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I Seminário Nacional de Conservação de Coleções Científicas

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Marta C. Lourenço (Editora convidada | Guest editor)

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Lisboa, 15 de Julho de 2019

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Fora do radar até agora: A conservação do património e das coleções científicas

Off the radar so far: The conservation of scientific collections and heritage

MARTA C. LOURENÇO
Editora convidada
Guest editor

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Portuguese Research Infrastructure of Scientific Collections

Que eu saiba, este é o primeiro volume dedicado a coleções científicas numa revista de conservação, algo que não posso deixar de agradecer ao anterior diretor da *Conservar Património*, António João Cruz, e à atual diretora, Elin Figueiredo. O facto de serem apenas quatro artigos não significa que a problemática seja escassa ou desinteressante, mas apenas que estamos na infância da arte. Espero que estes quatro artigos abram novas perspectivas de investigação em conservação ou, pelo menos, despertem a curiosidade dos conservadores-restauradores, sobretudo os que estão atualmente em formação.

Na minha vida de profissional de museus, apercebi-me cedo que as coleções científicas e o património da ciência estão fora do radar da conservação. Os objetos à minha responsabilidade de curadoria – barómetros, máquinas de cálculo, telescópios, lanternas mágicas, telégrafos – usados nos séculos XIX e XX para fins de ensino e investigação nas mais diversas áreas científicas – da física à biologia e da astronomia à medicina – pareciam, numa primeira instância, não ter suficiente *estatuto* para ascender à categoria de objetos *conserváveis* ou *restauráveis* por profissionais. Primeiro, porque já chegam ao museu largamente partidos, incompletos ou canibalizados em resultado dos seus ciclos de vida, digamos, ativos. Depois, salvo raras exceções, não são preservados em museus para funcionar e, caso o sejam, tipicamente chama-se um especialista – mestre-relojoeiro, um físico, um engenheiro – e não um conservador-restaurador. Finalmente, os materiais são em larga medida resistentes – metais, madeiras, vidro – e, desde que asseguradas as condições ambientais básicas, não carecem de cuidados especiais de conservação.

Foi entre 2001 e 2007, durante a recuperação do *Laboratorio Chimico* da Escola Politécnica de Lisboa, um magnífico espaço oitocentista, hoje sob a responsabilidade do Museu Nacional de História Natural e da Ciência (MUHNAC) da Universidade de Lisboa, que me comecei a aperceber das nuances e complexidade da preservação do património científico. A abordagem necessariamente integrada desta recuperação – envolvendo património edificado, mobiliário, coleções e arquivos, bem como especialistas de múltiplas áreas disciplinares – a par da especificidade de alguns problemas de conservação, como por exemplo a contaminação química e radioquímica, a conservação de reagentes (que merecia, por si só, uma tese de doutoramento) e o paradoxo de alguns equipamentos onde os próprios agentes da corrosão deviam ser mantidos e documentados, entre outros, fez-me pensar que as coleções e o património científico traziam desafios novos quer às práticas, quer à ética, quer ainda à investigação em conservação. Mais tarde, em faculdades de medicina, universidades, laboratórios e escolas secundárias em Portugal e no estrangeiro, a estas especificidades juntaram-se as problemáticas da contaminação bacteriológica/virológica e do interface conservação-taxidermia.

Claro que se algo está fora do radar, isso significa que a literatura é escassa, os protocolos inexistentes e o número de profissionais treinados insignificante. Assim, a partir de um pequeno núcleo duro de conservadores-restauradores provenientes sobretudo do projeto de recuperação do *Laboratorio Chimico* e do Instituto de Investigação Científica e Tropical, que integrou a Universidade de Lisboa em 2015, o MUHNAC traçou um plano estratégico para colocar as coleções e o património científico no mapa da conservação. Este plano tem três eixos principais. O mais importante – e com maior sucesso – é ao nível da formação de futuros profissionais e investigadores. Até agora, o acolhimento por parte dos cursos de licenciatura e pós-graduação em conservação – Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, Universidade Católica Portuguesa, Instituto Politécnico de Tomar, entre outros – tem sido muito estimulante, tendo o MUHNAC acolhido já dezenas de estudantes destes cursos, para estágios de curta duração ou desenvolvimento de teses.

O segundo eixo é a especialização com recursos próprios. Para além de conservadores-restauradores especializados em coleções científicas que integraram recentemente o seu quadro de pessoal, o MUNHAC, através da infraestrutura PRISC (*Portuguese Research Infrastructure of Scientific Collections*), vai inaugurar em 2020 dois laboratórios avançados de ponta dedicados à conservação de coleções científicas, um especializado em contaminação e outro em taxidermia. Estes laboratórios ficarão à disposição da comunidade científica da conservação mediante *calls* a anunciar em breve.

Finalmente, o terceiro eixo é o do debate e da reflexão interdisciplinar. Para além de múltiplos seminários avulsos realizados nos últimos cinco anos, o MUHNAC promoveu em Junho de 2018, o "I Seminário Nacional de Conservação de Coleções Científicas". É desse Seminário que resulta a seleção de textos apresentada neste volume. Os quatro textos, sem naturalmente esgotar a problemática, constituem uma boa introdução às questões envolvidas.

Dois dos textos tratam da problemática mais genérica da preservação do património científico em duas instituições não-museológicas – o Instituto de Investigação Científica Tropical e a Escola Secundária Sebastião e Silva – e os outros dois tratam de questões mais específicas de conservação, um de *naturalia* e outro de *artificialia*.

O artigo de Conceição Casanova e Maria Manuel Romeiras – *Legacy of the Scientific Collections of the Instituto de Investigação Científica Tropical, University of Lisbon: A critical review and outlook* – faz uma atualização e revisão crítica de quase duas décadas de intervenções de conservação naquelas que são as mais importantes coleções científicas de origem colonial portuguesas até ao seu ingresso em 2015 na Universidade de Lisboa. Fora do olhar do grande público e do setor do património cultural durante décadas – o Instituto nunca teve funções museológicas – os desafios da preservação eram ainda maiores. As autoras discutem como estes foram sendo ultrapassados e como, gradualmente, foi dada uma nova vida e uma nova identidade às coleções do IICT.

Igualmente órfãs no contexto do património cultural português são as coleções histórico-científicas das escolas secundárias portuguesas, particularmente dos antigos liceus. Por razões que não posso aqui detalhar, são talvez as mais difíceis de preservar e, portanto, as mais vulneráveis coleções científicas portuguesas. O caso do antigo Liceu Nacional de Oeiras, aqui detalhado no artigo *O Plano de Valorização do Património Cultural da Escola Secundária Sebastião e Silva, Oeiras*, por Maria Mota Almeida, Clarisse Mendes e Carmen Fernández, parece-me um excelente exemplo de persistência, dedicação e *savoir faire*, quer pela abordagem integrada – espaços, coleções, arquivos – ao património e memória da Escola, quer ainda pela mobilização de professores, alunos e antigos alunos que conseguiu. Os desafios continuam a ser muitos – é preciso continuar – mas estamos melhor do que estávamos há 10 anos atrás.

Manuel Lemos e Isabel Tissot, no seu texto *Reflections on the conservation challenges of scientific and technological objects*, abrem novas perspectivas de investigação trazidas pelas coleções científicas de equipamentos e instrumentos históricos. De forma convincente, os autores argumentam que a conservação (e o restauro) destes objetos não se deve ancorar na mera análise de materiais, mas carece de uma abordagem rigorosa do "invisível": a relação entre esses mesmos materiais e os mecanismos de funcionamento no presente e no passado, particularmente ao nível do desgaste pelo uso. É uma abordagem exigente e interdisciplinar, que amplia os horizontes não só da conservação, mas também da história da ciência e tecnologia.

Finalmente, o artigo de Catarina Teixeira, David Waterhouse, Laura Moura e Pedro Andrade – *Displaying a Taxidermy Rhinoceros in a Museum: The Lisbon Conservation Approach* – problematiza a conservação de coleções científicas pelo ângulo das coleções de história natural, discutindo em particular dilemas novos por estas trazidos à deontologia da conservação e do restauro e o papel da taxidermia vs. conservação na preservação destas coleções.

No seu conjunto, o volume traz um conjunto de questões interdisciplinares novas que merecem a atenção dos conservadores-restauradores, quer na óptica das práticas, da ética e da investigação. Nos próximos anos, o MUHNAC e o PRISC continuarão a promover o debate sobre estas questões, bem como a acolher com entusiasmo todos os estudantes e investigadores que as pretendam aprofundar.

As far as I know, this is the first volume dedicated to scientific collections in a conservation journal, something I have to thank to the previous director of *Conservar Património*, António João Cruz, and the current director, Elin Figueiredo. The fact that there are only four articles does not mean that the problem is uncommon or uninteresting, but only that we are in its infancy. I hope that these four articles will open up new perspectives of conservation research or at least awaken the curiosity of conservator-restorers, especially those currently in training.

During my life as a museum professional, I soon realized that scientific collections and the heritage of science are off the radar of conservation. The objects that were under my curatorial responsibility – barometers, calculation machines, telescopes, magic lanterns, telegraphs – used in the 19th and 20th centuries for teaching and research in the most diverse scientific areas – from physics to biology and astronomy to medicine – seemed, in a first instance, not to have sufficient status to reach the category of conservable or restorable objects by professionals. First, because they already arrive at the museum largely broken, incomplete or cannibalized as a result of their active life cycles. Then, except for rare exceptions, they are not preserved in museums to function and, if they are, typically an expert is called – a master watchmaker, a physicist, an engineer – instead of a conservator-restorer. Finally, the materials are largely resistant – metal, wood, glass – and, provided that basic environmental conditions are ensured, they do not require special conservation care.

It was between 2001 and 2007, during the recovery of the *Laboratorio Chimico* (Chemistry Laboratory) of the Escola Politécnica de Lisboa (Polytechnic School of Lisbon), a magnificent 19th century space, today under the responsibility of the Museu Nacional de História Natural e da Ciência (National Museum of Natural History and Science) (MUHNAC) of the University of Lisbon, that I began to realize the nuances and complexity of preserving scientific heritage. The necessarily integrated approach for its recovery – involving built heritage, furniture, collections and archives, as well as specialists from multiple disciplinary areas – along with the specificity of some conservation problems, such as chemical and radiochemical contamination, the conservation of chemicals (which per se deserved a doctoral thesis) and the paradox of some equipment where corrosion agents themselves should be maintained and documented, among others, made me think that the scientific collections and heritage have brought new challenges to both practices and ethics as well as to conservation research. Later, in medical schools, universities, laboratories and secondary schools in Portugal and abroad, other problematics were added to these specificities, such as bacteriological/virological contamination and the conservation-taxidermy interface.

Of course, if something is off the radar, it means that the literature is scarce, there is absence of protocols and the number of professionals trained is insignificant. Thus, from a small hard core of conservator-restorers coming from the recovery project of *Laboratorio Chimico* and from the Instituto de Investigação Científica e Tropical (Institute of Scientific and Tropical Research) (IICT), which joined the University of Lisbon in 2015, the MUHNAC outlined a strategic plan to place collections and scientific heritage on the conservation map. This plane has three main axes. The most important – and most successful – is the training of future professionals and researchers. So far, the reception by undergraduate and graduate courses in conservation – Faculty of Sciences and Technology of the NOVA University of Lisbon, Catholic University of Portugal, Polytechnic Institute of Tomar, among others – has been very stimulating, having the MUHNAC already welcomed dozens of students from these courses, for short-term internships or thesis development.

The second axis is the specialization with own resources. In addition to conservator-restorers specialized in scientific collections that have recently integrated its staff, MUNHAC, through PRISC infrastructure (Portuguese Research Infrastructure of Scientific Collections), will inaugurate in 2020 two state-of-the-art advanced laboratories dedicated to the conservation of scientific collections, one specialized in contamination and the other in taxidermy. These laboratories will be available to the scientific community of conservation through calls that will be announced soon.

Finally, the third axis is that of debate and interdisciplinary reflection. In addition to multiple single seminars held in the last five years, MUHNAC promoted in June 2018 the *I Seminário Nacional de Conservação de Coleções Científicas*

(1st National Seminar on the Conservation of Scientific Collections). It is from this Seminar that the selection of papers presented in this volume results. The four papers, without naturally exhausting the problem, are a good introduction to the issues involved.

Two of the papers deal with the most general problem of preserving scientific heritage in two non-museological institutions – the IICT and the Escola Secundária Sebastião e Silva (Sebastião e Silva High School) – and the other two deal with issues more specific on conservation, one of *naturalia* and the other of *artificialia*.

The article by Conceição Casanova and Maria Manuel Romeiras – Legacy of the Scientific Collections of the Instituto de Investigação Científica Tropical, University of Lisbon: A critical review and outlook – makes an update and critical review of almost two decades of conservation interventions in those that are the most important scientific collections of Portuguese colonial origin until its entry in 2015 to the University of Lisbon. Outside the gaze of the general public and the cultural heritage sector for decades – the Institute never had museological functions – the challenges of preservation were even greater. The authors discuss how these were being overcome and how, gradually, a new life and a new identity was given to the IICT collections.

Equally orphaned in the context of the Portuguese cultural heritage are historical-scientific collections of secondary schools, particularly the old high schools. For reasons I can not detail here, perhaps they are the most difficult to preserve and therefore the most vulnerable Portuguese scientific collections. The case of the former Liceu Nacional de Oeiras (National School of Oeiras), detailed here in the paper "The Plan for valuing the Cultural Heritage of the Sebastião e Silva Secondary School, Oeiras", by Maria Mota Almeida, Clarisse Mendes and Carmen Fernández, seems to me an excellent example of persistence, dedication and savoir faire, both by the integrated approach – spaces, collections, archives – to the heritage and memory of the School, as for the mobilization of teachers, students and former students. Many challenges remain – we need to continue – but we are better off than we were 10 years ago.

Manuel Lemos and Isabel Tissot, in their paper "Reflections on the conservation challenges of scientific and technological objects", open new research perspectives brought by scientific collections of historical equipment and instruments. Convincingly, the authors argue that the conservation (and restoration) of these objects should not be anchored in mere material analysis, but incorporate a rigorous approach of the "invisible": the relationship between these same materials and operating mechanisms in the present and in the past, particularly at the level of use-wear. It is a demanding and interdisciplinary approach that broadens the horizons not only of conservation, but also for history of science and technology.

Finally, the article by Catarina Teixeira, David Waterhouse, Laura Moura and Pedro Andrade – Displaying a Taxidermy Rhinoceros in a Museum: The Lisbon Conservation Approach – problematizes the conservation of scientific collections from the angle of natural history collections discussing in particular new dilemmas brought to the deontology of conservation and restoration and the role of taxidermy vs. conservation in the preservation of these collections.

As a whole, this number brings a set of new interdisciplinary issues that deserve the attention of conservator-restorers, both in the perspective of practices, ethics and research. In the coming years, MUHNAC and PRISC will continue to promote the debate on these issues, as well as enthusiastically welcome all students and researchers who wish to deepen them.

ARTICLE / ARTIGO

Displaying a taxidermy rhinoceros in a museum: the Lisbon conservation approach

A exposição de um rinoceronte taxidermizado no museu: a abordagem de conservação adoptada em Lisboa

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Abstract

The present problems around the public display of a full taxidermy mounted rhinoceros in Lisbon and the motifs for the replacement of its original horns are presented in this paper. The twentieth century specimen concerned belongs to the National Museum of Natural History and Science of the University of Lisbon (MUHNAC). The several warnings of rhino horn thefts occurring in museums across Europe in the last two decades and the frequency of requests for loans of this specimen for exhibitions, raised an internal debate at the MUHNAC. In this paper, firstly, we present a short overview of the problems in terms of the international context and the vulnerability of these specimens at museums, followed by a brief overview of the history of the Lisbon specimen. Finally, we detail and discuss our conservation, methodology and ethical approach to the removal and replacement of the specimen's original horns with replicas, based on Norfolk Museums Service's (UK) protocol and experience.

KEYWORDS
Horn
Replica
Replacement
Ethics
Preventive restoration

Resumo

A presente problemática em torno da exposição pública de um rinoceronte taxidermizado completo, existente em Lisboa, e os motivos que levaram à substituição do material de corno original são apresentados neste artigo. O exemplar em causa, do século XX, pertence atualmente ao Museu Nacional de História Natural e Ciência da Universidade de Lisboa (MUHNAC). As diversas advertências para os furtos de corno de rinoceronte em museus a decorrer por toda a Europa nas duas últimas décadas e a frequência de pedidos de empréstimo do espécime para exposições originaram um debate interno no MUHNAC. Neste artigo, em primeiro lugar, apresentamos um breve panorama da problemática em termos do contexto internacional e da vulnerabilidade destes espécimes em museus, seguido de um breve contexto histórico do espécime. Finalmente, detalhamos e discutimos a nossa abordagem de conservação, metodologia e ética na substituição do material de corno original por réplicas, baseado no protocolo e experiência dos museus de Norfolk em Inglaterra.

PALAVRAS-CHAVE
Corno
Réplica
Substituição
Ética
Restauro preventivo

Introduction

In recent years, several specimens of rhinoceros in museum collections all over the world have been damaged or stolen due to the high market value of their horns, particularly in Asia. This has raised concerns in natural history museums, zoos, professional associations, and societies [1-2]. Some museums have replaced the horns of their specimens with replicas or removed them from public display to the safety of secure storage. Although newspaper articles about museum thefts abound, specialised literature discussing horns replacement with replicas is scarce. In this paper, we examine an intervention to remove the original horns of a fully mounted specimen of a black rhinoceros (*Diceros bicornis*), in all dimensions, but particularly from a conservation perspective. The specimen is part of the collections of the National Museum of Natural History and Science (MUHNAC), University of Lisbon. The intervention took place during autumn 2016.

The cultural and scientific heritage preserved by MUHNAC covers c. 400 years of history of teaching and research in Portugal. Its collections have multiple origins [3-5], now encompassing a total of 3.5 million objects covering natural history specimens, artistic, archaeological and ethnographic artefacts, scientific and medical instruments, as well as books, manuscripts, drawings, and maps. MUHNAC also has two botanic gardens – the Lisbon Botanic Garden (1878) and the Tropical Botanic Garden (1906) – and two historical astronomical observatories – the Ajuda Astronomical Observatory (1861) and the Polytechnic School Astronomical Observatory (1898) –, among other buildings of scientific and historical significance. In 2015, the Tropical Research Institute (IICT) – a Portuguese institution dating from the nineteenth century – was integrated with the University of Lisbon [6]. Its collections result from scientific expeditions to the former Portuguese colonies [7], particularly in Africa, and are presently curated and preserved by MUHNAC. The rhino specimen discussed in this paper is part of the IICT collections.

As we will explain, the idea of removing the original horns resulted from a series of loan demands for temporary exhibitions in Portugal, coupled with MUHNAC's intention to display the specimen in its longterm exhibition. Initially, the idea was far from consensual. Concerns were raised regarding the inevitable risk of damaging the specimen and loss of material. Doubts were also raised about the sequence of the procedure, and the materials and techniques to model the replicas, given that the internal structure and the nature of attachment of the horns were initially unknown. Perhaps more importantly, the idea of removing original parts from an object of cultural and scientific significance seemed against, not only the ethics and fundamental principles of conservation and restoration, but against everything that a museum is and does.

In order to reach the possibility of consensus and grounded decision-making, thorough interdisciplinary research coordinated by MUHNAC's conservators Catarina Teixeira and Laura Moura and taxidermist Pedro Andrade supported by Ana Campos, was developed. It covered similar interventions in other museums, relevant literature on methods and ethics, and the history of the rhino specimen itself, particularly its taxidermy mount. After considerable internal discussion involving the conservators, taxidermists, curators and the director, the decision was made to replace the original horns with replicas. In the absence of significant and detailed literature [8], this paper aims to provide a comprehensive narrative of the whole process, including the security context and the preliminary research, the ethical guidelines established, and the materials and methods used. Ultimately, we examine the broader implications of this case in the preservation of cultural heritage.

