The trajectory and digital reconstitution of a canoe of Museu Paulista – USP

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ABSTRACT: In this article, we intend to elaborate the expository trajectory of the bow of a canoe belonging to the collection of Museu Paulista since its acquisition in 1924, until the present day, reflecting on the construction of the memory of monsoon expeditions in the museum over time. The interdisciplinary activities conducted between Museu Paulista, the Laboratory of Plant Anatomy of the Institute of Biosciences – USP and the Department of Naval Engineering of the Polytechnic School – USP will also be addressed to better understand the constitution of the now musealized canoe, using the results obtained from historical research, conservation efforts, the processes of anatomical identification of wood and short-range photogrammetry.
KEYWORDS: Canoe. Monsoon expeditions. Museum. Photogrammetry. Wood anatomy.

RESUMO: Neste artigo, pretende-se elaborar a trajetória expositiva do beque de proa de uma canoa pertencente ao acervo do Museu Paulista desde seu ingresso na instituição, em 1924, até os dias atuais, refletindo sobre a construção da memória das monções no museu ao longo do tempo. Também serão abordadas as atividades interdisciplinares realizadas entre o Museu Paulista, o Laboratório de Anatomia Vegetal do Instituto de Biociências – USP e o Departamento de Engenharia Naval da Escola Politécnica – USP, a fim de melhor compreender a constituição do canoão, agora musealizado, por meio dos resultados obtidos a partir da pesquisa histórica, dos trabalhos de conservação, dos processos de identificação anatômica da madeira e de fotogrametria de curto alcance.
PALAVRAS-CHAVE: Canoa. Monções. Museu. Fotogrametria. Anatomia da madeira.

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In 1917, in the first year of his management of Museu Paulista, Afonso d'Escragnolle Taunay, when thanking an anchor offered to the institution by the city of Porto Feliz, asked Eugênio Motta – then mayor of that city – to donate a 15-meter canoe that was on the banks of the Tietê river, near the port of departure of the old monsoon expeditions. The mayor denied the request, alleging difficulties in transporting the piece to the museum due to its size and weight, the lack of a railroad and high transportation cost.[8]

However, ten days after this missive, on December 27, 1917, Eugênio Motta would send another letter to Taunay, informing him of the existence of a barge owned by a farmer of the region who transformed it into a trough for *garapa* (sugarcane juice), with the difference that this piece was devoid of stern and bow – which had been trimmed.[9]

Six years after this correspondence exchange, Taunay would again resort to the same Porto Feliz mayor, inquiring him about the canoe hull transformed into a trough and pleading a donation from the owner.[10] After conversations and visiting the farm, Taunay was finally gifted the bow by Mr. João Batista Portella, who stated that the piece was already owned by his grandparents many years ago.[11]

Even though Taunay had communicated Mr. Alarico Silveira, secretary of the Interior of the state of São Paulo – to which Museu Paulista was subordinate at the time – that the transport would be on behalf of Mr. Portella, he had given 30 thousand *réis* to the farmer for expenses with the dispatch of the cargo. In fact, the value did not reach such amount since Taunay was able to get a freight exemption from Colonel E. Johnston, superintendent of S. Paulo Railway Co.[12]

The 15-meter barge requested in 1917 would later be offered by the mayor of Porto Feliz – still Mr. Eugenio Motta – to Taunay in 1937, most likely due to protection and maintenance difficulties. However, this was the museum director's turn to refuse the donation, claiming not to have a room capable of accommodating the barge, unless it was placed in a corridor, while also pondering that the town residents would never forgive the offeror.[13]

Finally, on January 24, 1924, a large-circulation newspaper of São Paulo reported that

> Mr. João Baptista Portella, farmer in Porto Feliz, has just gifted a large fragment to Museu Paulista, the bow of a monsoon canoe. We all know that these vessels were used in the navigation from Porto Feliz to Cuyabá by the Tietê, Paraná, Pardo, Taquary, São Lourenço, and from what is known, only two currently exist, both as fragments. One, the largest, belon-

8. Letter from Eugenio Motta, mayor of Porto Feliz, to Afonso de Taunay, October 25, 1917, Permanent Archive of Museu Paulista/Fundo Museu Paulista (APMP/FMP) – Series: correspondence.

9. Letter from Eugenio Motta, mayor of Porto Feliz, to Afonso de Taunay, December 27, 1917, APMP/FMP – Series: correspondence.

10. Letter from Afonso de Taunay to Eugênio Motta, November 29, 1923, APMP/FMP – Series: correspondence.

11. Letter from Afonso de Taunay to Alarico Silveira, secretary of the Interior, January 08, 1924, APMP/FMP – Series: correspondence.

12. Letter from Afonso de Taunay to Cel. E. Johnston, superintendent of S. Paulo Railway Co., January 19, 1924, APMP/FMP – Series: correspondence.

13. Letter from Afonso de Taunay to Eugênio Motta, 1937, APMP/FMP – Series: correspondence.

gs to the City Council of Porto Feliz, which constructed a shed to protect it at the "Port", at the margins of Tietê. The second had been removed from water more than 60 years ago and was since then under the possession of Mr. João Baptista Portella's parents, unfortunately sawn to pieces. What remains – 3 ½ meters in length – was gifted to Museu Paulista by Mr. Portella.[14]

Figure 1 – *Canoão* bow (3.56 m long, 1.17 m wide and 0.83 m high). Collection of Museu Paulista. Photo by José Rosael da Silva.

As the press disclosed the donation, the long-lasting negotiations to take a canoe to the institution came to an end. According to Taunay, this canoe was used in the route of the monsoon expeditions between Araritaguaba – currently Porto Feliz – and Cuiabá in previous centuries (Figure 1). But why the insistence of this endeavor?

In this article, we intend to investigate the reasons that motivated Afonso de Taunay to actively collect artifacts linked to river journeys to integrate them to Museu Paulista's collection, and to elaborate the expositional trajectory of the bow, from its entry into the institution to the present day, reflecting on the construction of monsoon memory over time. We will also address the interdisciplinary activities conducted between Museu Paulista, the Laboratory of Plant Anatomy of the Institute of Biosciences – USP and the Department of Naval Engineering of the Polytechnic School – USP to better understand the constitution of the musealized *canoão*[15] and the use of similar vessels, using the results obtained from historical research, conservation efforts, the processes of anatomical identification of wood and short-range photogrammetry.

14. MUSEU PAULISTA. *O Estado de S. Paulo*, 28 jan. 1924, Geral, p. 3.

15. Among the staff of Museu Paulista and Museu Republicano de Itu, the bow is often called *canoão* – large canoe – despite being only a fragment, and we shall call it like this here.

To understand the bow as a musealized object, one must understand its trajectory from its context of origin – or from other vessels of the same type – to the present day, reflecting on the people who handled it over time and on the colonial past of São Paulo and its monsoon expeditions that Museu Paulista sought to represent when displaying the *canoão* in different exhibitions. In this sense, both the unveiling of the paths traversed by the artifacts in the institution, and the approximation to the production conjunctures and prior uses provide subsidies to defetishize museum pieces as relics.

Currently, historiographic practice has largely employed the construction of the trajectories of artifacts as a methodological instrument, and Igor Kopytoff's classic study, *The cultural biography of things*,[16] in general, has been a reference for studies on the movement of objects in space and time. However, I tend to agree with the critical positions of Hans Peter Hahn & Hadas Weiss[17] regarding the use of the term biography for objects and collections given the difficulty of pointing out moments such as the birth and death of objects – terms like itineraries, trajectories or pathways are more favorable.

