL", 52
- 75 SEE ANA CARNEIRO AND TERESA SALOMÉ MOTA, "THE GEOLOGICAL SURVEY OF PORTUGAL (1857-1948), AN OVERVIEW", *EARTH SCIENCES HISTORY*, SPECIAL ISSUE, PIETRO CORSI (ED.), 28 (2007), 85-96.
- 76 NERY DELGADO, *LES SERVICES GÉOLOGIQUES DU PORTUGAL*, COMUNICAÇÕES DA DIRECÇÃO DOS SERVIÇOS GEOLÓGICOS, TOMO IV, FASC. I., 1901; F. MOUTINHO DE ALMEIDA AND A. BARROS CARVALHOSA (1974), *BREVE HISTÓRIA DOS SERVIÇOS GEOLÓGICOS EM PORTUGAL*, SEPARATA DAS COMUNICAÇÕES DO SERVIÇOS GEOLÓGICOS DE PORTUGAL, Nº 58, 1974, 239-265.
- 77 DELGADO, *LES SERVICES GÉOLOGIQUES*, 25
- 78 SCHIELE, "LES SCIENCES DE LA MUSÉOLOGIE » ; ALEXANDER, *MUSEUMS IN MOTION*, 59; WINKER, "NATURAL HISTORY MUSEUMS", 455; PANESE, "LES RÉGIMES MUSÉOLOGIQUES », 18; JANEIRA, *FAZER VER*; ROGER HEIM (2001 (1951)), "PROTECTION DE LA NATURE ET MUSÉES D'HISTOIRE NATURELLE", IN *MUSÉUM INTERNATIONAL*, Nº 212, VOL. 53, Nº 4, 2001, 30-32.
- 79KEN ARNOLD, "PRESENTING SCIENCE AS PRODUCT OR AS PROCESSES: MUSEUMS AND THE MAKING OF SCIENCE" IN *EXPLORING SCIENCE IN MUSEUMS*, ED. S. PEARCE, (LONDRES: THE ATHLON PRESS, 1996), 60
- 80 VAN PRAET AND FROMONT, "ELÉMENTS POUR UNE HISTOIRE"; HEIM "PROTECTION DE LA NATURE", GOODMAN, "FEAR OF CIRCUSES", 269; DONNA HARAWAY, *PRIMATE VISIONS: GENDER, RACE, AND NATURE IN THE WORLD OF MODERN SCIENCE*, (LONDON: ROUTLEDGE, 1990), 42-45
- 81 BRIAN MILLER ET AL., "EVALUATING THE CONSERVATION MISSION OF ZOOS, AQUARIUMS, BOTANICAL GARDENS, AND NATURAL HISTORY MUSEUMS", IN *CONSERVATION BIOLOGY*, VOL. 18, Nº 1, 2004, 87
- 82 S. M. NAIR, "L'ÉCOLOGIE ENTRE AU MUSÉE", *MUSEUM INTERNATIONAL*, Nº 190, VOL. 48, Nº 2, 1996, 12; P. BLANDIN AND F. GALAUNGAU-QUÉRAT, "DES 'RELATIONS HOMME-NATURE' À 'L'HOMME, FACTEUR D'ÉVOLUTION': GENÈSE D'UN PROPOS MUSÉAL" IN *LA MUSÉOLOGIE DES SCIENCES ET SES PUBLICS: REGARDS CROISÉ SUR LA GRANDE GALERIE DE L'ÉVOLUTION DU MUSÉE NATIONAL D' HISTOIRE NATURELLE*, ED. EIDELMAN, E VAN PRAËT, PARIS, PUF, 2000), 31-52.
- 83 [HTTP://WWW.GGWINTER.DE/ICOM/FMIS.HTM](http://www.ggwinter.de/icom/fmis.htm)
- 84JANE GREGORY AND STEVE MILLER, *SCIENCE IN PUBLIC: COMMUNICATION, CULTURE AND CREDIBILITY*, (NEW YORK: PLENUM TRADE, 1998); ALAN IRWIN, *CITIZEN SCIENCE* (LONDON: ROUTLEDGE, 1995); BRUCE V. LEWENSTEIN, (1995), "SCIENCE AND THE MEDIA", IN *HANDBOOK OF SCIENCE AND TECHNOLOGY STUDIES*, ED. S. JASANOFF, ET AL., (LONDON: SAGE, 1995), 343-360.
- 85 GREGORY AND MILLER, *SCIENCE IN PUBLIC*, 7
- 86 HOUSE OF LORDS, *SCIENCE AND SOCIETY*, SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY, THIRD REPORT, (LONDON: HMSO, 2000), C1