The increasing vulnerability of rhino horns in museum collections

Rhinoceros have been overhunted in the wild for many decades, resulting in significant population reduction and even the extinction of the Vietnamese Javan rhinoceros (*Rhinoceros sondaicus annamiticus*) [1]. In some cases, nature conservation programmes have successfully enlarged rhino populations, namely in some subspecies of black Rhinoceros (*Diceros bicornis*) [1]. However, unfortunately, poaching has considerably increased since 2008. In 2014, the number of poached rhinos increased more than tenfold since 2008 [9]. Ultimately, poaching is driven by pseudo-scientific claims from Asian traditional medicine that powdered rhinoceros horns – made from hard keratin proteins [10] – can treat and prevent cancer [1, 10], although demand for horns as artistic artefacts and collectible investments also plays a role [9]. The lack of rhinos in the wild, combined with the steep increase of the horns' market value, resulted in organised criminal groups targeting alternative sources, namely horns in museum collections, universities, antique dealers, private collections, and zoos. Some recent robberies have been violent [11]. Unlike rhinos in Africa, frequently protected by heavily armed guards, museums can be seen as relatively soft targets [12].

In order to better understand this context, we have compiled information about incidents in museums between 2002 and 2017, from reports and newspapers [1, 12-22]. It should be noted that many incidents are likely to remain unreported. Data are compiled in Figure 1, with thefts sorted per year/location and type of institution, covering mostly European museums. As shown, 2011 was the year with the largest number of reported thefts, with 21 cases in Europe. Before 2011, only nine cases were reported, mainly in African countries; after December 2011, 13 more cases were reported, all in Europe except a recent case in the USA.

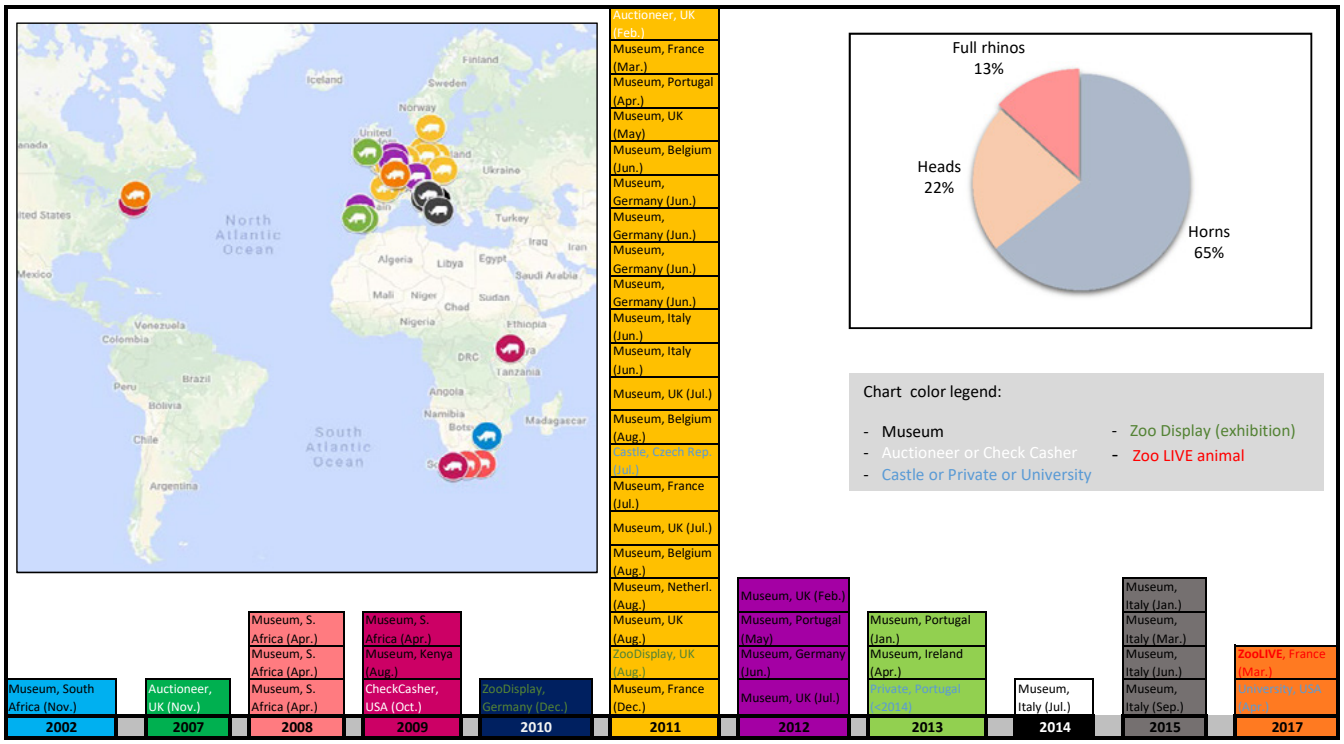

Figure 1. Number of rhino horns thefts per year, location and typology of stolen specimens, mainly reported in museums – for security reasons the institutions names have been omitted.

The post-2011 decrease in incidents is likely to result from public warnings, increased awareness, and the adoption of preventive measures to raise the security of museum specimens [1, 18].

We have also examined the typology of stolen specimens: 65 % correspond to individual horns, 22 % are trophy heads, and 13 % are entire specimens of mounted rhinos. Individual horns can be more easily and discreetly stolen since no removal work is implied. At the same time, in strict prevention terms, loose horns are also easier to protect than mounted and larger specimens, which are normally on public display. In the case of trophy heads and full mounts, the horns are generally well-fixed and thieves have resorted to sawing and violent detachment, causing significant damage and loss. At Ipswich Museum (UK), the rhino horns were wrenched off a full mount [17]; in Rotterdam's Natural History Museum (The Netherlands) the horns were sawn off a trophy head [12] and the same happened in the Gothenburg Museum of Natural History (Sweden), but from a whole taxidermy specimen [16].

After 2011, Portuguese museums were also targeted in this wave of robberies. The first reported incident occurred at the Science Museum of the University of Coimbra. Two eighteenth-century individual horns were stolen from their permanent exhibition. The theft was prominent in the news [19], even internationally [1, 13-14, 20] and resulted in detentions by the Portuguese authorities and Interpol [23], along with the recovery of several stolen horns [24] (but unfortunately not those from Coimbra). In 2012, an individual horn was stolen from the Ethnographic and Zoological Museum of St. Tirso, in the north of Portugal [19]. In 2013, five individual horns were stolen [24] from the exhibition of the Hunting Museum of Vila Viçosa, in the south of Portugal, after opening hours [19]. Before 2014, a robbery of 13 individual rhino horns was reported in a private collection in Mafra, north of Lisbon [19]. In private collections, the numbers of thefts could be even higher, but the information is scarce.

In this context, several recommendations have been published. The Humane Society International (HSI), an organisation working with animal protection issues around the world, suggests that, "museums or other public places that display preserved rhinos should, ideally, replace the horns with artificial replicas" [13]. Likewise, the UK-based Natural Sciences Collections Association (NatSCA) advises on a set of procedures for the care and safety of rhino horns in museums collections [25]. In one of the few papers on this subject, Paolo Viscardi also suggests that

> *for horns which are difficult to take off display, for example horns on large trophy heads or full taxidermy mounts, it may be worth considering removal of the horn by a conservation professional and replacement with replicas [1].*

The Lisbon black rhinoceros

MUHNAC holds a full taxidermy mount of a female Black Rhinoceros *Diceros bicornis* (Inventory Nr. UL-IICT-MAC-ZOO/34), as far as we know, the only specimen in a Portuguese public collection.

Once the specimen arrived in Portugal, its history

Figure 2. Undated photo of the adult female black rhinoceros and the juvenile on display at the JMAU (inv nr. PT/AMLSB/CMLSBAH/ PCSP/004/NUN/001441, Arquivo Municipal de Lisboa, Casa Fotográfica Garcia Nunes).

is already relatively well known. It was delivered by the Portuguese Overseas Agency (Agência Geral do Ultramar, AGU) to the Overseas Agriculture Museum and Garden (Jardim e Museu Agrícola do Ultramar, JMAU) in January 1957, along with a full mount of a juvenile specimen (inv. nr. UL-IICT-MAC-ZOO/30) [26-27]. According to the archives, its final destination should be the future Portuguese Overseas Museum (Museu Português do Ultramar) [28]. However, the two specimens remained at JMAU until 2016. This museum was created in 1906 to collect and display natural products of agricultural interest from the former Portuguese colonies, supporting tropical agricultural education. In 1916, it was located in Belém, Lisbon, in the main building – the Calheta palace – of the Tropical Botanic Garden, but official inauguration happened only in 1929 [29]. Visual sources depict both rhinos on display on the Calheta palace (Figure 2) [30-31]. The museum seems to have been closed to the public for long periods. Since 1978, visits could only be made by appointment and audiences were largely reduced to specialists [26]. The museum was closed in the early 1990s [32-33]. Today, both the garden and the palace are part of the University of Lisbon and its collections are managed by MUHNAC.

Our provenance research seems to confirm that the two specimens were collected in Angola, in 1954, near the Luengue river in the Cuando-Cubango region by Joséf J. Fenykövi (1891-?) [34]. Fenykövi himself reports having hunted a huge ("probably a world high record, given its 1.80 m" [35, p. 356]) rhinoceros female and baby, on that location [35, p. 353] and year [35, p. 324], adding that the adult specimen would be naturalized [35, p. 356] and "offered […] to the Portuguese Government to be part of the Overseas Museum" [35, p. 357]. Fenykövi also refers to an English taxidermist from the British Museum (now the Natural History Museum, London), who had followed him on a previous expedition and shared his methods for measurement and skinning [35, p. 357]. Both specimens' taxidermy bases bear labels and inscriptions assigning the mounting to the Rowland Ward, Ltd., at the time based in London (Figure 3) – a renowned taxidermy company founded in England in 1870 [36]. More recent research conducted for this paper using the IICT and AGU historical archives confirmed that the Rowland Ward Company was definitely responsible for mounting these two rhinos both "offered by J. J. Fenykövi" [27].

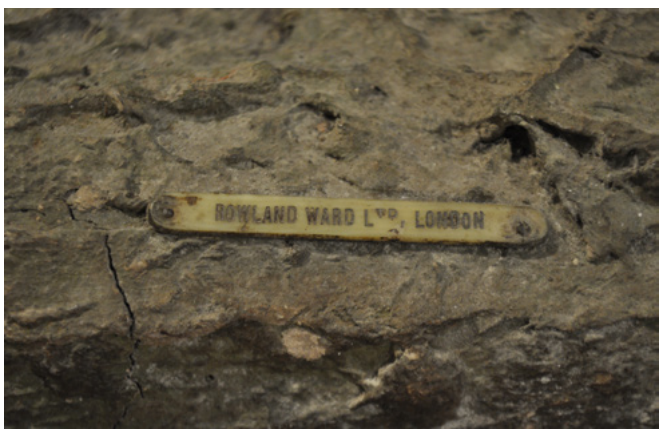

Figure 3. Label of the taxidermy company "Rowland Ward, Ltd, London" placed on the base of the adult specimen (photo: C. Gonçalves, IICT, 2012).

After the museum closed, the two rhinos remained at the Calheta palace. They were only accessible to staff and researchers. A few temporary exhibitions organised between 2006 and 2014 [37-39] brought broader audiences to the palace and the collections in general, including the two rhino specimens. In the past 20 years, the adult specimen has been requested for several types of loan: *i)* for a temporary exhibition at the Torre de Belém (1992) [26, 40]; *ii)* to feature in an art installation film by Javier Téllez [41-42], recorded in the Miguel Bombarda Psychiatric Hospital (2010); and *iii)* for the temporary exhibition *360º Ciência Descoberta* at the Calouste Gulbenkian Foundation (2013) [43], which took place after the robbery wave in Europe and specific security measures were already addressed.

In 2016, the request for the loan of the adult rhino for the temporary exhibition *Cidade Global – Lisboa no Renascimento* (first at the National Museum of Ancient Art, in Lisbon, then at the Soares dos Reis National Museum, in Porto [44-45]), raised the discussion to a more urgent level. These were two highly exposed and visited museums in Portugal. The security of the specimen and the safety of staff and public could have been at risk. At this point, replacing the horns with replicas became an option to consider as a preventive measure.

Preserving rhino horns in museum collections: the problems and similar cases across Europe

In scientific museums, particularly natural history museums, the use of replicas and didactic models has a long history and tradition. Apart from traditional skin-mounts, taxidermists often build reproductions of animals and plants in resin and fibreglass for educational purposes. Replicas of footprints and entire specimens are often used in palaeontology for both display and research. More recently, 3-D imaging has been increasingly used in exhibitions and research alike. These replacement techniques are also part of the daily life of MUHNAC, namely, for conservation reasons (e.g. to reduce specimen handling), to replace what no longer exists (e.g. extinct species), or to avoid unsustainable or unethical collecting practices (e.g. killing animals or plants [46, p. 4]). Therefore, building replicas of rhino horns, was technically relatively easy – MUHNAC had the experience and resources. The problem was that, in this case, not only the reasons were different (safety and security) but the intervention was at direct odds with the concepts of integrity [47, p. 2] and authenticity [48-49].

Guidance by the cultural heritage sector at large (although not directly addressing the case of natural history heritage) proved important. Some charters and conventions for the protection of buildings, monuments and sites include recommendations for security reasons. For instance, the Australia Burra Charter mentions the possibility of removing parts of a site if it constitutes ensuring its ultimate security, preservation and protection [50]. More specifically, the European Confederation of Conservator-Restorers' Organisation (E.C.C.O.) states, in its *Professional Guidelines: Code of Ethics*, that a conservator-restorer should only remove original material from cultural heritage if it is indispensable to its preservation, by fully documenting it and preserving all the materials, including anything removed [47, p. 2]. In the same article, the exceptions for the decision of removal also includes interference with the historic and aesthetic values of the cultural heritage; however, security criteria could be an issue to ponder for exceptional situations as in the case described in this paper.

On the issue of replicas, E.C.C.O. indicates that reproductions are also a mean to consider for the preservation of cultural objects, especially when the public use seems to be incompatible with its preservation in the long-term [47, p. 2]. This could be more related to the display of an object in a fragile conservation condition. But, once again, in the case of specimens of endangered species, this is definitely a point for further discussion. A replica could be exhibited with the option of removing the original or part from display – note that larger trophies and full taxidermy mounts require space in storage –, whilst at the same time ensuring that the original is kept safely in storage and preserved for future use.

Perhaps more to the point in this case, inquiries for advice were posted to the NHCOLL-L forum [51], the largest forum of natural history collection professionals, particularly curators and conservators. Museums that were known to have replaced horns on taxidermy rhinos were also contacted [52-53]. Nigel Larkin (a natural history conservation specialist) provided literature, including a simple step-by-step guide of the reproduction process of rhino horns [54-55].

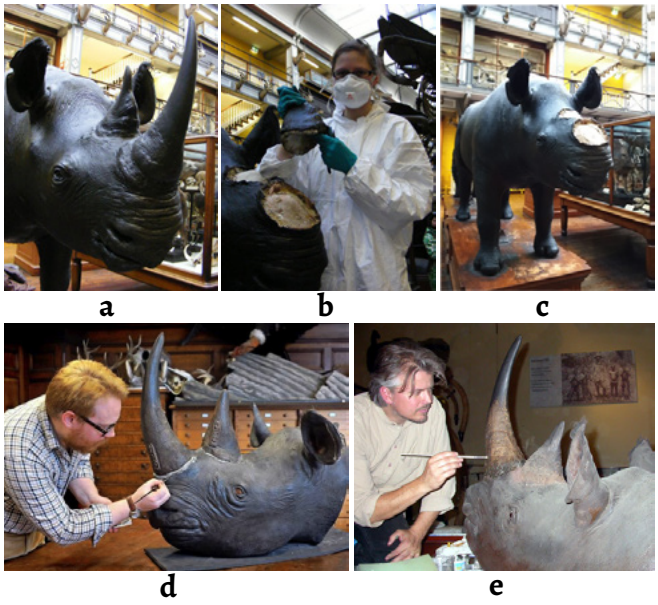

Figure 4. Images from the National Museum of Ireland mounted specimen until 2012 (a-c); David Waterhouse from Norfolk Museums Service with a rhino trophy head (d) and Nigel Larkin from Natural History Conservation (natural-history-conservation.com) installing replica rhino horns (e).

Nigel Monaghan, the keeper of the Natural History Division of the National Museum of Ireland, Dublin, also provided useful information and images. At the time of contact, the museum in Dublin had decided to replace its rhino horns as a preventive measure [56], but their replicas were not yet completed [57]. However, the originals had been removed in 2012 and, from images, we could conclude that the Dublin specimen's modelling was different from that of the Lisbon specimen (Figure 4). The Dublin horns did not seem so strongly attached as ours and they were removed simply by detaching first the filler around the base, and then the spot tacks holding them to the skin [57]. Another museum that adopted horn replacements as a preventive measure was the Natural History Museum of Bern (Switzerland) [52], but information could not be obtained regarding the procedure.

Historical research on the Rowland Ward Company was paramount. The literature [58-59] provided important clues regarding the mounting (Figure 5):

> *Very large specimens would have a hollow torso, built like a barrel around the centre board, with wood wool bound over the top [...] cover it with strips of sacking ("scrim") dipped in plaster of Paris. When this was dry,* papier maché *would be added to create a malleable layer, allowing the skin to be manipulated from the outside to create folds and natural cavities [58, p. 94].*

The Norfolk step-by-step procedure provided us clear information about requirements, techniques and materials. A step of major concern was the actual removal of the horns, a mechanical operation that had to be simultaneously forceful – to successfully extract the horns – and delicate – to produce as little damage as possible in the original material. The Norfolk procedure seemed comprehensive and thorough in its detail of requirements. Moreover, it respected the fundamental principles of conservation and restoration, both in the removal process and in the subsequent replicas, final retouching, and presentation. It guided the Lisbon intervention from the start to the end.

MUNHAC's intervention: replacing the Lisbon rhino's horns with replicas

Establishing the intervention guidelines

The analysis of the risks involved, coupled with research into the relevant literature, similar cases in European museums and the history of our collections enabled the Museum to reach a consensus and decide to go ahead with the replacement of the horns of our *Diceros bicornis* specimen.

Having the Norfolk intervention as a model, the MUHNAC conservation and taxidermy team began by

Figure 5. On the left, Alfred Taylor, foreman of the preparation of all large mammal taxidermy at Roland Ward's Company until 1958; in this picture assisted by Roy Hale and Eric Hare (photo: P. A. Morris Archives).

establishing the general guidelines of the intervention in terms of general ethical principles, evaluation, security and safety, and documentation.

First, the intervention should ensure the least possible damage to both the surface and structure of the specimen and follow high conservation standards, namely the principles of minimal intervention, reversibility, and legibility. Second, the intervention should be done step-by-step, allowing close monitoring, reflection, and eventual adjustments to the methods or materials. Third, for security reasons the intervention should be performed discreetly and away from public view; all safety measures to guarantee the team protection from hazardous materials should be in place throughout the intervention. Fourth, the intervention should be fully documented in photos and video, before, during and after its conclusion. All fragments removed, no matter how small, were to be collected, registered, and further analysed. Finally, after removal, the original horns and fragments would be moved to the collections' store for purposes of future research and education, maintaining the same catalogue number and associated scientific data as the specimen they came from. Documentation resulting from the intervention should also be added to the specimen documentation in the MUHNAC's collection database.

The removal procedure

In Lisbon, the intervention – including research, horn removal, replica development and final attachment – took exactly three months, from 19 September to 19 December 2016. A multidisciplinary team from MUHNAC composed by conservators and taxidermists planned, conducted and evaluated this intervention. The rhino specimen was at Calheta palace, in Belém, and the taxidermy and conservation labs were located in MUHNAC.