Researchers argue that ethnographic and archaeological investigations increasingly state the transformations of things, to the extent that new meanings emerge from the reuse of certain artifacts after their original use, or the assigning of new values to objects that were buried for years. The notion of itinerary, in turn, illuminates the non-linear character of an object's mobility and the changes in its contexts and roles always motivated by human agency.

When the trajectories of objects end up being directed to the institutions of custody, such movement allows us to study the formation of collections and their mobilization for the writing of history and the production of memories, as marvelously made by Regina Abreu when studying the Calmon collection of Museu Histórico Nacional,[18] by Francisco Régis Lopes Ramos, when studying the objects of Caldeirão at Museu do Ceará,[19] Ulpiano Bezerra de Meneses, when discussing personal documents in public environments,[20] Mariana Françozo, when analyzing the paths traversed by a Tupinambá cape from the Dutch Brazil period until its current exhibition at the National Museum of Denmark.[21]

Interested in the composition of collections of natural history and human anatomy in English museums of the nineteenth and twentieth centuries, Samuel Alberti considered three phases in the life of objects directed to institutions of custody: the collection and its provenance, the life in the collection and the view

16. Cf. Kopytoff (2008).

17. Cf. Hahn; Weiss (2013).

18. Cf. Abreu (1996).

19. Cf. Ramos (2011).

20. Cf. Meneses (2011).

21. Cf. Françozo (2012).

of the object. As he took material culture as an analytical perspective for the history of the collections and museums and not as the object of study itself, the historian of science shed light on the actions of men in history since, according to him, even if one looks at an object, what one observes are people – especially their practices and institutions.[22]

THE BOW AND THE REMNANTS OF MONOXYLON VESSELS IN BRAZIL

The following excerpt is how Afonso Taunay refers to the recently-received bow in the 1924 Annual Activity Report of Museu Paulista: "It is a curious piece and with great evocative value, this *canoão* was excavated in the trunk of a large *peroba* tree and the hull is relatively well preserved".[23]

Eighty-five years later, when drafting the conservation report to transport the piece from Museu Paulista to Museu Republicano de Itu, conservationist Julio Moraes stated that the piece is

> part of a vessel made in a single and manually excavated trunk. This piece was cut at both ends, in an evidently remote time. It is clear that there was at least one alteration beyond the cuts, with possible structural implication: the elimination of one of the two internal reinforcements, carved transversely to the direction of the vessel's body; it is also a very old intervention.[24]

The emphasis on the use of a single piece of wood in the manufacture of the canoão illuminates monoxylon vessels obtained by the process of reducing the raw material through excavation and modeling of the trunk until reaching the shape of a vessel.[25]

According to Rambelli, this is perhaps the most basic form of universal water transport but warns that "the techniques of making these objects, as well as the utensils used and the raw material chosen, are different, even considering factors such as form and function".[26]

Some remaining pieces discovered since the 1990s in Brazil prove such diversity. The indigenous pirogue studied by Rambelli, Mario Tomazello & Plínio Barbosa de Camargo, found in Bragança Paulista, in the state of São Paulo, in 1998, was made from a single trunk of Brazilian pine (*Araucaria angustifolia*), dug with stone adzes and fire. The absence of traces of metal tools in its manufacturing process combined to the approximate age of 250 years – measured

22. Alberti (2005, p. 561).

23. Activity Report for the year 1924, APMP/FMP, L08, p. 2-3.

24. Moraes (2010, p. 1).

25. Souza; Lins Júnior (2016, p. 61-62).

26. Rambelli; Tomazello; Camargo (2000, p. 32).

by radiocarbon dating – indicate that, although the Portuguese were already in Brazilian territory, there were monoxylon vessels still being built according to traditional indigenous methods.[27]

Similar raw material and constructive technique were identified in the canoe found in 2014 in Rio Grande, on the border of Andrelândia and Santana do Garambéu, in the south of Minas Gerais. Radiocarbon dating made on a wood sample showed that the whole piece is from approximately 1610. According to engineer Gilberto Pires de Azevedo, advisor of the Archaeological Research Center of Alto Rio Grande, the canoe has indigenous origin "because it was dug in a single wooden trunk, has no apparent signs of use of modern tools such saws or chisels, but presents fire marks, indicating the ancient technique of indigenous peoples".[28] The vessel found in 1999 in the Aiuruoca river – also belonging to the Rio Grande Basin in São Vicente de Minas, in Minas Gerais – originated from the excavation of a piece of *Andira fraxinifolia*, and carbon-14 dated it in a period between 1480 and 1660.[29]

The team of archaeologist Carlos Rios analyzed four monoxylon canoes found in the 2010s at the Extremoz lagoon in Rio Grande do Norte, also conducting radiocarbon dating. The results revealed that the vessel named Extremoz 04 is the oldest nautical artifact for sheltered waters ever discovered in Brazil, with a calibrated age between 1290-1320 and 1350-1385, which correspond to the two possible periods of its construction.[30] Vessels Extremoz 01 and 02 date from the colonial period and present traces of the cultural exchanges of the peoples given the modifications applied on the structures of traditional indigenous monoxylon vessels, e.g., the adoption of stern seats – indicating possible changes in the rowing technique – and the construction of more prominent bows with elliptical or ogival shape, providing greater hydrodynamics to vessels.[31]

For the fragments of the vessels found in Porto Feliz in the beginning of the twentieth century – Museu Paulista's bow, 3.56 m in length, and the piece exposed in Parque das Monções, located in that city, 9.25 m in length – we count on the archaeological records made by Francisco Alves and his team in 2008. From observations, photographs and measurements, the Portuguese archaeologist produced drawings of the two artifacts and compared its dimensions with the drawing of a *Ubá* by illustrators Joaquim José Codina and José Joachim Freire during Alexandre Rodrigues Ferreira's (Philosophical Journey) in the end of the eighteenth century. From this comparison, he estimated the lengths of the fragmented vessels of the Tietê river, assigning 11.5 m in length to Museu Paulista's vessel, and 16.5 m to the Parque das Monções's vessel. Alves also had the opportunity to send a sample

27. Ibid.

28. Cf. Werneck (2015). <https://bit.ly/2Po9h8a>. Access on July 25, 2019.

29. Idem.

30. Cf. Rios; Lavalle; Lins; Santos Junior (2015)

31. Cf. Lins; Rios (2016)

of wood from Porto Feliz's barge for "radiocarbon dating, and the result proved to be comparable to that of the monoxylon vessel of Bragança Paulista".[32]

Despite his thorough work in the article written in 2013 on "The monoxylon vessel tradition in Portugal and Brazil", Alves did not refer to the wood from which the museum's bow had been made, nor did he describe the marks of tools used to carve the vessel's trunk so one could conjecture on when it was manufactured. He also judged that adjectivizing these large vessels of Porto Feliz – known as *canoões* (large canoes) or *batelões* (large barges) – as "monsoon vessels" was arbitrary due to lack of historical-archaeological proof.[33]

However, Alves himself considered such demonstration as a difficult one, even if one resorts to radiocarbon dating because

> […] the application of this dating method on trees of relatively "recent" slaughter dates – dating back only a few centuries – presents a very broad index of imprecision since these have a low dissipation rate of atmospheric carbon-14 absorbed while alive.[34]