- 87 GREGORY AND MILLER, *SCIENCE IN PUBLIC*; IRWIN, *CITIZEN SCIENCE*.
- 88 ANDREAS L. STEIGEN, "SCIENTIFIC ILLITERACY: A CHALLENGE TO NATURAL HISTORY MUSEUMS", *MUSEUM INTERNATIONAL*, N. 188, 1995, 51
- 89 ANDREAS L. STEIGEN, "LES MUSÉUMS ET L'ENVIRONNEMENT PLANÉTAIRE", IN *MUSÉUM INTERNATIONAL*, N° 190, VOL. 48, N° 2, 1996, 7; NAIR, "L'ÉCOLOGIE ENTRE", 8-10; MELBER AND ABRAHAM, "SCIENCE EDUCATION", 48
- 90 STEIGEN, "SCIENTIFIC ILLITERACY"; MELBER AND ABRAHAM, "SCIENCE EDUCATION".
- 91 NAIR, "L'ÉCOLOGIE ENTRE", 13; MELBER AND ABRAHAM, "SCIENCE EDUCATION".
- 92 [HTTP://WWW.GGWINTER.DE/ICOM/FMIS.HTM](http://www.ggwinter.de/icom/fmis.htm)
- 93 BRUCE V. LEWENSTEIN AND STEVEN ALLISON-BUNNEL, "AU SERVICE SIMULTANÉ DU PUBLIC ET DES SCIENTIFIQUES", IN *LA RÉVOLUTION DE LA MUSÉOLOGIE DES SCIENCES*, ED. B. SCHIELE AND KOSTER, (LYON: PRESSES UNIVERSITAIRES DE LYON, 1998), 160, 169.
- 94 VAN PRAET AND FROMONT "ÉLÉMENTS POUR UNE HISTOIRE", 61
- 95 WINKER, "NATURAL HISTORY MUSEUMS", 455-456
- 96 WINKER, "NATURAL HISTORY MUSEUMS", 456-457; H. BRADLEY SCHAFFER, ROBERT N. FISHER AND CARLOS DAVIDSON, "THE ROLE OF NATURAL HISTORY COLLECTIONS IN DOCUMENTING SPECIES DECLINE", *TREE*, VOL 3, N. 1, 1998; MD. BROOKE, "WHY MUSEUMS MATTER", *TRENDS IN ECOLOGY AND EVOLUTION*, 15, 2000:136-137.
- 97 BLANDIN AND GALANGAU-QUÉRAT, "DES 'RELATIONS HOMME-NATURE'"
- 98 EIDELMAN AND VAN PRAET, *LA MUSÉOLOGIE DES SCIENCES*; GIRAULT AND GUICHARD, "DU JARDIN DES PLANTES", 31; YVES GIRAULT AND FRANÇOISE GUICHARD, (2000), "SPÉCIFICITÉ DE LA DIDACTIQUE MUSÉALE EN BIOLOGIE" IN *LA MUSÉOLOGIE DES SCIENCES ET SES PUBLICS: REGARDS CROISÉ SUR LA GRANDE GALERIE DE L'ÉVOLUTION DU MUSÉE NATIONAL D' HISTOIRE NATURELLE*, ED. EIDELMAN AND VAN PRAËT, (PARIS : PUF, 2000) 30; JACQUES MAIGRET, "L'ESTHÉTIQUE AU SERVICE DE LA SCIENCE : LA GRANDE GALERIE DE L'ÉVOLUTION À PARIS", *MUSÉUM INTERNATIONAL*, N.° 190, VOL. 48, N.° 2, 1996 ; MICHEL VAN PRAËT ET AL., "L'ESPRIT DU LIEU, UN CONCEPT MUSÉOLOGIQUE", IN *LA MUSÉOLOGIE DES SCIENCES ET SES PUBLICS: REGARDS CROISÉ SUR LA GRANDE GALERIE DE L'ÉVOLUTION DU MUSÉE NATIONAL D' HISTOIRE NATURELLE*, ED. EIDELMAN, E VAN PRAËT, (PARIS : PUF, 2000), 28-29; JACQUES MAIGRET AND FLORENCE RAULIN-CERCEAU, (2000), "LES COLLECTIONS MISES EN SCÈNE", IN *LA MUSÉOLOGIE DES SCIENCES ET SES PUBLICS: REGARDS CROISÉ SUR LA GRANDE GALERIE DE L'ÉVOLUTION DU MUSÉE NATIONAL D' HISTOIRE NATURELLE*, ED. EIDELMAN, E VAN PRAËT, (PARIS : PUF, 2000), 53-61 ; BLANDIN E GALANGAU-QUÉRAT, "DES 'RELATIONS HOMME-NATURE'"
- 99 MAIGRET, , "L'ESTHÉTIQUE AU SERVICE", 19-20
- 100 LAISSUS, *LE MUSÉUM NATIONAL*, 90-92.
- 101 LEWENSTEIN AND ALLISON-BUNNELL, "AU SERVICE SIMULTANÉ", 167; CHALMERS, "PUBLIC UNDERSTANDING OF RESEARCH"
- 102 DECREE N. 5:689, *DIÁRIO DA REPUBLICA*, 10TH MAY 1919