The removal of the two horns lasted three days, between 19 and 21 September. Personal protection equipment, such as lab coats, chemical resistance gloves, dust and solvent masks, goggles and a mobile dust extractor, supported the intervention and assured the correct health and safety protection of staff involved. This was particularly important to reduce the risks of inhalation of toxic substances that could have been used in the preservation of the skin either in the field [35, p. 357], or later at mounting stage. Arsenical soap, mercury chloride [60-61], powdered alum, corrosive sublimate, phenol, turpentine, are among the substances possibly present detailed by Morris [58, p. 89] and Ward [59, pp. 16-31].

From a technical perspective, the first stage of the removal process consisted of outlining the removal area, using metals scalpels and spatulas, and gently starting to mechanically detach the ring of painted plaster that covered the join of the horn with the skin, without scratching the two materials. The layer of plaster was not difficult to remove, unlike the inner filler (mortar). This initial step aimed at enabling a more confident search for the base of the horns, broadening the angle of view and the exposure of the attachment system to the wooden manikin head. A first set of four small rusty nails along the edge of the skin (with the shape of the base of the horns) were also removed,

Figure 6. Details of the beginning of the removal work of the original rhino horns by Catarina Teixeira and Pedro Andrade (photos: MUHNAC archives, 2016).

despite no apparent sustainable function at the time.

In the second stage, the objective was to mechanically remove the mortar layer between the skin and the base of the two horns, in order to reach the assembling nails and the wooden manikin head. This proved difficult because the mortar was very strong, tight and perfectly preserved. Its removal was only possible with a Dremel tool, chisels, screwdrivers, and hammers. Cutting pliers and hacksaw blades were also used to sever the nails, with the support of magnifying work-lamps and fixed vacuum cleaners (Figure 6). The first four nails removed were thinner and along the edge of the skin and horn, but the second group – another four, with similar orientation – were thicker and found deeper inside the wood.

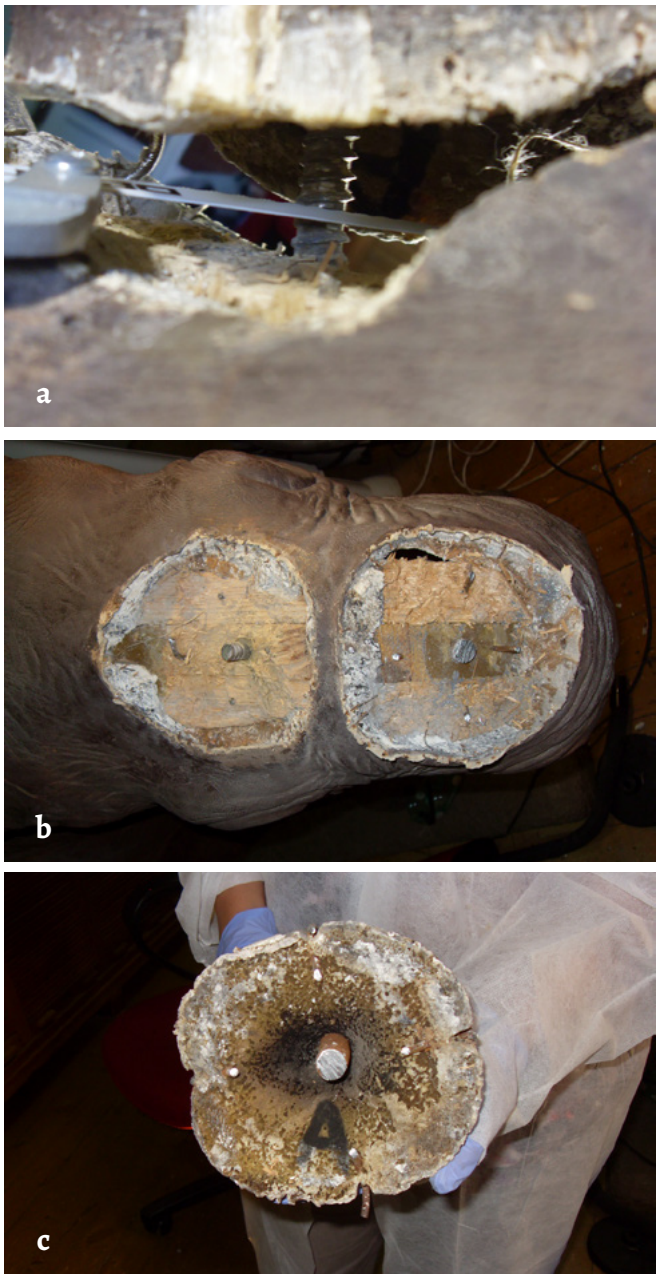

Figure 7. Detail of cutting the deepest and central nail with a hacksaw blade (a); from the base of the wooden manikin head where the horns were fixed (b); and detail of the base of one of the horns after its removal, showing the capital letter 'A' (c) (photos: MUHNAC archives, 2016).

At this point, the horns needed to be carefully and slowly pulled upwards to better reach the nails underneath without causing any damage. The inner nails were found to be wider and the central nail (which was the primary horn attachment) was also the deepest, with approximately 1 cm in diameter. The attachment system was similar in both horns. A capital letter A was found inscribed on the base of each horn, although it significance remains yet unknown (Figure 7). After removal, the horns were cleaned with soft brushes, identified, dated, and securely stored, together with all fragments and original material. To prevent any release of vapour, gases or infestations, particularly near the skin, the holes left in the specimen remained covered with Tyvek tissue until the attachment of the replicas.

Some of the materials collected during the removal were further analysed. Three samples from the mortar removed between the preserved skin, the base of the horns and the wooden manikin head structure were analysed with X-ray diffraction (XRD) and proton-induced X-ray emission (μPIXE) techniques. These analyses were conducted in November of 2016 at the Department of Engineering and Nuclear Sciences, Instituto Superior Técnico, University of Lisbon, in the context of a course addressing the use of nuclear analytical techniques for the compositional characterisation of cultural heritage. One of the samples (Figure 8) was selected for cross-analysis in both techniques, with the purpose of determining composition, particularly the presence of arsenic.

The XRD results [62] of the mortar confirmed the presence of *bassanite* (common plaster of Paris), *gypsum*, calcite, and a small quantity of quartz (Figure 9), meeting some of the composite materials of the mounting process of the specimen

Figure 8. Detail of the mortar sample ('Corno 1_Am. 2') analysed by XRD .

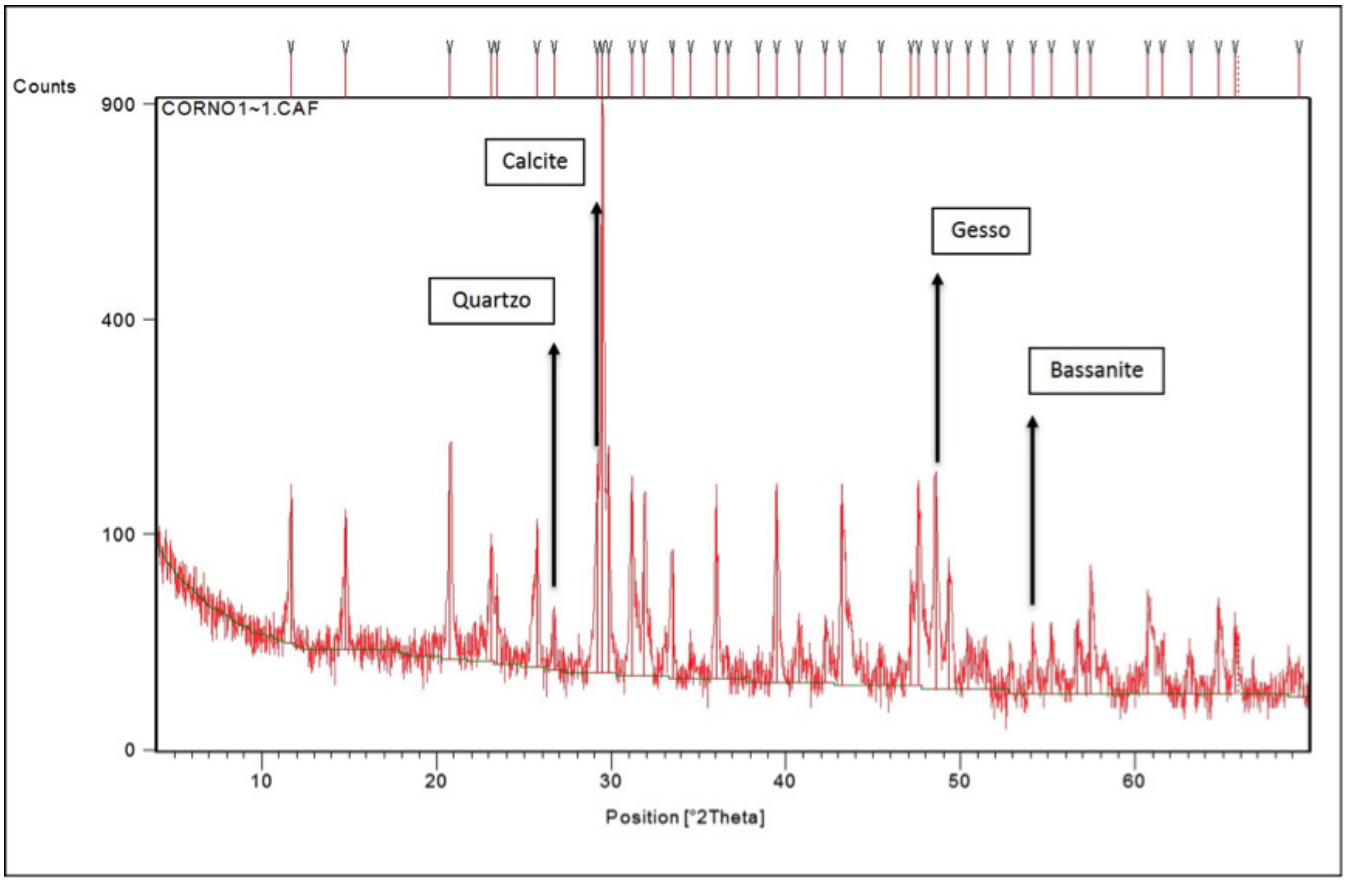

Figure 9. XRD diffractogram of the mortar sample in Figure 8 (CTN-IST/University of Lisbon) (Quartzo: quartz; gesso: *gypsum*).

described by Morris [58, p. 89] and Ward [59, pp. 16-31], namely plaster of Paris, and *papier maché*. From the μPIXE analyses, we could infer that there was no relevant presence of arsenic on the mortar, consistent with the preparation of mammals described in 1880 by Ward [59, pp. 16-31], although further analyses will need to be completed, since this specimen is from the mid-20th century. With more expression, we have obtained calcium that matches with the XRD analyses; data also implied the presence of sulphate, calcium carbonate, and aluminosilicate, probably concerned with a subcutaneous layer of clay used during mounting [58, p. 89]. Confirmation of the latter requires further analyses and data comparison between the two analytic techniques with more samples, in order to better understand its presence and origin [63].

The moulds and casts

The established guidelines for the intervention determined two decisions regarding the rhino horn replicas. On the one hand, they should be as exact as possible to prevent visual distortion or disruption. On the other hand, the replicas should be clearly and unequivocally identified as such for ethical reasons – the introduction of a *fake* element and the legibility of the intervention – and for security reasons – to prevent theft. Therefore, the word *REPLICA* would be added to each side of the replicas, again like in Norfolk.

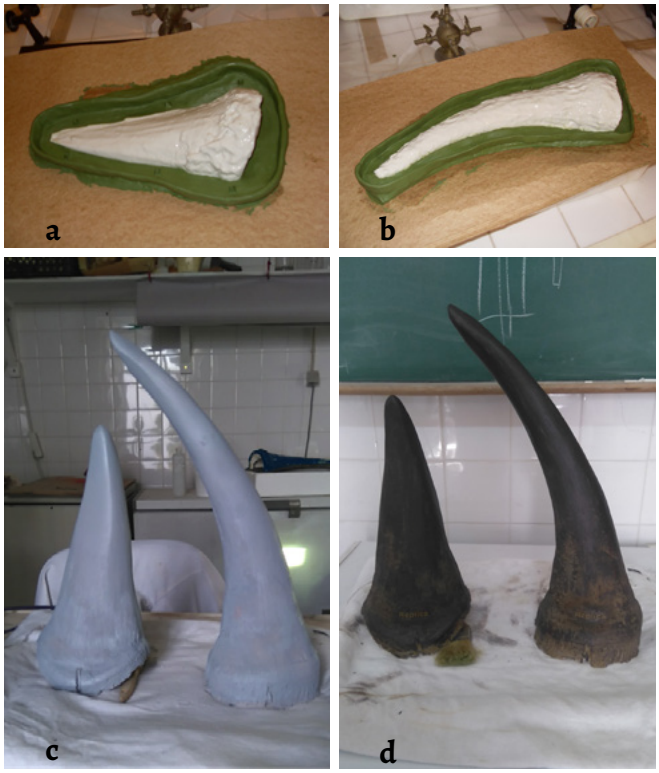

Figure 10. Details of the moulds, support moulds (a-b) and finished horn replicas (c-d) created by Pedro Andrade (MUHNAC).

The first step in any replica building is to create the moulds. In this case, the original horns were covered with a finely spread initial layer of Elastosil M 4514 silicone [64]. The process was repeated for four days to obtain a relatively thick layer and provide solidity to the mould.

For support, an outer mould for each horn was made by using polyester resin [65]. The first step included the application of a Plasticine lip dividing each silicone mould into two parts (Figure 10). With this rim created, two first layers of polyester resin were applied into one of the halves of the mould, followed by a third layer with fibreglass [66] to add strength, and finished with a fourth layer of the same resin covering the entire mould surface. The second half of the support mould was created using the same technique as already described, except that a release agent was applied using polyvinyl alcohol BÜFA 741-0052 between the rims, in order to avoid sticking [67].

Once the two halves of the outer support moulds were completely cured, one of the halves was removed. Before removing the second half, the silicone was cut in two parts with extreme care to avoid damage to the original horn. A soft suture was made in the silicone along the flap of the remaining half of the support mould using a scalpel. Finally, the support moulds and the internal silicone moulds were gently released from the original horns. These were mechanically cleaned and would only be used again during this process for colour-matching tests.

After the moulds, the second step was to construct the replicas with Jesmonite AC 100, a two-component system of acrylic polymer and water-based mineral resin [68]. A thin layer of Jesmonite was placed on the surface of the moulds, followed by two more layers that catalysed after 24 hours each. The halves of the replicas were also attached with Jesmonite. After 24 hours, more Jesmonite was applied inside the replicas to provide additional support, particularly around the junction areas. The joins of the replica surface were then repaired with Apoxie Sculpt putty, a two-part system of sculpting clay and epoxy adhesive [69].

For the inscriptions, a small tablet made of Plasticine with the word *REPLICA* was cast in Elastosil M 4514. The mould was replicated four times in a two-component rigid polyurethane resin Polyol + Isocyanate 9190/HT16 [70] and, before the catalysing process was concluded, it was adapted to the curvilinear shape of the horn replicas. The four small tablets were then fixed on each side (Figure 10), using polyurethane resin. Finally, a primary dye (water-based) was applied both to the inscription and the replica itself, and the colouring process was performed according to the colours and shades of the real horns, using acrylic dyes with brushes and an airbrush.

The third step consisted of attaching the replicas to the rhino specimen. This was done with two layers of Apoxie Sculpt putty: the first to cover the entire section of the wooden manikin where the horns had previously been, and the second to bond the replicas to the manikin. These were firmly tied to each other for two days using cotton tying tape for solid attachment and correct positioning. Subsequently, the joints between the skin and the replica horns were homogenised using an outside ring of the aforementioned putty, applied with a spatula, and gently completed with a pattern sculpted using a needle and sponge. The colouring process also included acrylic dyes applied with soft brushes and blended with the colour of the replica horns, thus leaving the whole intervention perfectly discernible (Figure 11).

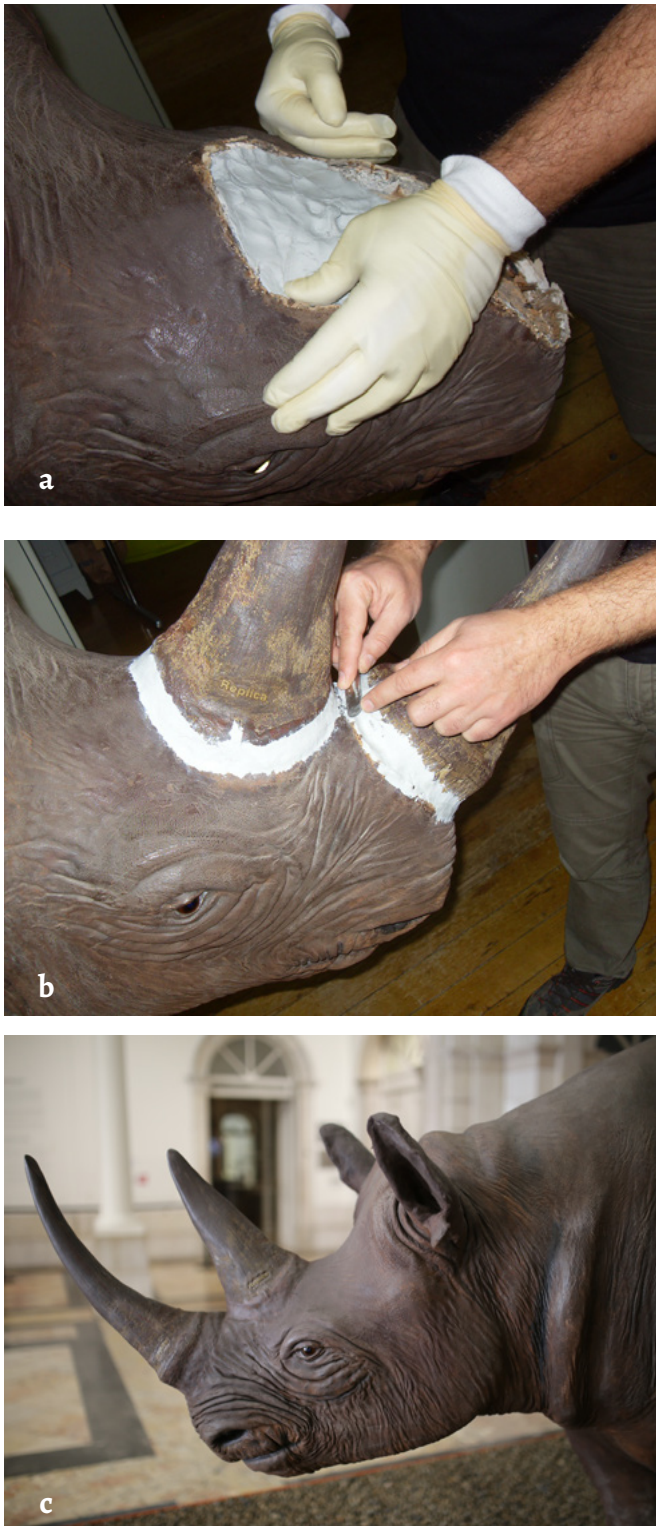

Figure 11. Detail of the attachment of the replica horns onto the specimen (a-b) and the specimen after the intervention and on display at MUHNAC (photo C. Garcia, 2018) (c).

Figure 12. Specimen on display at MUHNAC (photo: C. Garcia, 2018).

The choice of fixing the replicas to the specimen only using the ring of Apoxie Sculpt putty was deliberate. On the one hand, it respects the guidelines establishing the minimal and reversible nature of the intervention, as in general the whole replica procedure was intended to create the least damage possible to the original material [46, p. 2]. So, no new holes were made and no new metallic elements or adhesives were introduced. On the other hand, the replicas are much easier to remove than the original horns, facilitating conservation monitoring, an eventual replacement and other museum functions, including education. Furthermore, in the event of an inexperienced thief trying to steal the replicas, damage associated with any removal attempt would be minimal [71].