Given the inaccuracy indicated by Alves and the fact the radiocarbon dating has not been applied on Museu Paulista's bow, and to capture the techniques used in the manufacturing process, we follow the guidance of Rambelli, Tomazello & Camargo, for whom "the direct testimonies of the action of man on wood are the traces of utensils left excavated on it".[35]

We thus turn to the technological analysis of the carving of the bow conducted by Béat Arnold on a visit to the Museu Republicano de Itu in 2016, according to which

> Une cloison est réserve dans le fond à mi-hauteur, excluant tout écartement secondaire des flancs par chauffage. Elle a été dégagée à l'aide d'herminettes à tranchant plan. Les traces d'herminettes à large tranchant concave peuvent être observées pour l'évidage du fond au niveau des bouchains. La partie haute des flancs, côté intérieur, a été finalement encore affiné à l'aide d'une herminette à tranchant concave utilisée dans un plan vertical, donc avec un manche court, sous la forme de séries parallèles. Enfin, on note la présence d'une nervure, probablement destinée à contrôler l'évidage du fond entre cette dernière et la cloison.[36]

Through the marks of the tools in the vessel's hull, the study of materiality showed the constructive techniques employed, which led him to conclude that

> L'outillage utilisé était en fer. La forme et les dimensions de l'esquif montrent qu'il ne s'agit pas une pirogue indienne traditionnelle, mais d'un esquif commandé ou réalisé par des colons pour effectuer des transports de marchandises lourdes, au vu de la forme de la section transversale.[37]

32. Alves (2013, p. 14).

33. Ibid., p. 8-9.

34. Ibid., p. 39.

35. Rambelli; Tomazello; Camargo (2000, p.32).

36. Arnold (2016, p. 1). "At the bottom, at half height, a bulkhead is observed, which excludes any secondary opening of the flanks by heating. It was carved with a straight blade adze. The marks of adzes with large concave blades can be observed in the digging of the bottom at the side-plate level. The upper part of the flanks, on the inner side, was also minced with a concave blade used in a vertical plane and, therefore, of short handle, in the form of parallel series. Finally, a vein can be seen, probably intended to control the digging of the bottom between the vein and bulkhead [*sic*]" (translation by Márcia Valéria Aguiar)

37. Arnold (2016, p. 1). "The instruments used were iron. The shape and dimensions of this small vessel show that it is not a traditional indigenous pirogue, but a small craft commissioned or made by Portuguese settlers to transport heavy goods, considering the form of the cross-section part (translation by Márcia Valéria Aguiar).

Figure 2 – Analysis of the *canoão* bow shows excavation marks with a short-blade adze. Photo by Béat Arnold.

The mention to the transportation of heavy goods in the evaluation of a renowned naval archeology expert leads us to conjecture about the use of the canoe to supply inland populations in a period before the canoe was transformed into a trough for horses on the Portella family's farm in Porto Feliz.

THE PRODUCTION AND USE OF CANOES IN THE MONSOON EXPEDITIONS OF THE EIGHTEENTH AND NINETEENTH CENTURIES

Vessels similar to that of which the bow is a fragment of were manufactured during the period of monsoon expeditions, which grew starting from the second decade of the eighteenth century with the discovery of gold in the ravines of the Coxipó river and other tributary streams of the Cuiabá River, until the 1830s, for varied purposes, including commercial ones, the prospection of precious stones, foundation of villages, demarcation of boundaries, and scientific and artistic investigation.

The monsoons route comprised the journey through the Tietê, Paraná and Pardo rivers; land crossing – *varadouro* in Portuguese – by the Camapuã path; and return to the river path on the waters of the rivers Coxim, Taquari, Paraguay, São Lourenço and Cuiabá. The duration of these journeys was about five months – the

same period that travelers took when going from Portugal to India. This itinerary, however, was not the first to be traversed by the residents of São Paulo towards the west of the continent, but it was the last possibility to reach the mines in the eighteenth century since the Mbaiá and Caiapó populations had already dominated other regions of the Paraná and Paraguay basins, leaving no options for travelers eager to access the far west.[38]

The success of river voyages depended on the existence of a *varadouro* – Camapuã – for landing and replenishing supplies, the specialization of sailors from the *mameluco* culture, the presence of black labor to carry the loads and work on the plantations and mines, and the alliance with certain indigenous groups.

This route and the many *varadouros* of a path with over one hundred waterfalls imposed the use of more improved vessels that contemporaries compared repeatedly to cotton spinning wheels. According to Sérgio Buarque de Holanda, the size of the canoes may have been suggested and imposed by the typical forest forms of the Tietê area, where the possibility of choosing the type of wood was restricted to two species, *peroba* trees[39] and *ximobúva* (trees of the *Enterolobium* genus).[40] Vessels were of monoxylon type, and some wrought with iron and fire. Size ranged from 11.5 to 16.5 m (or more) and transported passengers, supplies, goods, and enslaved Africans. Both the manufacturing technique and management of the vessels were affiliated with a common indigenous tradition developed by the inhabitants of Itu whom specialized in the making of canoes and paddles very early.[41]

THE BOW IN MUSEU PAULISTA AND THE CONSTRUCTION OF THE MEMORY OF THE MONSOONS

> Two titans erect themselves at the door of the museum, animated by the chisel of a great sculptor: Antonio Raposo gazes at the horizon of the unknown and hostile lands, Fernão Dias Paes goes deeper on the underground of the virgin and and hostile soil that will soon kill him. And as the final movement, they have under their immediate feelings a material document of *bandeirantismo*: the essential vehicle of São Paulo's inhabitants of the final exploratory phase: a monsoon *canoão*, a caravel of this Western river that was, for two centuries, the prepared spear of São Paulo against the Spaniards.[42]

Between the first attempts to bring an alleged monsoon canoão to the museum in 1917, and the 1926 speech – mentioning the *peroba* monoxylon vessel under the protection of Fernão Dias Paes and Raposo Tavares –, Taunay had

38. Cf. Carvalho (2006).

39. *Perobas* are woods of the botanical genus *Aspidosperma*, and the most used in the past was *peroba-rosa* – *Aspidosperma polyneuron* – for its high resistance to deterioration and the existence of large straight trunks: taller than 45 m and with up to 3 m in diameter.

40. Cf. Holanda (2014).

41. Cf. Godoy (2002).

42. AUTOGRAPHO do Padre Anchieta, *O Estado de S. Paulo*, April, 28, 1926, p. 5.

designed the interior decoration of Museu Paulista and the assembly of expositional rooms focusing on the commemorations of the centenary of Brazil's independence in 1922. São Paulo was assigned a prominent role in this project as the material and symbolic place of Independence in the museum's central axis; the performance of the *Bandeirantes* and São Paulo's colonial past – as the foundation of national history – were emotionally recreated in several expositional rooms.[43]

The river journeys between Porto Feliz and Cuiabá gained prominence with the inauguration, in 1929, of room A-9, dedicated to the monsoon expeditions and to Almeida Júnior (Figure 3). The room presented the bow, anchors, a boiler, baskets and painting reproductions of nineteenth-century iconographic documents,[44] especially the drawings made by Hercule Florence, member of the scientific expedition led by Baron Georg Heinrich von Langsdorff, who traveled the western territories of Brazil by river paths, between 1825 and 1829, covering route of the sixteenth-century monsoons.

Figure 3 – Partial view of room A-9 dedicated to the monsoon expeditions and Almeida Júnior, with the bow at the back, decade of 1930. Collection of Museu Paulista, São Paulo. Unidentified photographer.