- 103 A. M. GALOPIM DE CARVALHO, “O MUSEU ABRIU-SE”, 1997,
[HTTP://GRALHAS0.TRIPOD.COM/SALAMAND/GALOPIM.HTML](http://gralhas0.tripod.com/salamand/galopim.html) (LAST ACCESSED ON 25TH JUNE 2011)
- 104 GAGO, “A HISTÓRIA DA BIOLOGIA”, 201.
- 105 CARVALHO E LOPES, “GEOCIÊNCIAS NA UNIVERSIDADE DE LISBOA”, 252
- 106 ARTUR RICARDO JORGE, “MUSEUS DE HISTÓRIA NATURAL, SUA FINALIDADE E PRINCÍPIOS GERAIS DA SUA ORGANIZAÇÃO”, *BOLETIM DA SOCIEDADE PORTUGUESA DE CIÊNCIAS NATURAIS*, VOL. XIII, SUPLEMENTO 5, 1942, 82
- 107 JORGE, ARTUR RICARDO, “A DUPLA MISSÃO, CIENTÍFICA E CULTURAL, DOS MUSEUS DE HISTÓRIA NATURAL À LUZ DA BIOLOGIA E DA MUSEOLOGIA MODERNAS”, *SEPARATA DOS ARQUIVOS BOCAGE XIII*, 1953, 22
- 108 CARLOS ALMAÇA, *MUSEU BOCAGE, ENSINO E EXIBIÇÃO* (LISBOA: PUBLICAÇÕES DO MUSEU BOCAGE - MNHN), 2000.
- 109 J. A. SERRA, “MUSEU E LABORATÓRIO ZOOLOGICO E ANTROPOLÓGICO - RELATÓRIO DO DIRECTOR” , IN *REVISTA PORTUGUESA DE ZOOLOGIA E BIOLOGIA GERAL*, VOL. 3, 1961, 1-24.
- 110 A SIMILAR PROCESS HAPPENS IN PORTO LATER, WHEN THE FACULTY OF SCIENCES LEAVES ITS HISTORICAL BUILDING IN THE CITY CENTRE FOR A NEW CAMPUS CLOSER TO THE OTHER FACULTIES.
- 111 CARVALHO E LOPES, “GEOCIÊNCIAS NA UNIVERSIDADE DE LISBOA”, 261
- 112 CARVALHO E LOPES, “GEOCIÊNCIAS NA UNIVERSIDADE DE LISBOA”, 261
- 113 CARLOS MATOS ALVES, “O MUSEU E LABORATÓRIO MINERALÓGICO E GEOLÓGICO DA FCUL E O INCÊNDIO DE 1978”, *BOLETIM DO MUSEU E LABORATÓRIO MINERALÓGICO E GEOLÓGICO*, VOL. 16, 1980, 25-34.
- 114 A. A. SOARES, (1979), “MUSEU E PATRIMÓNIO CULTURAL NACIONAL”, *ACTAS DO COLÓQUIO APOM 1976*, (LISBOA: APOM, 1979), 137
- 115 CARLOS TEIXEIRA, “MUSEU NACIONAL DE HISTÓRIA NATURAL”, IN *PANORAMA MUSEOLÓGICO PORTUGUÊS - ACTAS DO COLÓQUIO APOM 1976*, (LISBOA: APOM, 1979), 145
- 116 ANA DELICADO, “PRODUÇÃO E REPRODUÇÃO DA CIÊNCIA NOS MUSEUS”, *ANÁLISE SOCIAL*, Nº186, 2008
- 117 INTERVIEW WITH GALOPIM DE CARVALHO, 2004.
- 118 ANA DELICADO, “BETWEEN ENVIRONMENT AND SCIENCE: AN EXHIBITION ABOUT BUTTERFLIES”, IN ANASTASIA FILIPPOPOLITI (EDS.), *SCIENCE EXHIBITIONS: COMMUNICATION AND EVALUATION* (EDINBURGH: MUSEUMSETC, 2010), 464-485.
- 119 ARTICLE 4, STATUTES OF THE NATIONAL MUSEUM OF NATURAL HISTORY, *DIÁRIO DA REPÚBLICA* Nº 128, II SÉRIE, 3RD OF JUNE
- 120 ESTATUTOS DO MHNUC, ART.3º, 1996

121 JORGE SIMÕES, *OS SERVIÇOS GEOLÓGICOS EM PORTUGAL*, (LISBOA: OFICINA DO MUSEU COMERCIAL, 1922); ALMEIDA AND CARVALHOSA, *BREVE HISTÓRIA DOS SERVIÇOS GEOLÓGICOS*; JOSÉ BRANDÃO, “A COLEÇÃO PALEONTOLÓGICA”, *BOLETIM INFORMATIVO DO MIGM*, Nº 4, 2003.

122 M. MAGALHÃES RAMALHO, *GUIA DO MUSEU GEOLÓGICO NACIONAL* (LISBOA: SERVIÇOS GEOLÓGICOS DE PORTUGAL, 1979), 9

123 MUSEUM NEWSLETTER N. 1, 2002.

124 MUSEUM NEWSLETTER N. 3, 2002.

125 ANA DELICADO, *A MUSEALIZAÇÃO DA CIÊNCIA EM PORTUGAL* (LISBOA, FUNDAÇÃO CALOUSTE GULBENKIAN, 2009).