Concluding remarks

In 2016 the conservation and taxidermy teams of MUHNAC removed the original horns from a female specimen of black rhinoceros *Diceros bicornis* in its collections and replaced them with clearly identified replicas. The specimen is presently on long-term display (Figure 12).

At the beginning of the decision-making process, we realised from the little feedback we received, that the removal of original horns from taxidermy rhino mounts was relatively undocumented, perhaps due to security reasons. Even in museums and conservation communities in Portugal – with the exception of those targeted and mentioned above – this seemed to be a relatively unfamiliar issue. Direct contacts that derived from our personal research proved more effective as a source of information, but as previously referred to, dedicated literature was scarce.

The intervention performed in Lisbon generated considerable internal discussion about pros and cons, ethics and technical procedures. In-depth research regarding ethical issues, best practices in similar cases, and archival research into the history of the specimen played a paramount role in to the final decision.

Several lessons have been learned with this intervention and experience.

The first lesson is, naturally, the importance of sound research for the accomplishment of best practices on conservation and restoration, regarding ethical standards and principles.

The second is the establishment of clear criteria and guidelines in advance, as well as methods that can be shared and used by the community of conservators, conservator-restorers, taxidermists and museums abroad.

The third is the benefit of interdisciplinary teamwork: firstly, reaching out to our network of colleagues (including Norfolk) and ultimately the sharing of technical knowledge and new approaches; secondly, through the bridges built

between two different worlds, traditions, and training, of conservators and taxidermists – a crucial partnership in the conservation of this type of heritage.

The fourth is how off the radar this type of interventions is from mainstream conservation professionals and, more generally, how off the radar scientific collections and the heritage of science is from mainstream cultural heritage.

And finally, further research needs to be done, including:

i) to clarify both rhinos' history since their arrival in Lisbon and their preservation before MUHNAC. Further research could be accomplished by cross-referencing documentation from other Portuguese institutional archives (namely, AGU archive), but particularly from the IICT's historical archives. Ward's company archives should be worth contacting also;

ii) to collect more precise documentation regarding the juvenile rhino specimen – currently in need of restoration – namely the mounting and previous restoration treatments; these, complemented with analytical and imaging techniques, should contribute to our better understanding of both specimens' history, materiality, and conservation.

Both *i)* and *ii)* could not be done with the desired detail at the time of the adult rhino horns' replacement due to several reasons, including exhibition deadlines.

Although visitors were deliberately kept away from the intervention described in this paper for reasons already explained, we recognise that the procedure provides an extraordinary educational opportunity for audiences of all ages in the context of rhino extinction and nature conservation. Documentation collected will enable the museum to explore these opportunities in the near future.

Museums have the responsibility to preserve cultural heritage for future generations – and oftentimes to explore intricate issues as a response to social and cultural challenges and questions – but also to continue to make them accessible and displayed for a wider public.

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ARTICLE / ARTIGO

Reflections on the conservation challenges of scientific and technological objects

Reflexões sobre os desafios da conservação de objectos científicos e tecnológicos

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Abstract

The conservation of science and technology (S&T) heritage encompasses complex challenges. Among the reasons for this complexity are the S&T objects specific characteristics: the wide variety of materials, construction techniques and dimensions, and the existence of operating mechanisms. Present conservation methods are not fully adapted to the specificity of this heritage, requiring more research on S&T conservation. This paper identifies the main challenges of S&T objects conservation and gives guidelines to overcome them by *i)* increasing knowledge on materials and their degradation; *ii)* understanding the objects' function; *iii)* researching and developing new conservation techniques compatible with the characteristics of S&T objects; and *iv)* creating decision-making tools for the definition and implementation of conservation and maintenance programs.

KEYWORDS
Conservation
Objects of science and technology
Conservation methodologies
Decision-making tools

Resumo

A conservação do património da ciência e técnica (C&T) constitui um complexo desafio no domínio do património cultural. Existem várias razões que justificam esta situação, entre as quais as características específicas dos objectos da C&T: grande variedade de materiais, técnicas de construção e dimensões e a existência de mecanismos de funcionamento. Actualmente, os métodos de conservação utilizados são somente parcialmente adaptados às especificidades deste património e para ultrapassar este facto deve investir-se na investigação. Neste artigo identificam-se os principais desafios para a investigação da conservação do património da C&T que estão relacionados com *i)* o aumento do conhecimento dos materiais e da sua degradação; *ii)* a compreensão da função dos objectos; *iii)* a investigação e desenvolvimento de novas técnicas de conservação compatíveis com as suas características; e *iv)* a criação de ferramentas que auxiliem no processo de tomada decisão no sentido da definição e implementação de programas de conservação e de manutenção.

PALAVRAS-CHAVE
Conservação
Objectos da ciência e técnica
Metodologias de conservação
Métodos para tomada de decisão

Introduction

The importance of scientific and technological (S&T) objects as a primary source of information has consistently been recognised in different studies [1-2]. Nonetheless, their conservation is still a recent discipline when compared with conservation practices in other heritage areas [3]. Although S&T heritage encompasses a broad range of scientific and technological objects – from fossils to herbaria and from vacuum pumps to motors –, in this paper we focus exclusively on collections of historical instruments resulting from teaching and research practices in the sciences.

The disparity of S&T heritage conservation in the context of cultural heritage results from various factors, such as objects' diversity, dispersion and institutional custody, among others. Considering objects' diversity, scientific practices generate a large number of objects, with a variety of materials, dimensions, etc. Due to the impossibility of preserving all of them, the selection of what should be preserved is a complex exercise. Moreover, a precise definition of S&T heritage is needed to delimit the area of preservation action. Finally, the institutional framework where S&T heritage is produced generally lacks policies, mechanisms or resources for preservation. In addition, these institutions are out of culture institutions custody [4]. This context leads, among others, to the existence neither of preservation policies nor skilled personnel to intervene in S&T instruments. Throughout the years, the restoration of S&T heritage has been focused on repairing and replacing elements and substituting paint and lacquer coatings. These actions were intended to keep the objects in operation, especially those with mechanisms [5-7], and with the original appearances disregarding historical value [3, 5]. These restorations were often carried out by unskilled personnel, which led, in several cases, to irreversible loss of information.

As a result, for many years several crucial issues such as the characterisation and conservation of original surfaces, the presence of marks of use, and instruments' wear and tear, were not systematically approached. More recently, studies have identified the conservation of S&T objects requirements, enhancing the need for detailed knowledge of the object's materials and function and underlining the importance of specialised training for conservator-restorers [8-9]. However, there is a lack of conservation methodologies and research guidelines in relation to S&T heritage, coupled with a lack of training of conservators-restorers. To address this, a reflection on the challenges of S&T objects' conservation is needed. This paper intends to contribute to this reflection by systematically identifying and exploring the main conservation issues and suggesting conservation research lines.

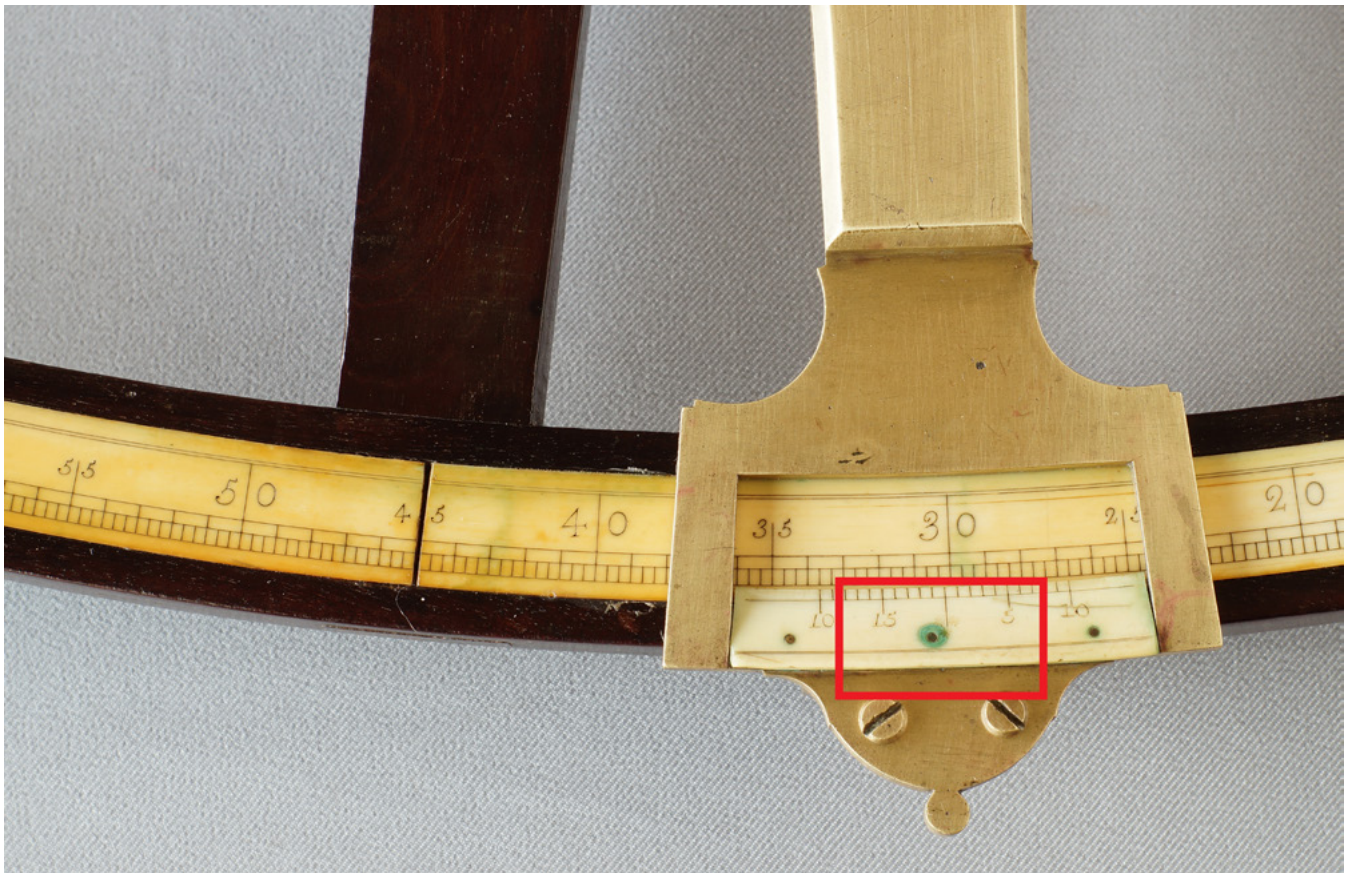

Figure 1. Detail of a nineteenth century sextant from the Museum of Lisbon, showing the ivory element degraded by the contamination of corrosion products from a copper alloy nail (photo: Matthias Tissot; courtesy Museum of Lisbon).

Challenges of S&T objects conservation

Features of S&T objects and conservation constraints

The main conservation challenges of S&T objects result from four of their features: materials, dimensions, function and moving components of mechanisms. Our aim here is to discuss in broad lines the constraints each one of these features imposes on conservation.

The wide range of objects that fall under S&T heritage is reflected in a multiplicity of materials, such as wood, glass, metals, plastics, among so many others. From a strictly material perspective, three types of objects can be highlighted: *i)* composite objects; *ii)* objects containing toxic and radioactive components; and *iii)* objects manufactured with materials introduced in the second half of the twentieth century, what is commonly designated 'recent S&T heritage'.

The conservation of composite objects can be complex as the degradation of one material can induce the alteration of the other. For example, Figure 1 shows the degradation of an ivory element from a sextant, induced by the corrosion of a copper alloy nail. This complexity is amplified if the degraded material is part of a structural element, jeopardizing the object's physical structure. Although conservation research on materials corrosion and degradation mechanisms largely exists, there are insufficient studies on analytical research of degradation of composite objects and, hence, limited information to establish conservation methods, ethics and practice.

Some S&T objects are constituted by toxic and radioactive materials, as in the case of, instruments with chemical residues, radiographic equipment or photographic cameras. Hazardous materials are well signalled on some objects, while in others their presence is unsuspected [10]. The preservation of these objects requires identification protocols and procedures for handling, storage, transport and treatment, including decontamination and elimination [11-12]. Even though procedures to conserve these objects have been developed, their implementation is yet to be achieved [10]. In addition, decontamination or elimination procedures can result in a loss of original materials of an object, for example, the removal of radioluminescent paint from an element of an object, for safety reasons [10]. Needless to say, the procedures can also result in the total loss of objects, a matter that requires specific documentation protocols.

A significant number of S&T objects are manufactured with materials introduced in the second half of the twentieth century (e.g. plastics, iron-nickel and cobalt-based superalloys) [13-14]. The visual identification of these materials is often complex, particularly in the case of metallic alloys. Furthermore, knowledge of degradation processes is still scarce, hindering the definition of conservation procedures.

The second feature of S&T objects with implications on conservation is their dimension. Objects can have large-scale

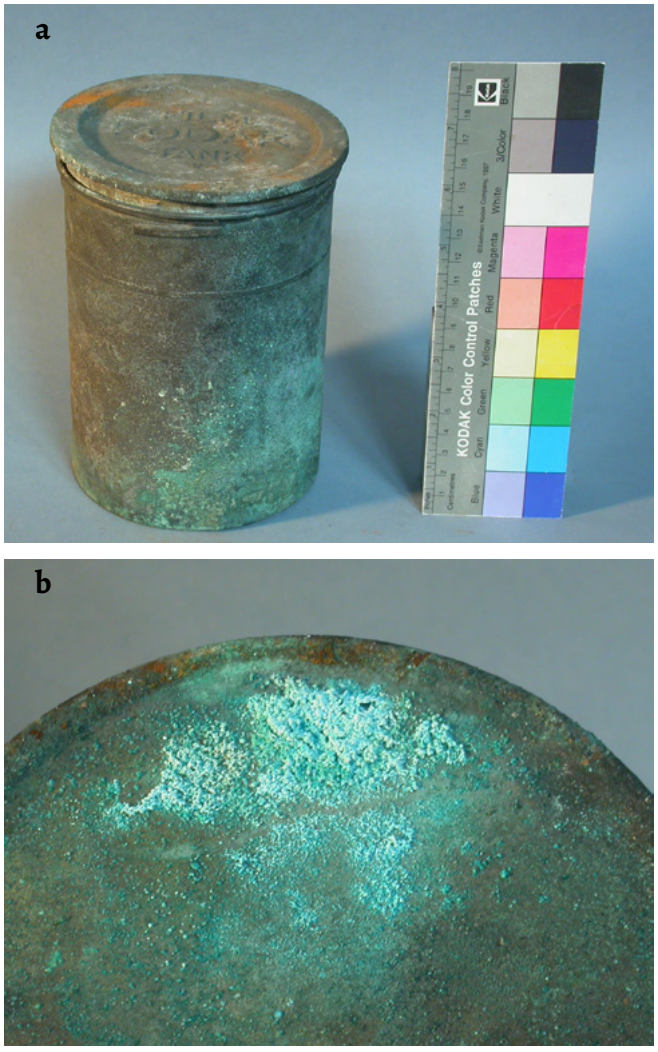

Figure 2. a) Kodak developing tank in copper alloy from MUHNAC; b) detail of the surface corrosion (photo: Manuel Lemos; courtesy MUHNAC, University of Lisbon).

dimensions in themselves or be composed of components with disparate scales as, for example, the Repsold-Merz meridian circle from the Lisbon Astronomical Observatory [15]. These characteristics lead to time-consuming and costly treatments, an aspect that can hinder the decision to preserve an object or a set of objects [16].

The third feature is function. The conservation of S&T objects requires detailed knowledge of function and contextualisation, which can be highly specialised. Moreover, documentation about uses is generally lost or scarce. However, without this knowledge, a proper assessment of the conservation state of the object cannot be done, let alone the treatment without damage or vital information loss, such as marks of S&T uses and practises.

Here we discuss two examples. The first is a Kodak developing tank in copper alloy from the National Museum of Natural History and Science (MUHNAC), University of Lisbon (Figure 2). The object shows an abnormal corrosion development as a result of the chemicals used for film developing. The nature of the corrosion products provided information on the chemicals used to develop the films.

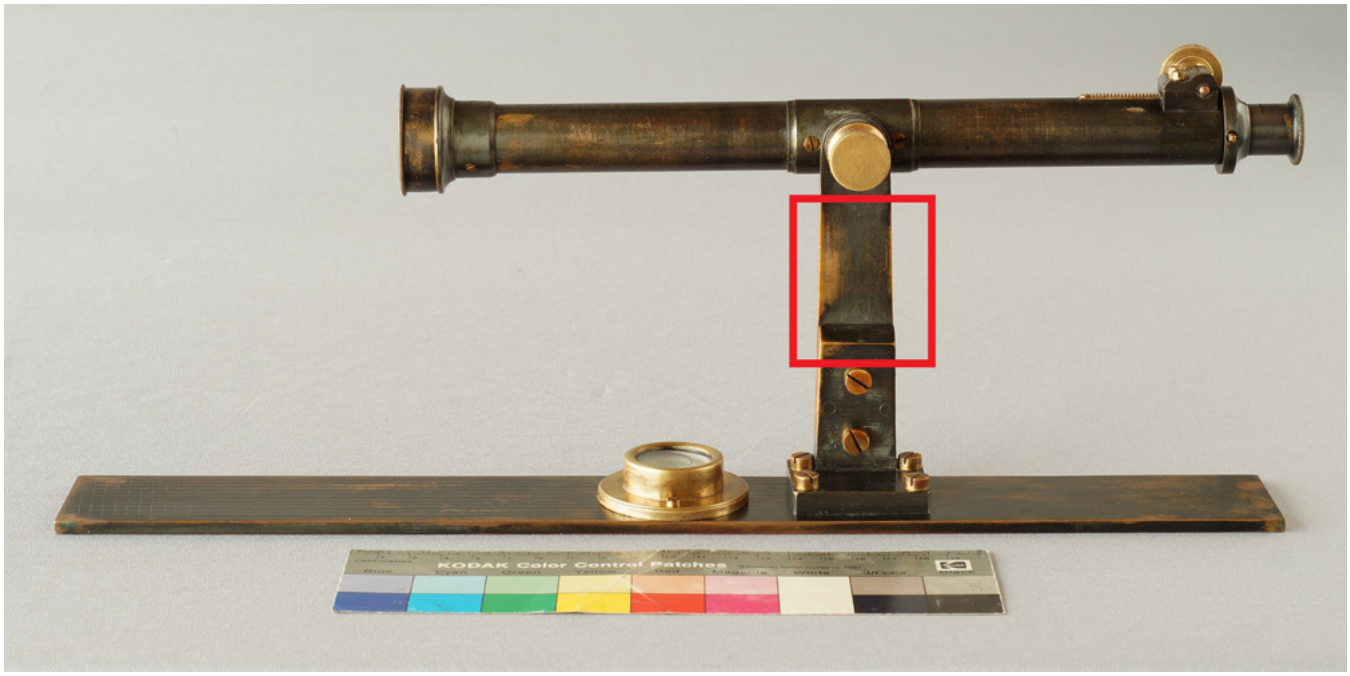

Figure 3. Nineteenth-twentieth century patinated copper alloy level from the Museum of Lisbon. The red rectangle highlights theareas with patina wear as a result of object use (photo: Matthias Tissot; courtesy Museum of Lisbon).

The second example is a copper alloy level, with an original black patina, from the Museum of Lisbon (Figure 3). This patina, probably composed of sulphur-based compounds, is worn out in specific areas. By knowing the function of the instrument is was possible to ascribe the patina lacunae to marks of use, as they correspond to parts mostly handled by users. These marks should be maintained as original information on object function and use. The specificity of the S&T heritage requires specialised conservator-restorers who are prepared to take into account object function and use, are aware that these do not always coincide and can engage on a peer-to-peer basis with historians of science, scientists and engineers, among others. Although in recent years there has been a reversal in the trend, conservators-restorers specialised in S&T heritage are still scarce.