Although the scenes portrayed the moments of the Russian expedition during the decaying phase of the monsoon expeditions, for Taunay, the painters' pigments referred to the already missing journeys of São Paulo's inhabitants for having – in his

43. Cf. Brefe (2005).

44. As Solange Ferraz de Lima & Vânia Carneiro de Carvalho (1993) have already stated, the original drawings – many of them not colored and of reduced sizes – would not be efficient in their pedagogical function, not possessing the degree of nobility, respectability and prestige held by paintings, thus Taunay's request that artists enlarged them.

45. Cf. Pardim (2005); Lima Jr. (2015).

46. Cf. Holanda (1945; 1994).

vision – traces of authenticity that could serve a greater truth.[45] The association between Florence's nineteenth century journey with the eighteenth century monsoons and of these with the seventeenth century *bandeiras* is even more evident – considering the room as a whole – when one realizes that the paintings based on Florence were placed alongside paintings that portrayed *Bandeirantes* and missionaries.

This visual narrative stems from Taunay's historiographic production, for whom the monsoon expeditions would be a final chapter of the *bandeiras* and would be intimately related to the mining activity, so much so that, according to him, they would have begun to end when gold sources were depleted; however, Taunay himself recognized the existence of river caravans until the early nineteenth century, when Langsdorff's expedition departed from Araritaguaba.

Such permanence over the eighteenth century and the annual regularity of the journeys were the factors that made Sérgio Buarque de Holanda, already in the first edition of *Monções* (Monsoons), published in 1945, dissociate the monsoons of village from the history of the *bandeiras*, linking them to the merchant activity – so much so that in *Caminhos e fronteiras* (Pathways and frontiers), published in 1957, he titled the chapter dedicated to these river expeditions as "Trade fleets".[46]

As room A-9 was disassembled in 1939 to give way to the Almeida Júnior Gallery – an initiative of federal interventor Ademar de Barros –, the paintings by Oscar Pereira da Silva and Aurélio Zimmermann depicting aspects of the Langsdorff expedition and the objects related to river journeys were transferred to other spaces of the institution until 1944, when they were placed in room B-4.

According to the news article published on March 24, 1944, in the newspaper *O Estado de S. Paulo*, Taunay informed that

> In room B-4, of the second floor of the Ipiranga palace – a room exclusively dedicated to the monsoons – there are twenty oil paintings, five of which of large dimensions. All are related to the iconography of river journeys to the lands of the distant midwest, in Mato Grosso, except for two compositions. There are reproductions of one hundred years old documents, almost all dating of 1826. They represent different aspects of the navigation of Tietê, Paraná, Pardo, Paraguay and other western rivers.[47]

At the top, prominently displayed, Hercule Florence, as painted by Oscar Pereira da Silva. Under this one, the paintings Benção das canoas (The Blessing of canoes), by Aurélio Zimmermann, and *Carga das canoas* (Loading the canoes), *Encontro de monções no sertão* (The meeting of monsoon expeditions at the sertão) and *Partida de Porto Feliz* (Departure from Porto Feliz), by Oscar Pereira da Silva.

47. MUSEU PAULISTA. *O Estado de S. Paulo*, 24 de março de 1944, p. 6.

In two walls, separated by a door, *Pouso do sertão – Queimada* (Rest at sertão – Fires), by Aurélio Zimmermann, *Mulheres do povo em Porto Feliz* (Women of the people in Porto Feliz) and *Dama de Porto Feliz com mucama* (Porto Feliz's Dame with a household slave), by Nicolò Petrilli, *Monstro fluvial piracangava* (Piracangava's river monster) and *Canoa fantasma no rio Tietê* (Phantom canoe in Tietê river), by Nair Opromolla Araújo. Finally, *Pouso de monção à margem do Tietê* (Beaching of an expedition on the Tietê banks), *Vista de Camapuã* (View of Camapuã), *Pirapora do Curuçá* and *Desencalhe de canoa* (Refloating of a canoe), by Zilda Pereira, and *Sítio do Capitão José Manoel em Porto Feliz* (The Farm of Captain José Manoel in Porto Feliz), *Vista de Porto Feliz* (View of Porto Feliz) and *Porto Feliz*, by Sylvio Alves.

A map made by astronomer and mathematician Francisco José Lacerda e Almeida, and another detailing the route of monsoon expeditions were also part of the room. The bow of the canoão, containing an anchor and a large pan were at the center of the room (Figure 4).

Figure 4 – Partial view of room B-4 dedicated to the monsoon expeditions, with the bow at the center, decade of 1940. Collection of Museu Paulista, São Paulo. Unidentified photographer.

What changes – or remains – from one assembly to another? What can the rooms tell us about the construction of the memory of monsoons by Afonso Taunay during his administration of Museu Paulista?

48. Pardim (2005, p. 201).

49. MUSEU PAULISTA. *O Estado de S. Paulo*, 24 de março de 1944, p. 6.

On the one hand, it reinforces the approximation of the reference of Langsdorff's scientific expedition to all other possible monsoon expeditions. Thus, Florence's drawings went on to play a demiurgic function of reconstituting São Paulo's past.[48]

The themes recorded by a traveling artist on a scientific expedition during the 1820's were regarded as authentic elements of any monsoon expeditions that occurred during the eighteenth century. The beaching in the *sertão* experienced by Florence and the grounding of Langsdorff's canoes say many things about the moments of rest and navigation difficulties experienced by all passengers of any monsoon expedition.

On the other hand, exposition project of this room did not reference the *bandeiras*. If such statement could make us conjecture that Taunay was seeking to move the monsoon expeditions away from the *bandeiras*, the very article written by him on the inauguration of room B-4 would put such assumption under doubt. Despite stating that the room was exclusively dedicated to monsoon expeditions, the director finished the description of the room with "a pan that served the *bandeirantes* for a long period".[49] Moreover, the continuum between the *bandeirante* and *monçoeiro* movements would be further explained in Taunay's monumental *História Geral das Bandeiras Paulistas* (The General History of São Paulo's Bandeiras), when he finished the last tome of 11 volumes, written in 1950, with the monsoons.

Finally, we must note that when Taunay finished his administration of Museu Paulista, in 1945, the room dedicated to the monsoons was B-4. The theme would only occupy room A-9 again in 1947, when the Almeida Junior Gallery was disassembled due to the transfer of 19 paintings to the Pinacoteca do Estado. That year, Sérgio Buarque de Holanda, director of Museu Paulista, sent back to that room the bow of the *canoão*, utensils used by travelers on their river journeys and copies of paintings based on Hercule Florence.

From the 1970s to the present day, the painting *A Partida da Monção* is in room B-29, having the *canoão* as its companion until 2007. The bow would once again play a prominent role in one of the rooms of the exhibition *Cartografia de uma história – São Paulo colonial: mapas e relatos* (Cartography of a history – colonial São Paulo: maps and reports), which was on display at Museu Paulista between March 2005 and November 2006. In the part "Paths and walkers: experiences of the *sertão*", the *canoão* was the dominant element in a room whose green walls evoked the forest to be traversed using maps in creation, still as manuscripts and with erasure marks (Figure 5).[50]

The bow's room was once again disassembled to give way to the exhibition *Imagens recriam a Hlstória* (Images recreate History), being moved to the museum's

50. Cf. Bogus (2009).

Figure 5 – Partial view of the room Paths and walkers: experiences of the *sertão*, with the bow in the foreground, decade of 2000. Collection of Museu Paulista, São Paulo. Photo by José Rosael da Silva.

lobby, on the side of the monumental stairs. Despite seemingly losing its importance in the museographic discourse, it was in this space that the bow was the object of the archaeometric studies conducted by Portuguese archaeologist Francisco Alves in 2008, as previously mentioned.[51]

In 2010, in its final days in Museu Paulista, facing the imminent transfer to the Museu Republicano de Itu, the *canoão* was the target of a conservation report by Julio Moraes, and exposed in the lobby of Museu Paulista, again under the gaze and protection of the two *bandeirantes* who welcomed it in Taunay's 1926 speech (Figure 6).

Once at Museu Republicano, the *canoão* was placed in the center of a small room, where it remained from 2010 to 2017, identified only with its dimensions, provenance and date of entry into the museum.

Staring from the second semester of 2016, however, a new history would be told; a partnership was established with a group of the Department of Naval Engineering of the Polytechnic School of USP, and using photogrammetry and other techniques combined with the observation of data from the drawings of Hercule Florence and Aimé-Adrien Taunay, the *canoão* was digitally recreated.

51. Cf. Alves (2013).

52. Cf. Luhmann (2011).

Figure 6 – Partial view of Museu Paulista's peristyle, noting the *canoão* exposed in the hall, 2010. Museu Paulista, São Paulo. Photo by José Rosael da Silva.

THE BOW IN THE EYES OF ENGINEERS

A procedure to digitalize the bow of the *canoão* – about 3.5 meters long – was conducted, followed by the digital reconstruction of a complete model of a monsoon canoe of the early eighteenth century – about 14.5 meters long.

Short-range photogrammetry[52] was the optical metrology technique used to obtain a cloud of spatial coordinates, resulting in 800 points that characterized the contour and surface of the historical artifact. From these points, the software Computer Aided Design (CAD) was used to obtain a high-fidelity 3D digital model of the frontal portion of the monsoon canoe displayed in Itu (Figures 7 and 8). Later mathematical inferences and the establishment of interdisciplinary relations allowed the 3D digital reconstitution of complete model of the monsoon *canoão*. Obtaining the mathematical surfaces that represent the surface of the canoe is required for conducting studies that use the Computer Aided Engineering (CAE) program for the determination of the cargo capacity and navigability characteristics of the canoe. Ultimately, this analysis allows greater questioning and considerations regarding the role of the *canoão* in that primitive system of freight transport, its crew and the operations necessary for the transposition of barriers in rivers with such a large vessel.

The data required for estimates and inferences regarding geometry, size and considerations of load capacity were obtained by analyzing drawings, reports, physical characteristics of the wood constituent of the canoe and consultation to anthropological research; thus, constructing the pertinent connections for the characterization of the monsoon canoe of Porto Feliz.

Figures 7 and 8 – Bow of the *canoão* displayed at Museu Republicano de Itu (USP) and 3D digital reconstruction by photogrammetry, respectively. Collection of Museu Republicano "Convenção de Itu" – MP, Itu, SP.

PLANNING AND EXECUTION OF PHOTOGRAMMETRY

The complete field procedure was ideally divided into five stages, conducted by different teams in subsequent intervals of time. Moving the bow from its room in the museum to the hall to be photographed required a specialized team due to the care for the conservation of the piece. A second team specialized in hoisting raised the *canoão* about 70 centimeters from the floor to allow photographs of the bottom of the canoe to be taken. Following, the piece was prepared with the application of the adhesive targets and positioning of the referencing equipment. The piece was inspected before the photographs were shot, as shown in Figure 9. To predict efficiency and, consequently, the need for resources to be employed in all field work, simulations based on motion time studies (MTM1) were previously performed for the five steps of photogrammetry. The complete schedule was established using the PERT project management tool.

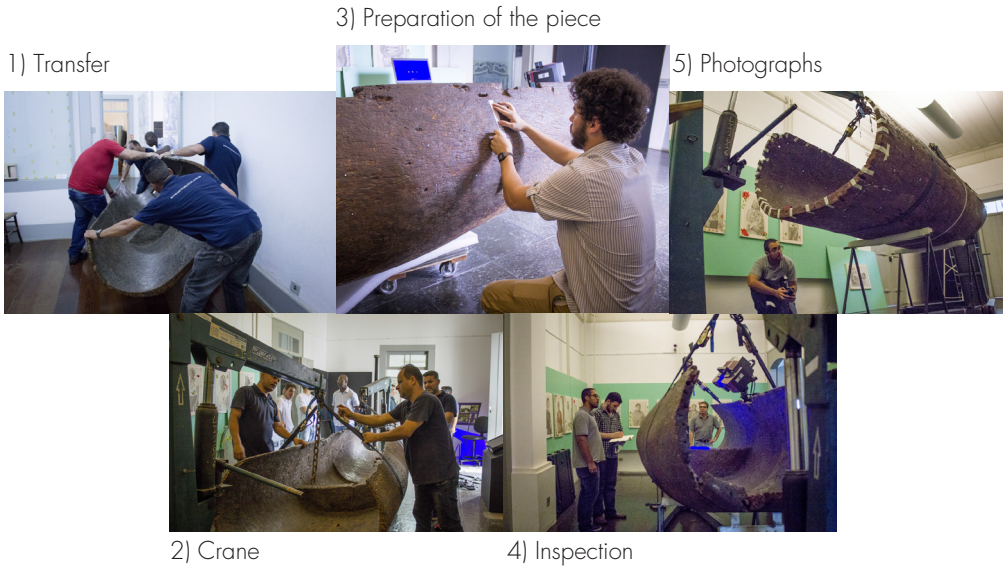


Figure 9 – Flow of the field work conducted at Museu Republicano de Itu, SP. Photo by Bernardo Andrade.

The field action plan was structured based on the knowledge of the maximum dimensions of the piece, the specifications of the hoisting equipment and of the space selected in the museum to accommodate the whole procedure. It was known beforehand that the maximum length of the bow is 3.55 meters, and a maximum diameter of just over one meter. Two hydraulic cranes were needed to hoist the piece in a stable manner, given that stability is crucial in short-range photogrammetric

measurements since any movement of the object mat compromise the success of photographs set. Table 1 presents the main values related to the field work of photogrammetric measurement.

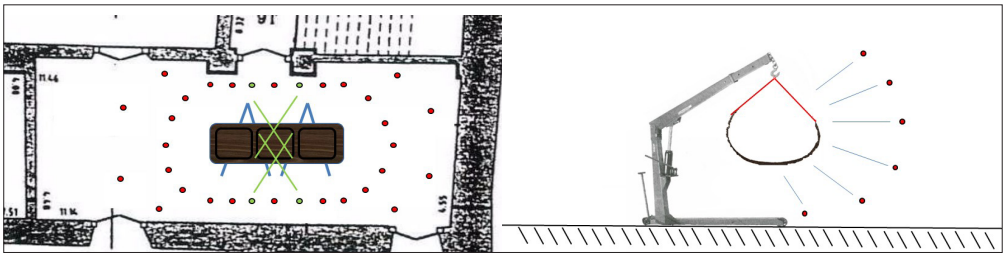
53. Ibid.

54. Cf. Kraus (1997).

Table 1 – Photogrammetry data of the bow.