The last of the four features considers S&T objects with mechanisms, i.e. systems of parts working together in an object to create movement. The movement is essential to understand objects' function and significance of objects. Preservation is often ensured by keeping the object in operation, raising questions related to historic value, long-term conservation and the sustainability of conservation maintenance programmes. Moreover, in order to preserve mechanisms, all parts need to be viable. This may not be possible because the object is too incomplete, cannibalised or damaged. And when it is possible, degraded materials, such as lubricants and rubber elements, may need to be replaced, leading to a loss of original parts [5] and authenticity issues. In addition, keeping an object in operation requires continuous maintenance and qualified staff to monitor and maintain the mechanisms, a problem for institutions with scarce human resources. Alternatively, S&T objects with mechanisms can be preserved in partial or total static mode. This option presents the advantage of preserving original parts. However, it poses risks to mechanisms' preservation because the lack of movement can induce physical degradation of the elements, for example the formation of cracks resulting from constant static load in one direction [17-18]. Furthermore, in both conservation options – static or operational mode – the maintenance and treatment of mechanisms, including moving components, require the implementation of methodologies outside the traditional conservation framework. The complex issue of conserving mechanisms in scientific instruments is somehow similar to the conservation of Kinetic art sculptures, in which the moving parts of mechanisms should be conserved to ensure movement [19] or, even, musical instruments.

Table 1 resumes the above-discussed conservation constraints established by S&T object's features – materials, dimensions, function and mechanisms. Understanding these constraints enables a clearer definition of the main challenges of S&T objects' conservation. From our point of view, those challenges are: *i)* increasing knowledge on materials, construction techniques, alteration, and corrosion mechanisms; *ii)* developing new treatments, suitable to the specific characteristics of S&T objects; and *iii)* developing decision making and management tools for the conservation of mechanisms.

Overcoming challenges

In a way similar to the conservation of cultural heritage in general, conservation of S&T heritage needs to be based on sustainable strategies that should be well-planned, action-oriented, collaborative and needed to be adapted to different levels of development. We briefly analyse below broad guidelines that we consider essential to define conservation

Table 1. S&T objects features related to the current main conservation constraints.

S&T objects features		Conservation constraints
Materials	Composite objects	Limited knowledge on mutual degradation processes
	Toxic and radioactive materials	Hazardous handling and treatments
	2nd half of XIX and XX centuries materials	Limited knowledge on materials and degradation process
Dimensions	Large-scale instruments	Time consuming and costly treatments
Function	Specialised instruments	Need of specialised S&T conservator-restorers
Mechanisms	Moving components	Complex decision on static or dynamic conservation
		Time consuming and costly maintenance

strategies specific to S&T heritage. Our non-exhaustive analysis is structured around two axes covering the constraints discussed in the previous section: *i)* conservation assessment; and *ii)* conservation treatment methods.

The conservation of S&T objects must be based on a detailed knowledge of materials. Material characterisation comprises the identification of substrates, coatings, lubricants, and degradation and corrosion processes. The material study should be preceded by an assessment of the instruments' conservation state, that will provide information on the nature of the materials, their chronological application and their usage [8]. For example, the characterisation of lubricants can give information on components usage and perceive which of them were submitted to more wear. To increase knowledge of the object's materials and degradation, a science-based study should be used towards their characterisation, often complemented with interactions with scientists, technicians and historians of science and technology to understand objects life cycles and associated documentation. Contrary to other cultural heritage objects, such as paintings and sculptures, analytical protocols for material and construction techniques of S&T objects need to be defined and established.

Scattered studies describe the application of non-invasive examination and analytical techniques such as X-ray fluorescence spectrometry (XRF) for the identification of substrates, radiography and tomography for the characterisation of construction techniques [19] and electrochemical impedance spectroscopy for conservation assessment [20]. However, systematic methods to characterise substrates, coatings, lubricants, alteration, and corrosion products are non-existent. In addition, existing approaches to study the wear and tear, the presence of internal cracks and tensions among components, and on the monitoring of mechanisms, are still very scarce. These analyses are fundamental to substantiate choice of conservation methods. For example, the conservation of the mechanical planetary model *Tellurium* (1819), from the Conservatoire National des Arts et Métiers in Paris, was preceded by a tribological study using interferometry to identify wear of structural axes in function of the lubricants. The results were used to define the conservation programme [21].

More applied research into the use of analytical techniques such as acoustic emission, infrared thermography, and tribological methods [22-24] is needed. These techniques are commonly applied in the industrial and engineering areas but their application and validation for S&T objects are still unexplored.

In relation to conservation treatments methods, current and common cleaning, stabilisation and protection methods used in S&T objects are mainly materials-oriented and derived from methodologies traditionally used in other cultural heritage objects (i.e. paintings, sculpture, metallic objects). However, lubricants replacement or selective cleanings for different materials assembled together remain unresolved. In addition, as mentioned, these issues are largely conditioned by the specific characteristics of S&T objects, such as the large-scale dimension of instruments and the presence of mechanisms.

Recent studies propose alternative conservation methods to overcome the above limitations. CO_2 blasting in surface cleaning [25-26] and the use of TiSiC and amorphous carbon deposited by PVD as new lubricants [27] have been used before. CO_2 blasting, used in a few objects from the *Laboratorio Chimico* of MUHNAC [26], has the advantage of non-interference of the cleaning agent (solid CO_2) with the mechanisms and allows cleaning surfaces in a short time frame [25-26]. Solid lubricants have the advantage of being more chemically stable, when compared with traditional oil lubricants, and also protect the surface. However, according to Cornet [27], parameters such as film deposition and film thickness control need to be improved. Further research is needed to improve these emerging conservation methods and develop new ones that can give effective contributions to the conservation treatment of S&T objects.

The definition of conservation strategies for objects with mechanisms is one of the most complex issues of S&T heritage, with multiple approaches, such as objects authenticity, musealisation, and maintenance costs, among others. It is the issue where documentation and interdisciplinarity are most important and *per se* worth

of a separate paper, particularly in the light of the recent increased use of S&T objects as historical sources [4]. In any case, some remarks about conservation aspects can be made. As discussed in the previous section, it is possible to conserve mechanisms either in static or in operational mode. From a material point of view, the conservation in operation can cause wear and tear of the mechanism parts, thus decreasing the objects' lifespan. On the other hand, the option to conserve the mechanism in a static mode, without the maintenance of the movement components, can also induce material rupture [28]. In that sense, decision-making regarding conservation methods, and related maintenance programmes, should be based on detailed science-based mechanism studies and thorough risk assessment resulting from both static and operational modes.

Recently, several conservation decision-making models have been developed, mainly for application to historical buildings and sites [29-30] and kinetics sculptures [19]. Moreover, decision-making models are well-known and applied in the industry for contemporary equipment maintenance and replacement [31]. However, decision-making tools for the conservation of S&T objects are yet to be developed, tested, and implemented, let alone integrated in time-based models orienting maintenance programmes. These tools will allow to *i)* structure the discussion among the different professionals involved in objects conservation (museum curators, conservator-restorers, historians, scientists, etc); *ii)* enlighten the decision in face of multiple risks; and *iii)* support the justification and documentation of the decision.

Towards a S&T conservation program

In this paper, the conservation of S&T heritage was discussed considering the specificities of the S&T objects and current limitations of their conservation practices. The challenges of conservation of S&T objects were discussed emphasising: *i)* existing limited knowledge on materials, manufacture methods, and their degradation processes; *ii)* the time-consuming and costly conservation treatments due to the large-scale objects and disparate scale components; *iii)* the complexity of mechanisms' conservation. After the conservation challenges were identified, some broad research lines were proposed, encompassing: *i)* the application of science-based techniques to objects' study, particularly wear and tear assessment; *ii)* the development and application of innovative conservation methods that can, among others, assure selective cleanings for different materials assembled together and lubricants replacement; and *iii)* the development and implementation of decision-making tools for the definition of conservation strategies and maintenance programmes.

In many respects, we are far from mainstream conservation research and before we have conservators-restorers aware of the issues discussed in this paper, considerable training efforts need to be made by higher education institutions.

The training of conservators-restorers specialised in S&T heritage is a complex issue also worth a separate paper. However, it should be noted that there are institutions in Europe offering conservation courses with a specialisation on S&T objects, namely the Haute-École Conservation Restauration (HE-ARC), in Switzerland, and the Fachhochschule Erfurt Konservierung und Restaurierung (FR & K&R), in Germany. Courses include topics such as the history of science and technology and conservation practices for S&T objects.

In terms of applied research, and in Portugal, there are concrete perspectives to develop innovative interdisciplinary projects to address the challenges of S&T objects conservation discussed in this paper. Collaborations with research groups from other scientific areas (e.g. physical engineering, mechanical engineering, corrosion science, history of science, technology and medicine) are being established. These scientific areas develop research that can be applied to S&T conservation. Two examples are the projects we have been developing with MUHNAC, University of Lisbon, and, more recently, with the Department of Physics of the NOVA University of Lisbon (DP-UNL). With MUHNAC, and for the past 10 years, we have been developing a continuous background work to establish requirements for the conservation of S&T objects in the frame of broader and global issues of the S&T heritage. With the DP-UNL we are developing analytical strategies based on distinct spectroscopy and exam techniques for the material characterisation and conservation assessment of scientific, technical and industrial heritage. The results of these projects will allow establishing conservation protocols and methodologies that are still undefined today. However, much more projects and collaborations are needed as the work perspectives remain numerous, complex, and largely outside the radar of mainstream conservation.

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ARTICLE / ARTIGO

Legacy of the scientific collections of the Instituto de Investigação Científica Tropical, University of Lisbon: a critical review and outlook

Legado das coleções científicas do Instituto de Investigação Científica Tropical, Universidade de Lisboa: uma revisão crítica e perspetivas

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Abstract

The Instituto de Investigação Científica Tropical, University of Lisbon (IICT), Portugal, holds the most important scientific collections from Portuguese-speaking African countries, which include anthropological, archaeological, ethnographic, mineralogical, botanical and zoological collections, as well as libraries and historical archives. The aim of this paper is to document the advances in conservation and management of IICT collections between 2005 and 2015, namely how the implementation of institutional initiatives created new challenges for the scientific community. After an overview of the IICT's scientific heritage since the creation of the Cartography Commission in 1883, we characterise several recent actions aimed at preserving and providing access to the collections. Considerations on the current preservation of the IICT collections are presented. It is argued that these collections are unique for tropical science and of critical importance for scientific cooperation with Portuguese-speaking countries in Africa.

KEYWORDS
Historic and scientific collections
Preventive conservation
IICT
Portuguese-speaking countries

Resumo

Em Portugal, o Instituto de Investigação Científica Tropical (IICT), na Universidade de Lisboa (UL) preserva as mais importantes coleções científicas dos países africanos de língua portuguesa, incluindo coleções antropológicas, arqueológicas, etnográficas, mineralógicas, botânicas e zoológicas, bem como bibliotecas e arquivos históricos. O objetivo deste estudo é documentar os avanços que foram realizados entre 2005 a 2015 na conservação e gestão das coleções do IICT e como a implementação de diferentes iniciativas institucionais criaram novos desafios para a comunidade científica. Começa-se por referir a herança científica do IICT, desde 1883 quando a Comissão de Cartografia foi estabelecida, passando-se a enumerar ações recentes que foram promovidas para conservar e permitir o acesso a essas coleções. Finalmente, são feitas algumas considerações sobre a preservação atual das coleções do IICT. Discute-se o papel que estas coleções têm para a ciência tropical e a sua importância para a cooperação científica com os países de língua portuguesa.

PALAVRAS-CHAVE
Coleções históricas e científicas
Conservação preventiva
IICT
Países de Língua Portuguesa

Introduction

Background

The historical and scientific collections here presented are currently at the University of Lisbon, as a result of the integration in 2015 of the Instituto de Investigação Científica Tropical (IICT, Tropical Research Institute) in the largest Portuguese university, the University of Lisbon (UL) [1]. Most of the scientific collections are now under the management of Museu Nacional de História Natural e da Ciência (MUHNAC, National Museum of Natural History and Science). Nevertheless, the archaeological collection was placed on a long-term loan at the Faculdade de Letras da Universidade de Lisboa (FLUL, Faculty of Humanities, UL), where most of the libraries were integrated. Additionally, the huge living coffee collections of the Centro de Investigação das Ferrugens do Cafeeiro (CIFC, Coffee Rust Research Centre), the main xylotheque (wood collection) and the earth science collections are under the management of the Instituto Superior de Agronomia (ISA, School of Agronomy, UL). On the other hand, the collections of the Arquivo Histórico Ultramarino (AHU, Overseas Historical Archive), were no longer integrated in the UL, but in Direcção-Geral do Livro, dos Arquivos e das Bibliotecas (DGLAB, General Directorate of the Book, Archives and Libraries), under the Ministry of Culture.

The history of IICT goes back to the Comissão de Cartografia (CC, Cartography Commission) established 19 April 1883, by José Vicente Barbosa du Bocage (1823-1907), then overseas and foreign affairs minister. The creation of CC, partly motivated by the so-called "scramble for Africa" [2], included what were initially designated *geographic* and *cartographic* expeditions and later *scientific* expeditions or missions. These aimed at advancing the "scientific exploration of the colonies" [3], in line with the directives of the 1884-85 Berlin Conference, also known as the Congo Conference, where the borders of European colonies in Africa were established. The potential and value of the regions already occupied by Portugal remained, until then, largely unknown.

The IICT scientific heritage is thus the result of scientific research and praxis developed over 132 years in the countries of the present Community of Portuguese-Speaking Countries (CPLP): Angola, Brazil, Cabo Verde, East Timor, Guinea-Bissau, Mozambique, Portugal, and São Tomé e Príncipe. This unique heritage of unequivocal interest bears testimony to the knowledge rooted into the natural and cultural diversity of the Tropics and can be seen as IICT's identity mark, for its singularity, symbolism and value as a whole.

When considering the historical and scientific collections altogether, including libraries and archives, the total number of items can be estimated at more than one and a half million. To these figures contribute the bibliographic catalogue, including the Centro de Documentação e Informação (CDI, Information and Documentation Centre) and publications edited by the IICT, including up to ca. 94,000 monographic works, ca. 13,000 titles of scientific journals, ca. 8,000 cartographic documents, a unique photography collection of more than 260,100 items dating from 1860 to 1974, and 543 film records from 1932 to 1983. Moreover, the central archives of IICT hold roughly 2.5 km of documents: 1 km corresponding to administrative archives and the remaining 1.5 km corresponding to archives of the different research units, encompassing field notebooks, technical scientific reports and other unpublished records. The relevance of these documents is paramount to the history of science and other natural sciences studies as the collections enable data comparison through time and the analysis of developments in tropical regions in different fields of knowledge. Closely related to the IICT bibliographic and archival collections are the collections of the AHU, created in 1931, within the Ministry of Colonies. This archive, transferred to the IICT in 1973 (and integrated in DGLAB in 2015), holds more than 15 km of records produced by the Portuguese overseas offices, between the mid-17th century and 1974 [4-5].

If we exclude archives and libraries, the IICT collections are estimated at about half a million items. The anthropological, ethnographic and archaeological collections, mostly collected between 1930-1980, include ca. 136,979 archaeological artefacts, 421 ethnoarchaeological items, 868 ethnographic artefacts and 16,000 blood samples. The natural history collections encompass: *1)* botanical collections (ca. 300,000 herbarium specimens, ca. 1,700 fluid-preserved specimens, plus two xylotheques (wood collections) with ca. 8,000 samples of different species); and *2)* zoological collections (ca. 82,000 specimens, including ca. 70,000 arthropods, and smaller collections, such as the fluid-preserved collection of reptiles and amphibians, the mammal collection and the bird collection). The earth sciences collections comprise 29,261 soil samples, 60 monoliths, 2,219 mineral and geologic samples, plus hundreds of mounted slides resulting from research. The Jardim Botânico Tropical (JBT, Tropical Botanical Garden) includes ca. 1,000 living plants and the *Index Seminum* (i.e., seed collection). The CIFC holds a collection of ca. 8,500 plants, derived from ca. 2,700 genotypes of *Coffea* spp. with diverse geographical origin and interspecific hybrids, plus a comprehensive pathogenic fungi germplasm bank (several isolates of *Hemileia vastatrix* and of *Colletotrichum kahawae*).

The scientific instruments collection (ca. 200 items) is also an important part of IICT heritage, as evidence of the practices of science in the 20th century and thus fundamental to the history of science and technology. Finally, the core collection of the Museu Nacional de Etnologia (MNE, National Museum of Ethnology) should also be mentioned because of its close relation to IICT collections. Founded in 1965 in the IICT's institutional sphere as the Museu de Etnologia Ultramarino (MEU, Overseas Ethnology Museum), the MNE become an autonomous institution in 1989.

Although distinct, these collections share collecting purposes and geographical scope, as well as relevance as a tropical research infrastructure and an instrument of cooperation and development between Portugal and the other

Portuguese-speaking countries. The collections respond to the challenges and demands of present-day society, having: 1) a relevant social and cultural value, and bear testimony to the relations between Europe and the African continent; and 2) a strong economic and political value, being an essential instrument for the responsible management of natural resources, within the framework of sustainable development policies.

Institutional developments

As mentioned above, the first institution responsible for the scientific and historic collections was the Cartography Commission (Figure 1). From the very beginning, the Commission's approach was interdisciplinary, comprising different fields of knowledge, namely the social sciences under "political geography" and the natural sciences under "physical geography" [4]. The CC created a library, which included both the state of the art of extant colonial cartography at the time, in addition to the cartography produced by the Commission itself. An important outcome was the Charter of Southern Portuguese Africa. This roughly corresponded to the "pink map" [6], drawn after the first scientific missions for border delimitation (geographic and hydrographic missions).

The CC underwent several structural changes and different designations throughout its history [5]. It was followed by the Junta de Missões Geográficas e de Investigações Coloniais (JMGIC, Colonial Research and Geographic Missions Board), with Decree no. 26 180, 7 January 1936. According to the legislator, apart from the need to continue border delimitation work, the new institution was expected to broaden its research scope. It was also expected to preserve the scientific materials collected during the missions, then extended to botany, zoology, geology, ethnography, anthropology and archaeology, as well as health and environmental studies [7].

Under Decree no. 35 395, 26 December 1945, the JMGIC became the Junta de Investigações Coloniais (JIC, Colonial Research Board) and was considerably reformed in the direction of increased decentralisation and expansion. No limits were imposed on the number of collaborators, aiming "to study and academically discuss the colonial scientific problems" [8]. The JIC welcomed several partners and established close working relations with national universities and research centres settled in the colonies. As Castelo [9] noted, by bringing together members of various universities and experts in diverse fields of knowledge, the JIC took advantage of the national university system critical mass and significantly increased its access to the colonial field. As a result, the institution became a powerful scientific instrument and the largest national and colonial network. During this period, the Colonial Scientific Documentation Service (later CDI, located in the last years at the Calheta Palace, Belém) and the Scientific and Campaign Equipment Storage (which some of the heritage was later found at the former Zoology Centre, Junqueira) were created. Furthermore, in 1948, the Herbarium (*Herbário*, LISC) was established [4]. The LISC, kept at specific facilities created in the former Botanic Centre, Palácio Burnay / *Junqueira*, in the beginnig of 2020 was transferred to MUHNAC to recently upgraded facilities, shared with the Herbarium (*Herbário*, LISU) of University of Lisbon.