DATA REGARDING THE PHOTOGRAMMETRY OF THE *CANOÃO* BOW					
Length	3,55m	No. of photos	207	*Encoded*	183
Beam	1,16m	No. of stations	34	*Uncoded*	616
Area	16,04m^2	Average overlap	75%	*Pixel points*	192
Volume	0,39m^3	Distance to the object	1m	*Uncoded/m^2*	38,4

From the floor plan of the museum, a sequence of procedures was prepared to circumvent the difficulty of capturing the internal elements in detail. Certain edges and hidden parts of the canoe are difficult to capture and identify due to the need for a correct projection of light on the object and impaired ergonomics in the process on the field. In total, 19 imaginary cross sections on the external surface of the *canoão* were considered, each consisting of 18 surface points; and 18 imaginary cross sections on the inner surface, with 19 points each. Additionally, internal structures were characterized with the application of 50 surface points. Figure 10(a) shows the positions adopted to take the shots. Green elements characterize the need for detailed shots of internal parts. Figure 10(b) highlights the need to shoot the side of the canoe at different angles and vertical dimensions.



(a) (b)

Figure 10 – a) Stations for photographs in the main room, and b) camera positions in each station.

In photogrammetry, the spatial position of each point of the object is defined by three coordinates but each image can be defined only in a 2D coordinate system; thus, changes in the geometry of the object occur due to its format, relative

position of the camera and object, perspective of the image and optical defects of the lenses.[53] Identification is based on the principles of collinearity and grouping. Regarding collinearity, basic principles of geometry from the knowledge of the projection center of the identified point enable, in conjunction with the principles of grouping, the adequate spatial consideration of the captured coordinates.[54] Thus, each adhesive target applied to the surface of the piece can be identified as a point in a three-dimensional coordinate system.

The overlap of the area of photographs of approximately 75% was used in the measurement of the *canoão*'s surface. In total, 50 encoded points of type RAD (Ringed Automatically Detected) were uniformly distributed across the whole surface, forcing the photographer to intuitively perform the high degree of overlap, thus ensuring the correct joining of the photographs. The process requires the identification of five encoded points in each photograph and that each point is recognized in at least three photographs for it to be validated. Figure 11 illustrates the adhesive targets identified in the photogrammetry and the positions in which the photographs were taken.

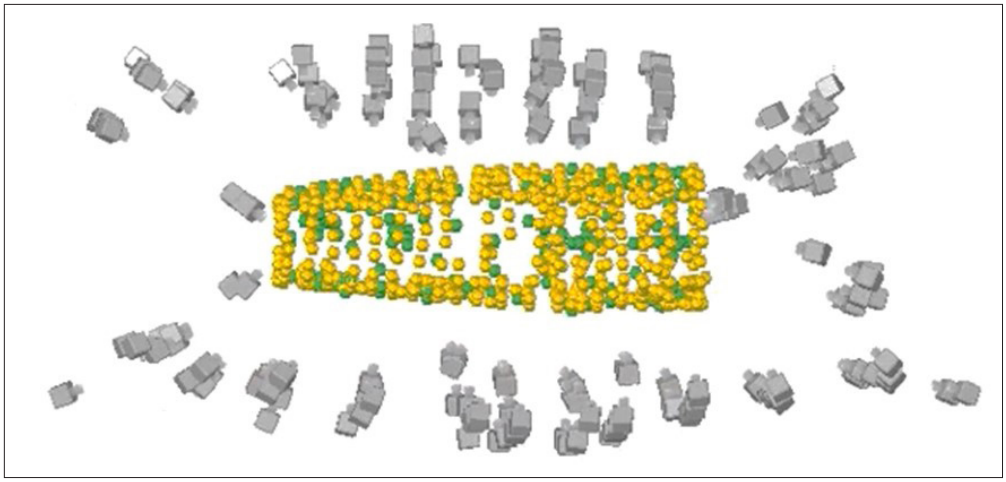


Figure 11 – Stations for taking the photographs of the bow.

CONSTRUCTION OF THE 3D DIGITAL MODEL OF THE BOW

After concluding the field photogrammetric processing, the images were processed in the commercial photogrammetry software GOM Tritop 6.2, identifying the spatial position of each target placed on the object via triangulation. The digital modeling process begins from such three-dimensional coordinates, following the

process of geometric primitives, that is, starting from points to the generation of curves and from these to the generation of surfaces, as shown in Figure 12.

The behavior of the generated curves must be observed to ensure its continuity. For such, a comparative study was conducted from different command configurations of CAD for the best combination of computational commands to define the set of curves characterizing the surface. This study can be visualized in more detail in Appendix 1.

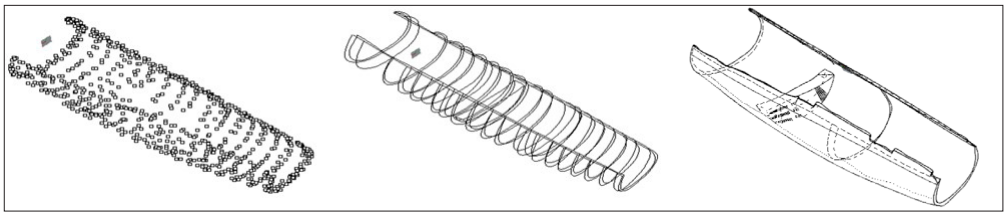


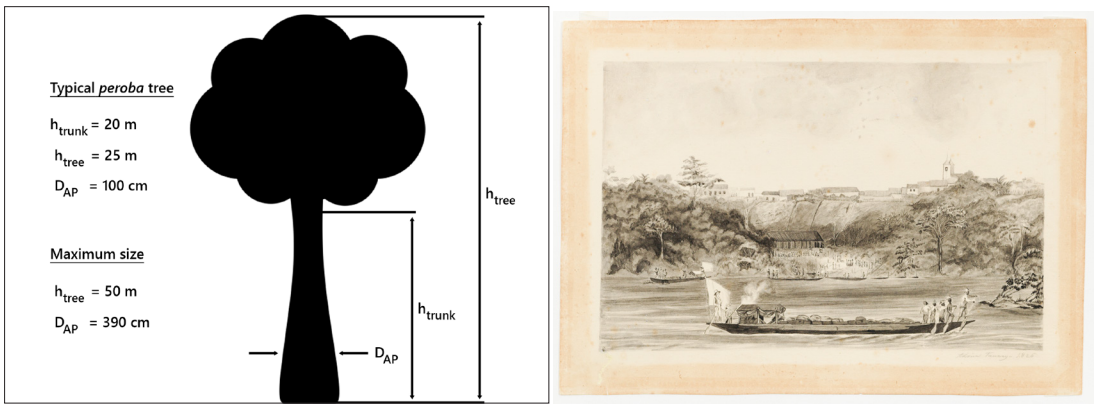
Figure 12 – Spatial coordinates obtained by photogrammetry, curves constructed from the points and final surface of the *canoão*'s bow, respectively.

INTERDISCIPLINARITY AND INFERENCES FOR THE MODELING OF THE COMPLETE CANOE

The digital reconstruction of the *canoão* began from the estimation of its total length, considering historical drawings by Hercules Florence and Adriano Taunay. The basis used for this analysis was the proportion between the height of men and the size of the canoe, as well as the length/beam ratio of the vessel. Considering the height of men of the time between 160 cm and 170 cm – as can be seen in Figure 14 – and using the beam value obtained with the piece, the approximate length calculated was 14.5 m.

The viability of this construction was then verified considering that the canoes were carved from a single trunk. The tree used was a typical *peroba* and its maximum dimensions ever recorded – 50 m in length and 390 cm in diameter, as shown in Figure 13a – validate the considerations. Following the same reasoning as the length estimation, the vessel's draft – submerged hull depth – was determined at 55 cm. The maximum dimensions of the modeled canoe (Figure 16) with a bow like the displayed at Museu Republicano de Itu were 14.5 m long, 1, 16 m of bream and 0.8m from the deck to the keel.