After the 1951 constitutional revision (Law 2048 of 11 June 1951) and the Colonial Act (law establishing relationships between Portugal and its colonies), the term *colonial* was gradually replaced by the term *ultramarino* (overseas), in accordance with the new constitutional terminology [10, 11 art. 4º]. This change was a rather cosmetic one, since there was no intention to question the nation's pluricontinental unity [9]. Although it has not been yet possible to locate the legal document supporting the official change, the Junta de Investigações do Ultramar (JIU, Overseas Research Board) became the name frequently used in official documents and legislation during the 1960s. Among JIU's achievements with impact on scientific heritage, it is worth mentioning the creation/establishment, in 1965 [5], of the above mentioned MEU, under the direction of António Jorge Dias (1907-1973). Dias – a Portuguese ethnologist and cultural anthropologist, who led the Missões de Estudo das Minorias Étnicas do Ultramar Português (i.e., Missions for the Study of Ethnic Minorities of the Portuguese Overseas) – conceived the

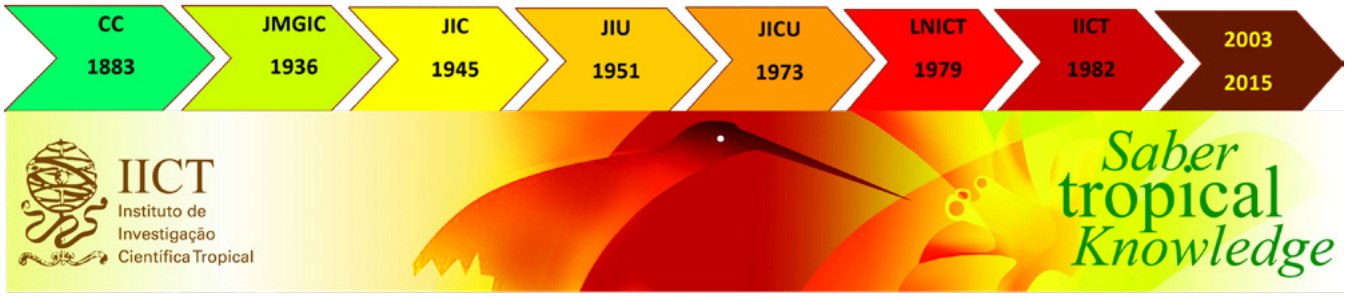

Figure 1. IICT 2015 Banner and evolution of the institutional acronyms (IICT, 2015).

Museum as an important tool of dissemination of African culture. The exhibition "Vida e Arte do Povo Maconde" (Life and art of the Maconde people, authors translation), organised in 1959 mainly with objects collected during this mission became the basis for the Museum concept.

In 1973, another Decree no. 583/73 of November 6/1973 [12], led to yet another name change – the institution became the Junta de Investigações Científicas do Ultramar (JICU, Overseas Scientific Research Board) – and yet another reform, oriented towards centralization. The JICU became autonomous in administrative and financial terms and expanded its services under the Overseas Ministry, receiving jurisdiction over: 1) the Jardim e Museu Agrícola do Ultramar (JMAU, Overseas Agricultural Museum and Garden), today the JBT (after the former Jardim Colonial and Museu Agricola Colonial, both created in 1906 and the latter discontinued in 1992) [5]; 2) the above-mentioned AHU; and 3) the Centro de Estudos Históricos Ultramarinos (CEHU, Overseas Historical Studies Centre), created in 1955 and responsible for developing research into the history of portuguese presence overseas, which includes the Filmoteca Ultramarina Portuguesa (FUP, Portuguese Overseas Film Archive), created to assemble microfilms of records documenting that presence, comprising more than 500,000 images [4, 12].

These changes were abruptly interrupted by the new political and social framework resulting from the revolution of 25 April 1974, which reintroduced democracy in Portugal. Perhaps unsurprisingly, a general crisis in the Overseas Ministry was ultimately followed by extinction, leaving its different structures – such as JICU – in undefined status [5]. The institutional situation was only clarified in 1976, when JICU became part of the Ministry of Culture and Science. On 31 December 1979, Decree no. 532 replaced JICU by the Laboratório Nacional de Investigação Científica Tropical (LNICT, National Laboratory of Tropical Scientific Research), oriented towards the development of scientific cooperation policies with the CPLP countries [13]. This decree omitted the ethnology museum and its collections since the prevailing idea was to establish an independent structure: the Instituto-Museu Nacional de Etnologia (i.e., National Institute-Museum of Ethnology) [14]. However, the idea was temporarily reverted when IICT was created on 8 April 1982, by the Decree no. 105/82, which included a museological component [6, 15]. In the aftermath of the reform carried out in 1982, 24 research centres covering the natural sciences, social sciences and humanities were created to develop scientific work in IICT [4-5]. Six years later, the Decree no. 249/89 dated 8 August 1989, moved IICT from the Ministry of Culture and Science to the Ministry of Management and Territorial Planning, ultimately resulting in the transition of the ethnology museum to the recently created MNE [16]. This became the first major dispersion of the IICT scientific and historical collections.

After two decades of stability, the last important reform of IICT resulted from Decree no. 297/2003 of 21 November 2003, which postulates the Normative Order no. 32/2005, when the institute internal regulation was defined [17-18]. A drastic simplification of the institutional structure was introduced, reducing the number of centres from 24 to 10 and the number of departments from six to two (i.e., Departamento de Ciências Naturais, DCN and Departamento de Ciências Humanas, DCH). Moreover, a Monitoring Unit composed of five specialists, two of which international, was created. The Orientation Council, comprising a maximum of 10 members, including representatives of different ministries, was also created. These structures were meant to advise and validate the Managing Unit, guaranteeing the internationalization of IICT and stimulating interdisciplinary approaches. On the other hand, increased relevance was given to IICT's scientific collections, now redirected towards a more central role in the internationalization effort and the cooperation context, a point we will detail later in this text. During this period, initiatives were made to recover, preserve and increase access to the collections, including those at the time outside the IICT but assembled during missions under the jurisdiction of *Junta*. These included, for example, the ethnographic collections collected by Mendes Correia (1888-1960), formerly housed at the University of Porto, and the Schiappa de Campos archives (1926-2018), a private collection donated to IICT in 2014, among others. Also, an effort was made to increased access to the MNE collections by IICT researchers through the establishment of a protocol with the Ministry of Culture in 5 July 2005.

The last reform aimed at mitigating the negative impact on IICT that resulted from its first international evaluation, promoted in 1997 by the Ministry of Science and Technology, within the framework of the state laboratories evaluation [6, 14]. This evaluation recommended the dismantlement of IICT into three distinct structures, ultimately separating heritage from research and researchers, in line with the previously mentioned decision to separate the ethnology heritage.

Ultimately, a similar separation happened a dozen years later, when IICT was integrated in the University of Lisbon and in the DGLAB at the Ministry of Culture. As mentioned before, responsibilities for the preservation, management and access to IICT scientific collections and archives were mostly attributed to the MUHNAC, while the central archive of IICT was attributed to the central services of the University of Lisbon. On the other hand, research staff was mainly integrated in the FLUL (namely researchers from the former DCH) and in the ISA (namely researchers from the former DCN).

Scientific and Historical Collections Management Strategy (2005-2015)

From the early days of the 2003 reform, the new IICT management team aimed to promote interdisciplinary research of the scientific and historical collections, which were understood as the identity mark of IICT. The mission statement and strategic management was based on two main priorities: 1) measuring and improving the quality and relevance of tropical

research, particularly through the programme Millennium Development Goals (United Nations joint effort to meet the needs of the World's poorest) in Portuguese-speaking countries; and 2) evaluating and preserving scientific heritage in accordance with the Portuguese Initiative [5], an agreement resulting from the II meeting of CPLP Ministers of Science and Technology, in 2003, in Rio de Janeiro. The latter corresponded to the commitment by the Portuguese government of making accessible IICT's scientific and cultural heritage to all CPLP countries. The CPLP ministers aimed to develop exchanges among CPLP members' museums, archives and scientific institutions and support the Portuguese Initiative of making IICT's collections available to other CPLP countries [19]. The final statement was unanimously signed by all ministers, including the Portuguese minister of science and higher education (Maria da Graça Carvalho). Endowed by this strong diplomatic and cooperative duty, conditions for the systematic treatment and increased access to IICT's collections were facilitated and a dedicated and innovative programme was established. This programme, which was underway for 10 years, until IICT joined the University of Lisbon, acted as a platform to share and disseminate knowledge related to the tropics. It encompassed activities of conservation, digitization, research, capacity building and cooperation around scientific and historical collections, favouring partnerships with local research entities and universities in Portuguese-speaking countries.

The programme also supported training in these countries as a core principle of the cooperation agreements. Thus, the initiative contributed to improve tropical research and increase our knowledge of the culture and history of tropical countries, notably those where Portuguese is the official language. The programme was supported by the Fundação para a Ciência e Tecnlogia (FCT, Portuguese Foundation for Science and Technology) through the provision of grants and post-doc fellowships, through the Programa do Compromisso com a Ciência (i.e., Science Compromise Programme). A total of 15 research grantees and three post-docs were hired to meet the Programme's objectives. Later, the work of these researchers was also fundamental to support the transfer of collections to the University of Lisbon.

The whole process involved three main steps: 1) since 2005, the implementation of the Programa Interministerial de Tratamento e Valorização do Património do IICT (PI, Inter-ministerial programme for the treatment and valorisation of IICT heritage), which involved the survey and preservation of collections through the establishment of a collection care policy; 2) in 2007, under the framework of the reform of State Laboratories established by the 124/2006 resolution of the council of ministers, the creation of the project Arquivo Científico Tropical (ACT, Tropical Scientific Archive), which involved promoting study and access to IICT collections through the development of the online platform Arquivo Científico Tropical Digital (ACTD, Digital Tropical Scientific Archive); and finally 3) in 2011, in the International Year of Forests, the launch of the project Promoção do Saber Tropical (PST, Promoting Tropical Knowledge), concerning mainly tropical ecosystems conservation, based on IICT vast biological heritage (botanical and zoological collections). These three steps are discussed in detail below.

Step 1: Survey and preservation

As far as collections' care is concerned, initial priority was given to locate and identify IICT's diverse and dispersed heritage. The task was challenging due to the sequence of institutional reforms and IICT's geographic dispersion. In 2003, the Institute had 24 different addresses in the city of Lisbon, Oeiras and Coimbra. A significantly heterogeneous situation was found, from considerably accessible and curated collections such as the LISC Herbarium and the AHU, to the lack of curatorial staff in other research centres for collections care, which became increasingly acute, mostly due to staff ageing. This situation inevitably led to risk of damage and loss due to inappropriate storage or lack of preservation facilities. Given this scenario, the principal task was to set up a systematic survey to identify and characterise the different collections (Figure 2). An inquiry was sent to researchers in charge, followed by regular visits by small teams, which always included a conservator-restorer, a specialist/curator and a collections manager. Characterisation included the collection's dimension/volume, their storage and conservation condition, their use (e.g., research, exhibition, others), regular care procedures and the level of treatment required. The existence of associated documentation was considered critical as it enables proper inventory and heritage significance recognition, thus was also registered in the survey.

Figure 2. Botanical collections survey (IICT, 2013).

The survey showed that more than 45 % of the heritage was at risk due to inappropriate storage conditions and poor conservation condition. Moreover, ca. 39 % of the scientific collections had insufficient associated documentation available and for 6 % no associated documentation at all was found. Digital treatment comprised only 17 % of all IICT collections.

The second task concerned the implementation of preventive conservation procedures for the different collections and establishing a preservation policy – the first ever – for IICT [5, 20].

Despite the large number of collections under its care, IICT did not offer standard conservation requirements for some collections. The building that raised the greatest concern was the one hosting the zoology collections. Hence, it was proposed to the minister of science and technology – Mariano Gago (1948-2015) – the construction of a new building in the land adjacent to the old one, with adequate storage facilities. Unfortunately, the economic crisis which profoundly impacted Portugal after 2008 precluded this initiative.

Usually, the main factors that affect long-term preservation of historical and scientific collections are light, temperature, relative humidity and pests. Thus, the implementation of a preventive conservation policy at IICT included regular monitoring of temperature, humidity and light in storage areas, coupled with the establishment of an integrated pest management program (IPM). Objects in storage were periodically inspected for evidence of insect activity (e.g., eggs, larvae, new powdery deposits or small holes), as well as mould evidence. This allowed early detection of infestations and further damage. Contaminated objects or collections were placed in isolation and treated under anoxic conditions. Basic conservation procedures were also implemented, such as regular dry cleaning (Figure 3) and proper storage conditions, taking into account collections' particular needs, such as low temperature requirements (Figure 4). Methods for secure display and storage, as well as staff training to ensure the integrity of objects during handling, transport and loans between IICT departments or to external institutions, were also main concerns. Other important improvements included the establishment of adequate procedures for object handling in collections regularly being used for teaching activities and located outside IICT facilities (e.g., ISA).

Step 2: Study & access

In 2006, the importance of the Portuguese Initiative was emphasised and supported by UNESCO. Joie Springer, a member of the information society division and the universal section Access and Preservation of UNESCO, visited the IICT. Springer considered that IICT should increase access and dissemination of heritage, which she considered of the highest relevance for humanity. Apart from the study, treatment and digitization, Springer suggested an application to the UNESCO program Memory of the World Register in order to seek recognition of the outstanding universal value of some of the IICT documental collections. Increasing access to IICT heritage included collections study, identification and classification, as well as their online accessibility. Individual databases with digital inventories did exist, but they brought little added value to the heritage as a whole, representing, as mentioned early, only 17 % of the total collections. Thus, expansion of the digital inventory scope was an early objective. For the Herbarium, the BRAHMS database, a natural history database developed by the University of Oxford to manage the collection, already adopted by IICT researchers, was kept in use. In parallel, SPECIFY, an open access software common with biological collections, was adopted for the zoology collections; and the software MATRIZ – Museum Collections Inventory and Management, used by national museums in Portugal, was adopted for the ethnographic and archaeological collections.

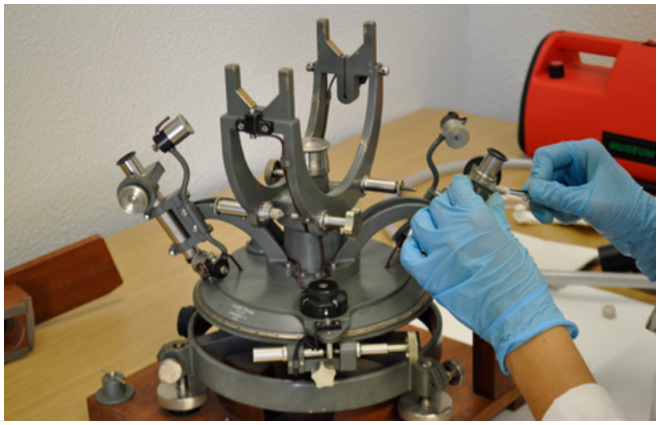

Figure 3. Cleaning operation of scientific equipment (IICT, AHU, 2010).

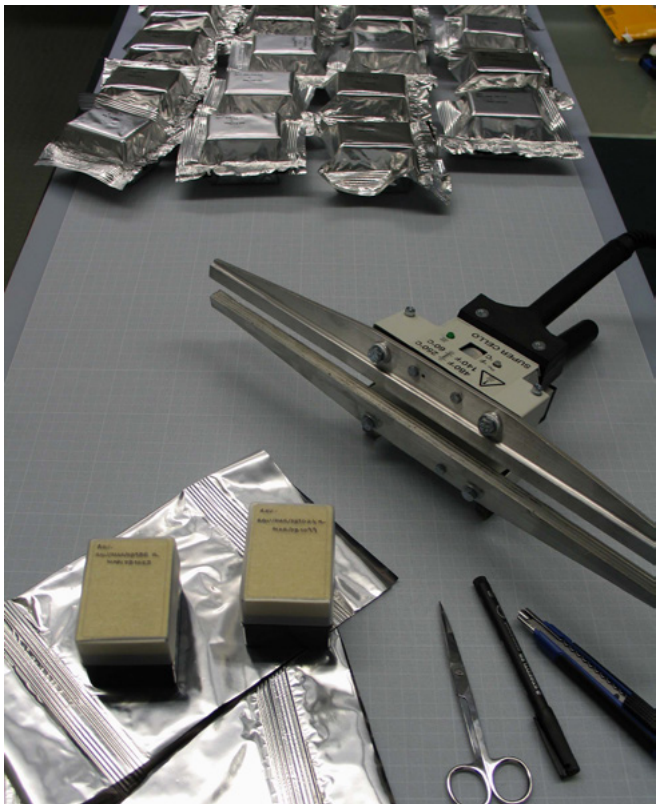

Figure 4. Packaging for cold storage (IICT, AHU, 2006).

Figure 5. Exhibition "Viagens e Missões Científicas nos Trópicos 1883-2010" (IICT, Calheta Palace, 2010).

In 2007-2008, a second main step was to provide access to IICT collections and archives through a single online platform. ACTD, an institutional repository based on open source software, was created, bringing together primary information from several databases and enabling users from all over the world to conduct autonomous searches based on the item type, scientific domain/topic and geography. This online platform aimed to collect, preserve, manage and disseminate both IICT's collections and research outreach, thus encouraging innovation in tropical scientific research.

During this step, an oral history programme was also developed to collect testimonies and life stories of IICT researchers and technicians and to make them available through ACTD. Moreover, a research line on the history of science was initiated, leading to the exhibition "Viagens e Missões Científicas nos Trópicos, 1883-2010" (Scientific Travels and Missions in the Tropics, authors' translation) (Figure 5). This exhibition, promoted by IICT under the auspices of the centenary of the republic national celebrations [21], provided access of IICT's scientific heritage and collections to broad segments of the public. These two initiatives where supported by a consortium composed of IICT, the Centro de História e Filosofia da Ciência e da Tecnologia of NOVA University of Lisbon (i.e., History and Philosophy Centre of Science and Technology; nowadays Centro Interuniversitário de História das Ciências e da Tecnologia, after the merge with the Centro de História das Ciências da Universidade de Lisboa) and ALGORITM Centre of the University of Minho.

In short, at this stage, several investments made in the study and dissemination of the collections for the benefit of the scientific community and the general public, through the treatment, publication, exhibition and, particularly, online access, by specialized databases and the digital repository ACTD, resulted in the consolidation of IICT's scientific collections and heritage as a strategic vehicle for international cooperation.

Step 3: Policy consolidation

Established in the last phase of IICT, the PST project was anchored on an agreement contract by IICT and FCT to ensure a considerable number of grants (i.e., 18) to continue the study and treatment of the IICT scientific collections. These grants would later be transferred to the University of Lisbon. Other agreements signed to improve collections standards and access included: 1) a collaboration with the Arquivo Nacional da Imagem em Movimento (ANIM, Nacional Archive of Movement Image) for film conservation and long term loan; 2) an agreement with Laboratório Nacional de Energia e Geologia (LNEG, National Laboratory of Energy and Geology) for mineralogical and geological collections preservation at the LNEG lithotech in Alfragide (near Lisbon); and 3) several agreements with researchers for long term loan or transfer of archival material and photographs, such as the above-mentioned collection of native habitat studies mission of Guinea-Bissau (1959-1960) from architect Fernando Schiappa Campos, and the collections resulting from several botanical expeditions by the botanist José Mendes Ferrão.

During this third step, the main access policy [22] and the loan rules [23] were revised and established, according to museum standards. Main assessment criteria included: object availability and value, conservation condition and size and relevance of the request in relation to IICT priorities.

Moreover, loan approvals were based on travel and display adequacy of the object(s), as well as the capacity of the borrowing institution to meet security requirements and care standards.

Another important preservation initiative was the creation of an open storage for the ethnographic collections in Calheta Palace (Figure 6). The open storage, comprising four rooms, was visited by appointment by researchers, school groups and senior groups, for investigation and education proposes or simply to enjoy the experience of visiting the collections. This storage facility also worked as a communication tool, namely addressing the minorities from the CPLP communities in Portugal, which were particularly invited to participate in special events such the international museums day and the European researchers' night, among others.

The improvement of data quality and access under PST included: 1) collections' georeferencing in ACTD; and 2) protocols for integrating ACTD data into the Registo National de Objectos Digitais (RNOD, Digital Objects National Record), thus becoming also accessible through EUROPEANA. Moreover, in 2013, FCT designated IICT as the Portuguese node of GBIF (i.e., Global Biodiversity Information Facility), an initiative aiming at bringing online access to biodiversity data.