Another step in the reconstruction was to determine the non-existent details at the edge of the bow. For such, the continuity of curvature on the topside of this region and details from Taunay and Florence drawings were considered.



(a) (b)

Figure 13 – a) Data for the characterized wood; b) Aimé-Adrien Taunay, *A Partida da Expedição Langsdorff no Rio Tietê* (1825), washed drawing on paper, 21 x 32.2 cm, Coleção Martha & Erico Stickel. Collection of Instituto Moreira Salles.

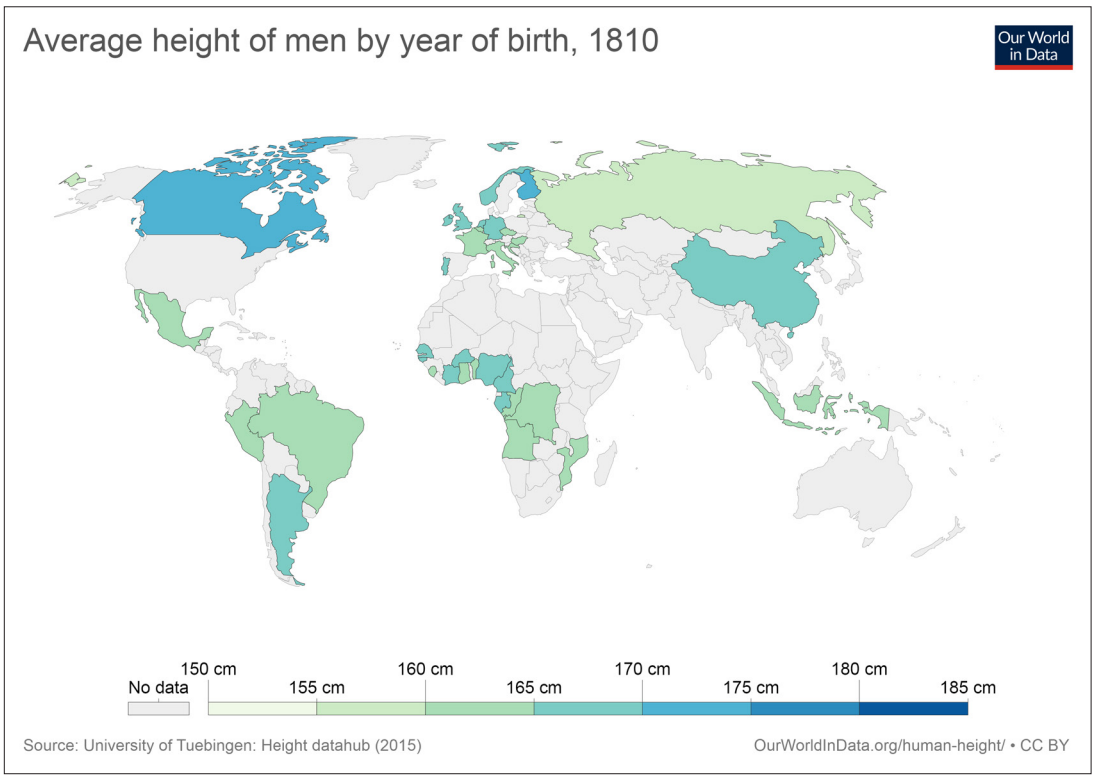


Figure 14 – Average height of men in the decade of 1810. Source: Tuebingen of Tübingen (2015).

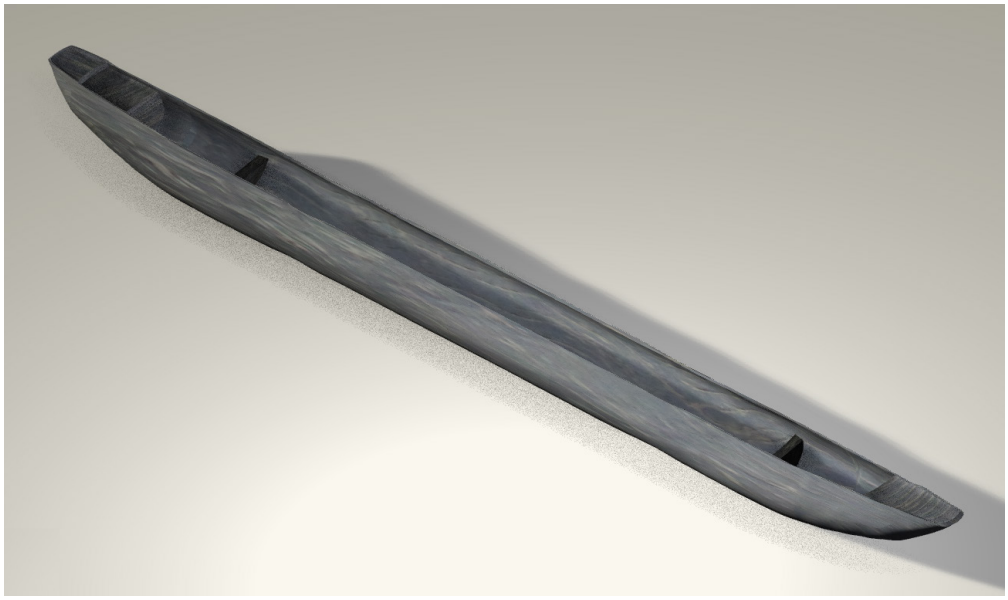


Figure 15 – View of the 3D digital modelling of the vessel.

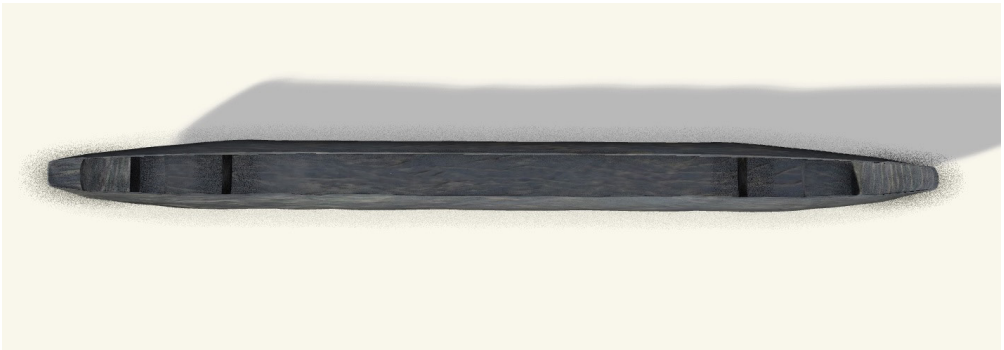


Figure 16 – Top view of the complete modeling of the early eighteenth century *canoão*.

DETERMINATION OF LOAD CAPACITY

The compatibility between the calculated density of the wood and the range considered acceptable for *peroba* wood was verified. The wood volume verified by the digitalization of the piece was 0.39 m^3, whereas the measured mass was 278.5 kg. The density obtained was 714 kg/m^3, matching the range between 660 kg/m^3 to 790 kg/m^3 of basic and apparent density at 15% moisture, respectively. Having the density of *peroba* wood, the mass of the complete canoe was calculated to be 1.2 metric ton.