The last two decades have been shaped by the effort to make IICT scientific data available to global networks and the need to create worldwide information platforms accessible to all researchers (e.g., GBIF; EUROPEANA Collections). A significant corpus of scientific research has resulted from these efforts, as detailed in the next section.

Figure 6. Open Storage Room (IICT, Calheta Palace, 2012).

Main achievements

Outputs

The multidisciplinary and diversity of the research lines developed under the Portuguese Initiative – comprising the PI programme, the ACTD and the PST – contributed to the acquisition and accessibility to a wealth of knowledge. They have also strengthened the role of Portugal as a key collaborative player alongside other international institutions with important collections from CPLP countries.

Information from biological collections, coupled with the legacy of several twenty century seminal studies by renowned naturalists, such as John Gossweiler (1873-1952) and Luís Augusto Grandvaux Barbosa (1914-1983), who published the *Phytogeographical map of Angola*, are still the baseline for more recent studies, namely the study of the biogeography of forest timber species [24] and mammals in Angola [25]. Other recent examples of studies using the biological collections of IICT include the study of the botanical explorations of Cabo Verde [26] and Guinea-Bissau [27] and the conservation status assessment of the Cabo Verde native flora [28].

The study of traditional plant uses by African populations is another example of interdisciplinary research promoted in recent years. By combining ethnobotany and plant ecology methods, the study of botanical collections is instrumental for cataloguing plant properties and uses accumulated over generations. This traditional knowledge represents an important cultural heritage and conveys relevant information about the potential of tropical floras. In this regard, research developed in the IICT has made recently available comprehensive ethnobotanical datasets for different African countries, including Angola [29], Guinea-Bissau [30] and Mozambique [31]. Furthermore, several studies were published based on the unique collections housed in CIFC (e.g., coffee leaf rust pathogen collections) [32] or in the response of *Coffea* species to cold impact and acclimation [33], which have contributed collectively to raise the quality and impact of the IICT's excellence at all levels of research.

Other important outputs include contributions to heritage conservation, namely in liquid collections [34], cultural heritage biodeterioration issues [35-36], integrated pest management [37], air quality and risk assessment [38-39], and conservation management issues, and disaster planning [40-41]. In the area of conservation, IICT gave priority to training and received students from different conservation schools, namely from the conservation and restoration department of NOVA University of Lisbon. IICT also provided opportunities for training, research, and networking, promoting capacity building in CPLP countries through the organization of courses and workshops, such as the international "Preventive Conservation Course" for archivists and librarians, promoted by the Arquivo Histórico de Moçambique/Universidade Eduardo Mondlane, with the support of the International Archives Council, in August 2014.

Other interdisciplinary studies worth mentioning targeted the ethnography and anthropology heritage and the archaeological collections involving, for example, Mozambique [42-43], Angola [44-46] and East Timor [47-48]. Other relevant publications refer to studies in the field of oral history [49], institutional history and history of science [50-52].

The dynamic atmosphere experienced during these years contributed to disseminate previous and ongoing studies carried out by researchers from IICT and partners. At the same time, new digital content on tropical issues

was produced and disseminated. A vivid idea of the work undertaken under the aegis of this initiative is given by the numbers achieved by the end of 2014: ca. 270,000 items catalogued and ca. 185,000 items encoded as records in different databases, of which ca. 177,000 were made available online through ACTD. The ACTD reached 905,477 views and 244,714 downloads, accessed by 206,083 different locations, in Europe, Africa, America and Asia, becoming a reference for international research on tropical issues. We have no numbers after the integration of IICT in the University of Lisbon in 2015, but ACTD is still the largest RNOD provider at national level.

Other relevant outcomes include 18 exhibitions organised during this period both in IICT and in CPLP countries. The already mentioned "Viagens e Missões Científicas nos Trópicos" explored the portuguese scientific agenda for the tropics, between the monarchy and the republic, as well as current research based on the Millennium Development Goals. This exhibition, presented in Calheta Palace between November 2010 and January 2012, deserves to be singled out due to the organization of more than 50 complementary workshops focusing on IICT collections and leading to the first "International Colloquium on Science in the Tropics". Another important achievement was the Memory of the World International Register of the Ndembo Archives (Angola), in 27 July 2011, proposed by IICT/AHU and the Angola National Archive to the UNESCO program Memory of the World. The IICT Heritage Week (i.e., Semana do Património), in 2007, was also a milestone, involving guide tours and an exhibition open to the general public, plus a seminar and a round table for the scientific community.

Briefly, the management of the IICT scientific and historic collections and resources, together with the study, treatment and digitisation efforts done more recently in the framework of these initiatives and different projects, have greatly contributed to improve the recognition of this heritage by the general public and the scientific community, mainly through the access to exhibitions and science dissemination and outreach events, the availability of the unique data in large public repositories and networks (e.g., GBIF, EUROPEANA and ACTD) and the publication of scientific papers and training initiatives.

SWOT analyses

The evaluation of IICT collections and heritage clearly indicates that without the 10 years (2005 to 2015) under the Portuguese Initiative, several collections would have remained under unsatisfactory curatorial conditions. Moreover, the integration in the University of Lisbon would have been considerably more difficult and uncertain. In conservation terms, the main weakness and threats were gradually overcome. The creation of a team and the establishment of a preservation policy enabled problem identification, grounded decision making and the provision of essential facilities for collections preservation, access and use. The creation of specific access tools enabled their greater visibility and increased their use.

The integration of IICT collections and heritage in the University of Lisbon has been greatly facilitated by this previous work. Moreover, their management by MUHNAC, a museum with a curatorial tradition, technical facilities and specialized human resources, is encouraging for the future of these collections. Table 1 summarises a SWOT analysis of the intervention on the collections. In terms of strengths, if we believe that the 2005 interdisciplinary body of researchers can, in part, be compensated by the specialised curatorial work of MUHNAC; on the other hand, the decrease of IICT collections as a cooperation tool for Portuguese-speaking countries is a weakness that can hardly be compensated by the general understanding of the collections as important research infrastructures, since these are both important valences of this heritage. The detachment of the IICT researchers (mainly integrated in FLUL and ISA and with new concerns and challenges to face) is another weakness

Table 1. SWOT analysis considering a comparison of the scientific collections conditions at the beginning of Portuguese Initiative and 10 years later, after IICT "extinction by fusion" and the incorporation of scientific collections at University of Lisbon.

	First assessment – 2005/2006	**Second Assessment – 2015/2016**
Strengths	- Unique collections of high interest - Interdisciplinary body of researchers with specialized knowledge of CH&C	- Previous survey and conservation treatments given by IICT team, allows to get a full picture of the situation of the CH&C - Some of the destination places at UL are expected to have better and specialised curation conditions
Weaknesses	- Insufficient specialised human resources and technical facilities - Preservation policy in the organisation nonexistent	- Connection between collections and former IICT researchers disrupted - The impact of CH&C as a cooperation tool tends to decrease within the new institutional environment
Opportunities	- Institutional renovation process going on and reinforcement of the international network - Reinforcement of interdisciplinary work and projects application opportunities	- FCT fellows integration at ULisboa as essential elements for knowledge transfer - Participation in the PRISC and PORBIOTA infrastructures
Threats	- Poor storage conditions and high deterioration rate of some collections - Some collections were disorganised and their scope was partially unknown	- Providing data and data management of ACTD and BD stopped - Partial dispersion of collections

that can be compensated by the opportunity of integration of fellows involved in the treatment of the collections in these last years. But this opportunity if not reached may become a real threat, resulting in a decrease of the rates of collections treatment and accessibility, as well as the expected scientific outputs. At the same time, the ACTD is at risk of losing its online visibility since the collections digitisation process has slowed down. This is a great loss after the international attention it attracted.

Final remarks

The European Union development policy indicates external cooperation programmes for furthering research and development in the Tropics, notably in Africa, as one of its goals [53]. There is a need to join efforts and to invest in the organisation of international networks and innovative research projects to fill the numerous gaps in our knowledge of tropical regions, especially in Sub-Saharan Africa. This will ultimately increase our understanding of these regions and contribute to their development. Accordingly, ensuring access to data from tropical regions is fundamental to foster future cooperation policies and actions, namely in Portuguese-speaking countries, where Portugal can lead by making available its scientific and historical collections and establishing bilateral research programmes.

The development of successive initiatives – from the Inter ministerial Heritage Management and Valorisation Program, the Tropical Scientific Archive to the Furthering of Tropical Knowledge Program – enabled the IICT to develop great expertise in the curation of historical and scientific collections in Portugal, shaped by an integrated and multidisciplinary perspective, as well as different methodological approaches. This achievement was only possible thanks to the support of FCT, which has funded human resources since 2004. A multidisciplinary team has developed an action plan oriented towards management and conservation, from the initial systematic survey and identification, organisation, indexing and cataloguing, preservation and conservation, to the computerisation, digitisation and dissemination of the collections from various scientific units. Moreover, the action plan involved a strong investment in new infrastructures, namely computer processing, online access and preservation facilities.

This investment by IICT and funding partners, especially FCT, has resulted in an enrichment and greater visibility of the scientific and historic collections and heritage. Importantly for its national outlook, IICT was integrated into two national consortia: 1) PRISC (i.e., Portuguese Research Infrastructure of Scientific Collections); and 2) PORBIOTA (i.e., Portuguese E-Infrastructure for Information and Research on Biodiversity), both included in the Portuguese Roadmap for Strategic Research Infrastructures [54].

Since 2005, the entire scientific heritage of IICT has been identified and referenced, including the recovering of lost paper inventories, the upload of new databases and the organization of a transversal repository. In 2008, the ACTD was launched and it quickly became a reference search tool for researchers interested in collections from the tropical region, with thousands of views and downloads from all over the world. The availability of information from IICT collections has strengthen their potential for interdisciplinary research, creating new challenges for the scientific community and contributing to science in the tropics. Furthermore, international collaboration with African institutions has settled local capacity building as one of the priorities of IICT's action. In this context, the involvement of researchers from Portuguese-speaking African countries has been privileged, a cooperation and training policy that the University of Lisbon should continue.

Finally, tropical research within the University of Lisbon, and its national and international status as a study centre of historical and scientific heritage, would greatly benefit from adequate and active curation and study of IICT collections, which rank among the largest in the world for Portuguese-speaking African countries.

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ARTICLE / ARTIGO

O Plano de Valorização do Património Cultural da Escola Secundária Sebastião e Silva, Oeiras

The Valorization Program of the Cultural Heritage of Sebastião e Silva Secondary School, Oeiras

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Resumo

A Escola Secundária Sebastião e Silva possui, tal como muitas escolas secundárias existentes em Portugal e noutros países, importantes coleções científicas. Estas são compostas, maioritariamente, pelos núcleos das Ciências da Natureza, Física e Química, revelando-se fundamentais quer como testemunhos da memória e identidade deste antigo Liceu, quer evidenciando as práticas pedagógicas adotadas na instituição, contribuindo para a história das ciências e da educação em Portugal. São, ainda, o espelho do valor dado a estas disciplinas pela instituição patente, por exemplo, nas preocupações inerentes à seleção do material constitutivo da coleção. O objetivo do presente artigo é o de explicar o contexto de constituição do acervo e de institucionalização do Núcleo Museológico, em que a relevância das coleções se cruza com o seu incomensurável valor patrimonial, enquanto construtor de uma identidade e memória coletiva da escola e da comunidade educativa. Pretende-se, seguidamente, explicar as estratégias de interação pedagógica já implementadas e, por fim, destacar os problemas e as perspetivas de futuro. Refletir-se-á, deste modo, acerca da relevância deste património numa era de tecnologias digitais e sobre os principais desafios colocados à sua preservação, estudo, interpretação e divulgação.

PALAVRAS-CHAVE
Memória Coletiva
Património
Educação
Acervo
Preservação
Divulgação

Abstract

Like so many secondary schools, in Portugal and elsewhere, the Sebastião e Silva Secondary School in Oeiras has important scientific collections. These mainly encompass the Natural Sciences, Physics and Chemistry fields, and their significance is associated both with the memory and identity of the School, and with local pedagogic practices, contributing therefore to the history of sciences and education in Portugal. Moreover, they reflect the value given to these subjects by their host institution, for example, by the selection of materials which integrate the collection. The main purpose of the present essay is to explain the origins and context of the collection and its institutionalization as a museological nucleus of the School. The collection relevance and its immeasurable heritage value is a maker of a collective identity and memory of the School and the educational community. In the present paper implemented strategies of pedagogical interaction are discussed and, ultimately, problems and future perspectives are highlighted. A reflection is made about the relevance of this heritage in an era of digital technologies, as well as the main challenges in its preservation, study, interpretation and dissemination.

KEYWORDS
Collective Memory
Heritage
Education
Collection
Preservation
Divulgation

Introdução

> *As colecções de história natural dos antigos liceus são património da escola, património da educação e património da ciência. A relevância das colecções científicas das escolas, no âmbito da história das ciências e da educação, e a sua importância patrimonial são significativas. Estas colecções não são meros objectos "empoeirados", tendo significado contemporâneo. [1, p. 135]*

Ao deambular pelos corredores desta vetusta Escola Secundária, antigo Liceu, ao entrar nas salas de aula e na biblioteca original sentimo-nos acompanhados pelo belíssimo mobiliário, algum dele feito à medida, que alberga uma enorme diversidade de peças, artefactos e espécimes, outrora usados quotidianamente em sala de aula. Ao cair em desuso, este património científico [2, p. 746], tal como o de muitas escolas espalhadas por este país e não só, corria o risco de se dispersar e degradar, nada mais lhe restando do que ser acondicionado num arquivo morto, "ou reduzidas a um mero papel decorativo" [1, p. 129] . A nível da tutela, e numa perspetiva nacional, algumas medidas de inventariação foram empreendidas, como é o caso das iniciativas coordenadas por Maria do Rosário Santos (1989), e o levantamento coordenado por António Nóvoa [3-4]. Os resultados encontram-se na Secretaria Geral do Ministério da Educação e Ciência. Mais recentemente, o projecto *Inventário e Digitalização do Património Museológico da Educação* pretendeu executar uma política de identificação, tratamento, conservação e divulgação pública do património histórico da educação. Este trabalho pode ser consultado em http://edumuseu.sec-geral.mec.pt/.

A nível da Escola Secundária Sebastião e Silva (ESSS) as preocupações pela inventariação, preservação, estudo e divulgação deste material e sob o lema, *Preservar a Memória, Construir a Identidade*, originaram a elaboração de um Plano de valorização do património cultural, em que assentou a institucionalização do Núcleo Museológico. Trata-se de um processo em que a escola é entendida como lugar em que se deve estabelecer uma profícua relação entre o passado e a contemporaneidade e em que se assume que a identidade não é um resultado acabado, mas um contínuo que a todos implica e enriquece. Deste modo, e tendo por eixo norteador esta preocupação, o presente artigo aborda, de forma sintética, três aspetos que consideramos essenciais para a compreensão cabal de todo este processo: 1) o contexto de constituição do acervo e de institucionalização do Núcleo Museológico da Escola Secundária Sebastião e Silva (NMESSS); 2) as estratégias de interação pedagógica que até ao momento foram empreendidas e; 3) os problemas e perspetivas futuras.

O contexto de constituição do acervo e de institucionalização do núcleo museológico

A constituição de acervos do tipo do da ESSS é guiada, em geral, por um padrão comum a muitas instituições de ensino secundário e superior. Os artefactos e espécimes são adquiridos para serem usados no apoio ao ensino e ao fim de múltiplos ciclos de utilização, que podem atingir décadas, tornam-se obsoletos por inúmeras razões (eliminação de conteúdos dos programas educativos, substituição de meios tecnológicos de apoio didático, entre outras), podendo adquirir novos significados para a memória e identidade da escola. Este processo de revalorização pode acontecer sob a forma de museus, coleções visitáveis, ou núcleos patrimoniais e museológicos, com maior ou menor acesso por parte do público em geral, e tem vindo a gerar um interesse crescente sobretudo em Portugal, Espanha, América Latina e França. Os estudos sobre o património da escola têm vindo a multiplicar-se nestes países.

Em Portugal, o estudo do património escolar de História Natural, em grande parte dos casos constituído por peças ainda com utilização muito recente, e a consideração de hipóteses de um futuro que pode ser perspetivado têm dado origem a trabalhos de investigação na área de Doutoramento, Inês Gomes [6], e de Mestrado, Catarina Leal [7]. Os trabalhos de Lourenço [1-2] evidenciam não só a preocupação pelo levantamento, preservação e divulgação destes artefactos, como ainda sobre a nova vida que estes espécimes podem e devem possuir no local onde foram colecionados. Esta investigadora criou no Museu Nacional de História Natural e da Ciência (MUHNAC) um grupo responsável pelo apoio às escolas. Mogarro e a sua equipa, ao serviço do Ministério da Educação, coordenaram um projeto de inventariação e digitalização do Património museológico escolar português com o objetivo da sua salvaguarda e divulgação [13]. A mesma autora num outro artigo coloca em evidência algumas experiências feitas a partir destes espólios materiais da educação [14]. Em Espanha, autores como Álvarez Domínguez [15-16], Avellaneda Artigas [17] e Agulló Díaz [18] têm feito um trabalho de levantamento e estudo dos museus pedagógicos destacando-se, igualmente, a sua importância para a História da Educação, num resgate de memória dos processos formativos e materiais didáticos utilizados no passado. Este tipo de estudo, com especial enfoque para a compreensão da História da Educação, tem atraído cada vez mais investigadores do outro lado do Atlântico, nomeadamente no Brasil. Zancul [19] faz um levantamento dos grupos de trabalho e dos centros de documentação que estudam e preservam este património escolar/educativo, destacando trabalhos que têm sido elaborados sobre o tema. Elenca, igualmente, muitos outros autores que se têm dedicado a esta área de interesse.

Os museus escolares/pedagógicos têm, como facilmente se constata, gerado uma quantidade significativa de produções. Ao divulgar a variedade de experiências museais

Figura 1. Modelo desmontável, ilustrativo de abelha em corte transversal (foto: F. Santana, AAAALNO/ESSS, 2019).

e de trabalho em torno das mesmas, pretende-se que possam servir de inspiração e de referência para outras instituições congéneres, nomeadamente, ao nível da investigação, exposição e divulgação, com o objetivo de valorizar, potenciando, a função cultural e educativa destes espaços ainda bastante esquecidos.

Origens do acervo da ESSS

A ESSS resultou da transformação do Liceu Nacional de Oeiras (LNO), após a mudança de regime político ocorrida no País em 1974, com a consequente alteração do sistema de ensino [5]. Inaugurado em 18 de Outubro de 1952, o LNO era, então, o único liceu entre Cascais e Belém, recebendo também alunos de Sintra, Queluz e Amadora. O edifício, pensado para um ciclo de estudos especialmente orientado para o acesso ao ensino superior, oferecia, numa das alas, todo um andar dedicado ao ensino da Física e da Química (com laboratórios e gabinetes específicos), e previa um outro, para as Ciências Naturais, à semelhança do que se passava noutras escolas [6], cuja edificação só foi concluída em 1959. A consulta dos inventários e dos relatórios do Reitor Mexia de Brito, relativos aos primeiros anos da década de 1950, esclarece a dimensão do investimento efetuado em benefício de um ensino que se pretendia inovador e adaptado aos novos tempos de mudança, com uma forte componente experimental, tal como o preconizavam os programas da reforma de 1947/48, certamente já influenciados pela Organização Europeia de Cooperação Económica (OECE) uma vez que Portugal foi membro fundador. Considera-se, neste documento, que "é indispensável basear todo o ensino na observação e na experiência, dirigindo o aluno, excitando-lhe a curiosidade e o interesse, deixando-lhe uma margem de iniciativa tão lata quanto possível [...]" [8, p.184].

A base das coleções do acervo do atual Núcleo Museológico da ESSS remonta, pois, a esse período [8]. Logo nos dois primeiros anos, foi avultado o investimento realizado pela tutela (Comissão de Reapetrechamento dos Laboratórios e Gabinetes dos Liceus, Junta das Construções para o Ensino Técnico e Secundário, Direção-Geral do Ensino Liceal) no que se refere ao equipamento [9] especialmente destinado às disciplinas com laboratórios – 469.228$60 – sendo ainda a escola dotada de "Armários e vitrines para Museu" – 51.900$00 –, entendidos como recurso educativo para aquelas disciplinas. Os quantitativos dispendidos são assinaláveis, se considerarmos que em 1962, no decurso do II Plano de Fomento, 82,5 % dos trabalhadores por conta de outrem recebiam menos de 15.000$ anuais [10]. Numa sensibilidade pela indispensável atualização do ensino foram adquiridos animais taxidermizados, conservados em líquido, esqueletos, rochas e fósseis, modelos anatómicos de plantas e animais, quadros parietais, entre outros, que permitiam uma observação de pormenores, podiam ser manipulados pelos alunos e reutilizados inúmeras vezes, em diversos contextos. Investiu-se em toda uma panóplia de recursos materiais e didáticos para as aulas das disciplinas experimentais, numa clara valorização da pedagogia ativa. Além das peças fornecidas pela tutela, algumas oriundas de conhecidas casas estrangeiras (Figuras 1 e 2), como por exemplo a Casa *Les Fils d'Émile Deyrolle*, em Paris, foram adquiridas outras, pelo orçamento do próprio LNO. Com efeito, "transformar os liceus numa escola moderna e fazê-lo através do apetrechamento das escolas com coleções didáticas [...] foi, assim, um desígnio

Figura 2. Projetor diascópico, com plataforma basculante (foto: F. Santana, AAAALNO/ESSS, 2019).

nacional, muito para além, das iniciativas governativas" [6, p. 233]. Foi o caso do apetrechamento das salas (Figura 3) e do Gabinete de Matemática criado pelo Vice-Reitor, Silva Paulo, membro de organismos internacionais de estudos matemáticos articulados com o ensino, e colaborador de Sebastião e Silva, com quem elaborou compêndios para o ensino liceal. Outros materiais do acervo resultaram, por exemplo do labor especializado de um dos funcionários do LNO, Eurico Pereira (Figura 4), que recebeu formação específica como preparador de Ciências Naturais, do professor Eduardo Pinheiro [11, p. 55].

Nos anos 1960 e viragem para 1970, o LNO viu aumentar exponencialmente a sua população, recebeu estágios e equipamento adequado, e foi integrado no *Projeto de Modernização do Ensino da Matemática* (iniciado em 1963), coordenado por Sebastião e Silva, com o patrocínio da Organização para a Cooperação e Desenvolvimento Económico (OCDE). Em 1975, quando a Direção-Geral do Ensino Secundário do Ministério de Educação, inquiriu o LNO sobre que personalidade pretendia como patrono, no momento em que se transmutasse em Escola Secundária, a escola escolheu chamar-se Sebastião e Silva.

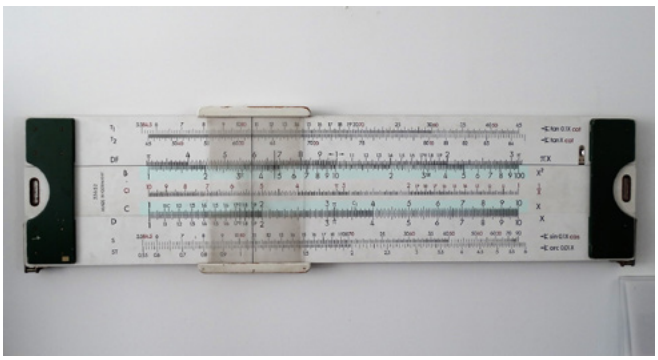

Figura 3. Régua de cálculo, de demonstração, acoplável à parede (foto: F. Santana, AAAALNO/ESSS, 2019).

O Núcleo Museológico

Relativamente à institucionalização do Núcleo Museológico destacam-se, como etapas fundadoras, as que correspondem aos anos de 2002, 2008 e 2012.

Em 2002, data do 50º aniversário da inauguração do LNO, antigos alunos e professores juntaram os seus esforços aos da ESSS, com o objetivo de comemorar a efeméride. Nessa data, foi fundada a Associação de Antigos Alunos e Amigos do LNO/ESSS (AAAALNO/ESSS), adiante designada por Associação, que estabeleceu como objeto estatutário a "preservação do património histórico e cultural e a prestação de apoio [...] ao funcionamento do LNO/ESSS " e, como " um dos meios para a realização desse objeto", a "criação e manutenção de um Núcleo Museológico" [12].

No plano das comemorações avultou uma exposição evocativa, que mobilizou toda a ESSS e contribuiu para reforçar a sua consciência patrimonial. A exposição (Figura 5), centrada no material didático e nas práticas pedagógicas da década de 1950, e correspondentes programas de ensino, implicou pesquisas nos arquivos da escola, para obtenção de dados que justificassem a seleção dos materiais a expor, alertou para a necessidade de salvaguardar material e impulsionou um conjunto de práticas de inventariação sistemática. Ao Conselho Pedagógico foi apresentada (2003) uma proposta de início de registos rigorosos, nomeadamente fotográficos, segundo normas museológicas, dando-se prioridade ao material didático entretanto fora de uso, tendo em vista a sua preservação.

Em 2008, a Associação, tendo conhecimento informal de que o Ministério da Educação (ME) se encontrava a desenvolver, em algumas escolas, um projeto de preservação e valorização do património educativo, designado por

Figura 4. Camaleão taxidermizado, em posição de ataque a gafanhoto – Preparador: Eurico Pereira (foto: F. Santana, AAAALNO/ESSS, 2019).

Figura 5. Exposição comemorativa do 50.º aniversário do LNO -2002 (foto: Arquivo da ESSS, 2002).

Inventário e Digitalização do Património Museológico da Educação [13], diligenciou, junto da Direção da ESSS, para que se solicitasse a inclusão da escola nesse projeto – pretendia-se, assim, institucionalizar o trabalho amador que se vinha fazendo. Embora não tivesse existido resposta positiva do ME, confirmou-se, no final desse ano, que a escola seria objeto de obras de requalificação. A ESSS passaria a contar com laboratórios e apetrechamento modernos, há muito desejados, e temeu-se que a benesse dessa novidade desvalorizasse a salvaguarda de materiais já identificados como musealizáveis. A Associação, invocando normas nacionais e internacionais relativas à necessidade de garantir "destino unitário aos bens culturais", bem como, "acesso para fomentar a democratização cultural, a promoção da pessoa, o desenvolvimento da sociedade", apresentou à Direção da ESSS, em 23 de setembro de 2008, um Memorando solicitando a preservação do material testemunho do percurso da escola e a criação de uma sala específica, para guarda e exposição, disponibilizando-se os associados para apoiarem a seleção de peças relevantes e a futura dinamização de atividades. Em virtude dos esforços desenvolvidos, a que se associou Raquel Henriques da Silva, Historiadora de Arte, Museóloga e antiga aluna do Liceu, veio a ser assegurada, no edifício, a preservação de um espaço, o antigo laboratório de Física, a musealizar. Entendemos musealizar, na esteira de Mairesse [20, p. 323] como um processo científico que implica o inventário/documentação, a preservação, investigação e a divulgação/comunicação.

Em 2009, deslocaram-se à escola equipas sob alçada do ME, para inventariação do património, tendo-lhes sido facultado apoio, nomeadamente listagens realizadas por professores de Ciências Naturais e de Física e Química (grupos com material mais numeroso e relevante), bem como dados de inventário, tornando mais célere um processo para o qual as equipas dispunham de reduzido tempo. De 2009 a 2012, viveu-se na ESSS um longo período de obras, com deslocalização de peças dentro do edifício ou encaixotamento e guarda em contentores. Estabilizado o processo, e embora a Secretaria-Geral do ME disponibilizasse, no seu sítio eletrónico, fichas referentes a algum material da ESSS, não se dispunha de informação sobre a totalidade dos registos do ME.

Assim, em 2012, principalmente no que respeitava à Física e à Química, cujo material fora todo guardado em contentor, levantaram-se dúvidas sobre o que salvaguardar. A Associação contactou então a Subdiretora do MUHNAC,

Figura 6. Laboratório Histórico de Física, apresentando as montagens da exposição de 2012 (foto: F. Santana, AAAALNO/ESSS, 2012).

Marta Lourenço, que, generosamente, se deslocou à escola, reconheceu a importância das coleções, proporcionou uma imediata ação de formação aos professores interessados em colaborar e viabilizou um protocolo entre o MUHNAC, a ESSS e a Associação.

Foi neste quadro que se comunicou ao MUHNAC o interesse em integrar na comemoração do 60º aniversário da escola (outubro de 2012), a abertura do Laboratório, musealizado, entendido como o polo central de um Núcleo com diversos polos, dispersos por vários locais do edifício, consoante as disponibilidades da escola. A abertura do Laboratório Histórico (Figura 6), em cuja musealização colaborou o MUHNAC, institucionalizou, assim, o NMESSS, sendo a evidência de um processo de estreita colaboração entre a ESSS e a Associação de Antigos Alunos e Amigos do LNO/ESSS, com o apoio do MUHNAC.

Desde então, tem-se vindo a desenvolver um laborioso trabalho: de verificação do inventário, agora já com as listagens globais do Ministério da Educação (ME) (acessíveis em http://edumuseu.sec-geral.mec.pt/, na opção "escolas"); de redefinição da "Localização Fixa de Base" das peças; de elaboração de tabelas; de divulgação do acervo, a propósito do Dia dos Museus (por exemplo, exposição de peças relacionadas com áreas de ensino já extintas na escola). Iniciou-se também a inventariação de materiais não diretamente ligados às disciplinas, mas com relevância na história do LNO/ESSS.

Porém, um trabalho mais profundo e sistemático, de interação pedagógica, só teve início no ano letivo de 2017/18, no Polo de Ciências Naturais, cuja metodologia será apresentada mais à frente.

Do património edificado ao património histórico do ensino – desafios e exposições

Em 2017/18 realizaram-se várias atividades de divulgação do património histórico do ensino e de interação pedagógica, todas no âmbito das Ciências da Terra, centradas na temática: "Fósseis na nossa escola".

A estratégia utilizada teve como ponto de partida alguns dos fósseis existentes no empedrado dos passeios da escola, ou de rochas fossilíferas que constituem o interior do edifício (pavimentos de chão ou revestimentos de paredes, de escadas e de parapeitos de janelas). Feita a escolha de cada fóssil, fez-se a respetiva fotografia, seguida de ampliação. O conjunto das imagens, com indicação do local onde tinham sido colhidas, foi exposto no átrio da ala da escola dedicado às Ciências Naturais. Finalmente, desafiou-se a comunidade escolar a procurar o fóssil *in situ*. Foi o caso do calcário com fóssil de gastrópode, em corte transversal, localizado no passeio do pátio de estacionamento da escola, junto ao portão de saída (Figura 7).

Fez-se, seguidamente, a divulgação dos fósseis de gastrópodes existentes no acervo do NMESSS, através da exposição das peças na Biblioteca Escolar (Figura 8). Pelo interesse manifestado por vários professores, a exposição foi depois transferida para a Sala de professores.

De salientar, além da componente de formação cultural para toda a comunidade escolar, a componente didática/formativa desta exposição (ao encontro do programa do 7º ano de Ciências Naturais, e dos do 10º e 11º de Biologia e Geologia), evidenciada na explicação pormenorizada dos processos de formação de fósseis e de rochas, constante de

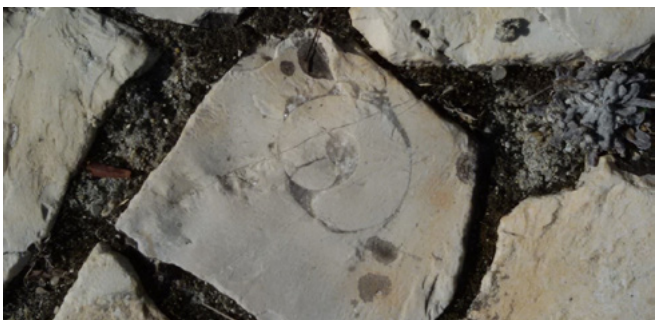

Figura 7. Calcário com fóssil de gastrópode em corte transversal (foto: C. Fernández, ESSS, 2017).

Figura 8. Fósseis de gastrópodes (foto: C. Fernández, ESSS, 2017).

Figura 9. Calcário com valvas de rudistas em corte longitudinal (foto: C. Fernández, ESSS, 2018).

Figura 10. Calcário de rudistas em secções transversais – parapeito de janela do corredor das Ciências (foto: C. Fernández, ESSS, 2018).

tabelas elucidativas, colocadas junto das peças expostas. Por exemplo, "a longa história do calhau rolado fossilífero" narra a formação deste exemplar, desde a deposição do calcário em meio marinho até ao desgaste de saliências e arestas durante o processo de transporte pela água e consequente formação do calhau rolado.

O segundo desafio de "Fósseis na nossa escola" foi em tudo semelhante ao primeiro, exceto na grande diferença de ter sido integralmente elaborado por dois alunos, embora com orientação de uma professora. Ambos tinham manifestado o seu gosto pela Geologia, no primeiro desafio, pelo que lhes foi proposta a participação num desafio mais exigente, que aceitaram. O trabalho foi integralmente elaborado numa tarde de sexta-feira, e exposto na segunda-feira seguinte.

Outra diferença foi a de tratar-se de um outro grupo de fósseis, os rudistas. Possuem duas valvas, sendo uma, a inferior, robusta (daí o nome rudista, do aspeto "rude" da concha), em forma de cone ou de corno, e outra, a superior, plana, funcionando como opérculo ou tampa. É um grupo que está extinto desde há aproximadamente 65 M.a. (final do Mesozóico), pelo que os seus representantes apenas podem ser observados petrificados, ou seja, fósseis.

As fotos tiradas no pavimento da escada que sobe para a Biblioteca da escola mostram calcário com valvas de rudistas, em corte transversal e longitudinal (Figura 9). As estruturas circulares correspondem a secções transversais das conchas. As estruturas em forma de cone ou corno correspondem a secções longitudinais das mesmas. A foto feita ao parapeito de janela do corredor da ala dedicada às Ciências mostra secções transversais de rudistas (Figura 10).

Esta exposição teve muito sucesso na comunidade escolar pelo que, após algum tempo de permanência no corredor das Ciências, foi transferida para um local mais central da escola.

Património histórico escolar: problemas e perspetivas futuras

> *Preservar, estudar e divulgar os objectos da escola é um trabalho que se torna urgente realizar, pois existe um número restrito de publicações sobre este tema e vastas colecções destes materiais que correm o risco de desaparecer. [13, p. 156].*

No Núcleo Museológico da ESSS, com um património científico tão rico e diversificado, e em que o trabalho de base se encontra muito avançado, muitos desafios se colocam, no quotidiano, para que não estejamos apenas perante coleções de objetos rigorosamente inventariados e documentados.

Este conjunto de materiais, essencial para a memória e identidade da ESSS, apresenta alguma vulnerabilidade no que respeita, sobretudo, à sua preservação e acessibilidade. Em termos de preservação deparamo-nos com a ausência de um grupo de profissionais com formação específica para as tarefas requeridas, nomeadamente no que respeita às coleções de história natural. Esta dificuldade foi parcialmente atenuada, mediante o protocolo estabelecido com o MUHNAC. Entre outras iniciativas, os profissionais deste museu já promoveram uma ação de formação destinada à preservação dos animais taxidermizados, estando prevista uma outra ação destinada aos animais conservados em líquido. Apesar desta ajuda preciosa, temos consciência de que a natureza do espólio exige conhecimentos científicos específicos, quer para a conservação e o restauro, quer mesmo para assegurar a manutenção e a limpeza mais comuns.

Acrescente-se os constrangimentos de acesso, sobretudo nas coleções de história natural, visto que o *Programa de Modernização do Parque Escolar* não previu espaços específicos para guarda e exposição do acervo. Assim, muitas vitrines encontram-se em salas de aula e outros espaços fechados, impossibilitando uma utilização pedagógica e científica mais frequente.

Para além destas dificuldades, observam-se problemas na dinamização do Núcleo Museológico, quer pela limitada disponibilidade horária dos docentes, quer pelo reduzido interesse por atividades de mobilização dos recursos que o museu tem para oferecer.

Em termos futuros, pensamos que é primordial a existência, na escola, de um grupo de pessoas diretamente afeto ao Núcleo Museológico que assegurem a valorização do património material e documental. É necessário que se reconheça, a nível governamental, a relevância contemporânea do património museológico das escolas e se criem, efetivamente, condições para a sua gestão. Ao Núcleo Museológico deveria ser atribuída uma bolsa de horas que permitisse constituir uma equipa qualificada e com tempo útil para se dedicar ao estudo, preservação e utilização pedagógica do acervo.

Afigura-se indispensável a existência de uma tal equipa, como forma de promover um maior envolvimento de todos, de modo a fomentar a utilização mais eficaz destes materiais que, como demonstrado, têm, mesmo na contemporaneidade e com programas de ensino muito diferentes daqueles para os quais foram idealizados, um potencial científico e cultural inegável.

Seria igualmente interessante criar uma rede de escolas com núcleos museológicos, fomentando a investigação, valorização e divulgação das coleções e, partindo desta rede, criar parcerias com instituições de ensino informal, como por exemplo museus de ciências e Centros de Ciência Viva. Acrescente-se que os Centros de Ciência Viva foram criados em 1997 com o objetivo de fomentar a divulgação científica e tecnológica, sobretudo junto das camadas mais jovens da população. A Rede Nacional de Centros Ciência Viva é atualmente constituída por vinte Centros Ciência Viva em todo o território nacional. Outra estratégia passaria por favorecer publicações, nomeadamente *online*, e conceber exposições temporárias com regularidade. Dever-se-ia, também, impulsionar trabalhos na área das pós-graduações, sensibilizando a comunidade científica, legisladores,

políticos e a sociedade em geral para a importância científica do acervo das escolas e para a necessidade urgente da criação de condições efetivas para a sua preservação, divulgação e utilização pela comunidade.

Considerações finais

O património científico existente na ESSS insere-se no quadro mais amplo de apetrechamento dos Liceus portugueses com materiais didáticos e espaços próprios para que a aprendizagem se tornasse mais prática e intuitiva, acompanhando as modernas tendências europeias. As coleções foram constituídas, tal como foi mencionado, por uma grande variedade de materiais que vão desde animais taxidermizados aos quadros parietais, filmes e diapositivos que tiveram um aumento crescente proporcional à valorização de um ensino cada vez mais experimental. A par das compras feitas pelos serviços centrais assiste-se a aquisições feitas, a nível local, por iniciativa dos docentes, que foram cruciais na diversificação e atualização das coleções. Destaca-se também a criação de materiais produzidos na própria escola, muitas vezes para suprir as deficiências existentes, e ainda as ofertas.

Por tudo o que foi explanado, consideramos que o acervo do Núcleo Museológico da ESSS tem, além do manifesto valor científico, um grande valor histórico, educativo e cultural, em particular numa escola equipada com os mais modernos laboratórios e materiais didáticos, para quem o passado é uma inspiração para aperfeiçoar o presente e projetar o futuro. A sua utilização não deve ser confinada apenas ao ensino das ciências, mas igualmente ao ensino de outras áreas disciplinares onde, em nosso entender, se podem incluir as artes e as humanidades.

Neste momento, o espólio encontra-se salvaguardado e começou a ser feita a sua divulgação mediante a organização de exposições. Apesar disso, temos consciência de que os desafios futuros são intensos, exigindo estratégias renovadas de trabalho e de investigação, só possíveis com a constituição de uma equipa multidisciplinar, com formação especializada.

Agradecimentos

Agradecemos ao MUHNAC-Universidade de Lisboa, à ESSS, à Associação de Antigos Alunos e Amigos do LNO/ESSS e às equipas de docentes, em exercício e aposentados, que viabilizaram a institucionalização do Núcleo Museológico e têm assegurado o seu funcionamento.

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