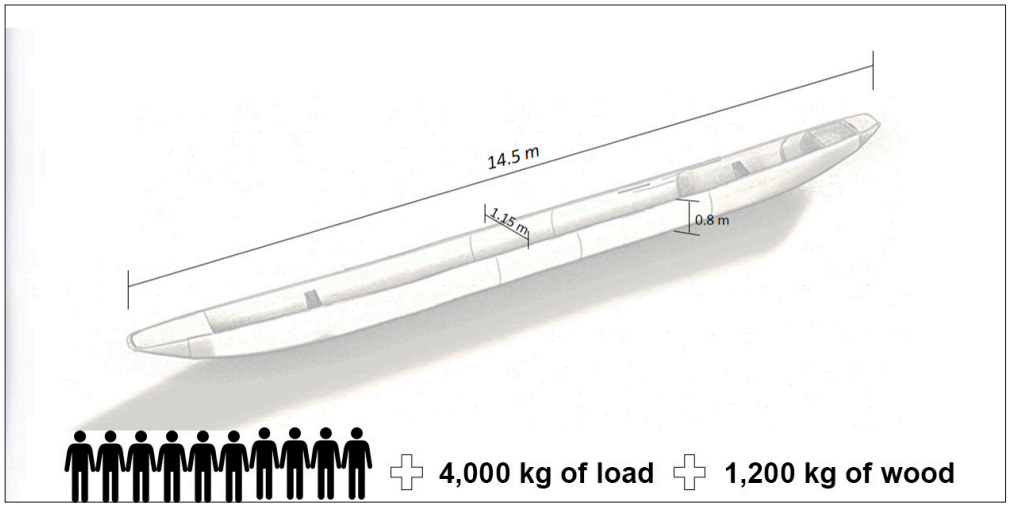


Figure 17 – Size of the complete *canoão*, wood mass and load capacity.

From the modeling, the estimated draft size – from historical drawings and reports – was inserted in the CAE software. The software uses digitalized geometries to calculate the water volume displaced by the vessel, which is related to the total mass of the canoe. In static balance, the complete canoe presents displacement in mass of approximately 6.5 metric ton. This displacement corresponds to the mass of wood, crew and its load.

Considering the average weight of people of the period and the typical number of crew members, the total mass of crew was established in 0.7 metric ton. Thus, for ten crew members, it was possible to estimate the load capacity of a canoe of this size in up to 4.6 metric ton. Another information that supported the determination of the canoe's load capacity was the description by Hercules Florence regarding this theme, corroborating the results obtained from the software.

This information allows us to revisit those incipient logistic systems under a completely new view, having the monsoon canoe as its main material source. The forms carved on the internal part of the trunk demonstrate some knowledge – albeit empirical – of some fundamental concepts of naval engineering such as the use of internal volume, the presence of structural elements, and forms that favor the floating stability of the hull.

While the photogrammetry effort was underway and new more accurate information about the original size of the *canoão* were surfacing, we contacted the Laboratory of Plant Anatomy of the Institute of Biosciences of USP so the anatomical identification of the vessel's wood could be conducted.

Taunay claimed that the *canoão* was of peroba wood, and Sérgio Buarque de Holanda said that the *canoão* of Museu Paulista was of *ximboúva*.[55] Although both species were present in the vegetation of the region of Itu and Porto Feliz – a privileged area for the construction of canoes –, the average density of *peroba* is 790 kg/m^3, whereas the average density of *ximboúva* (also called *fava-orelha-de-negro*, orelha-de-macaco, *timborana*, *timboúva* or *tamboril* in Portuguese) is 500 kg/m^3, which would significantly impact the vessel's performance in both speed and load capacity.

ANATOMICAL IDENTIFICATION OF THE WOOD

Wood anatomy is a renowned method of identification that has been used in several opportunities for the study of historical or archaeological canoes with great success and precision.[56]

For the anatomical analysis of the wood, the samples were collected from wood pieces that were already detaching from the canoe at Museu Republicano de Itu, under the supervision of Fabíola M.Z.F de Miranda, conservator of Museu Paulista. The samples were carefully collected without compromising the piece and taken to the preparation of permanent slides in the Laboratory of Plant Anatomy of the Institute of Biosciences of Universidade de São Paulo (IB-USP).

Since the wood is well-aged and underwent oxidation, the typical pink-salmon coloration of *peroba* was not present. Moreover, the simple macroscopic identification – *in situ* analysis at Museu Republicano using a razor and 10x magnifying glass – did not allow the confirmation that it was *peroba-rosa* or another species of the same genus (*Aspidosperma* spp.). Thus, biologists Gisele Costa and Milena Godoy-Veiga worked in microscopic preparations and photomicrographs of samples of the *canoão* and of current *peroba* trees to allow the most accurate microscopic identification possible. The observations followed the standardization of microscopic characteristics of wood for identification with computer compiled by the International Association of Wood Anatomists,[57] although several characters could not be observed in very small samples.

The traditional methods, involving only manual cuts with disposable blades or the use of sliding microtome with type C razor – the most used in wood anatomy –, did not provide good quality preparations for identification since the *canoão* is at a certain level of structural deterioration – caused by xylophagy such as bacteria

55. When requesting freight exemption for transporting the bow from Porto Feliz to São Paulo, Taunay explains to the railroad inspector that the object "is an open *peroba* trunk, thus I cannot inform your honor how much it will weight" (Letter from Afonso de Taunay to Calixto de Paula Souza, inspector of *Estrada de Ferro Sorocabana*, January 6, 1924, APMP/FMP – Series: correspondence). In the rewritten chapter of *Monções*, Paths of *sertão*, Sérgio Buarque de Holanda comments: "Another [canoe remains], well or poorly identified as a bow, is located in Museu Paulista. There is very little to comment about this one. Made of *ximbó*, the old canoe is now reduced to a fragment of 3.5 meters in length" (2014, p. 277-278) (our emphasis).

56. Cf. Donaldson; Singh (1998), Wheeler et al. (2003), Ruhl; Purdy (2005) and Gilman (2015).

57. Cf. IAWA Committee (1989).

and fungi, as well as by the oxidation by ultraviolet rays. The preparation of the *canoão* samples involved the inclusion in polyethylene glycol (PEG), a water-based polymer for conducting microtome sectioning later.

The material was softened only in an oven, using a mixture of water and glycerin (1:1) for one day. The sample was then included in PEG, closely following the procedures described by Antônio Carlos Franco Barbosa,[58] a technician with 50 years of experience of the Technological Research Institute (IPT). PEG solutions were made with distilled water in several concentrations (20%, 40%, 60% and 80%). The material was kept in each solution for 24 hours in a heated oven at 58°C, and the change pattern was 12 hours. After reaching PEG 80%, the sample was placed in PEG 100% and taken to the oven in vacuum for about eight hours. After this process, the samples were embedded in small paper boxes for the preparation of histological sections.

The sample was sectioned into a sliding microtome in the three planes – transverse, radial longitudinal and tangential longitudinal. The sections were placed in water to dissolve the PEG and clarified with 50% sodium hypochlorite. Following, the material went through a dehydration round (from 10% ethanol up to 100% ethanol), and when the sections were in 50% ethanol, they were stained with 1% Safranin and 1% Astra blue (modified from Kraus & Arduim).[59] The sections were mounted in permanent blades with Canada balsam after the dehydration process was finished. They were also prepared macerated to individually analyze the cells with Franklin's solution (hydrogen peroxide and acetic acid 1:1).[60] The material with the reagent remained in a heated oven at 60°C for 24 hours. After this procedure, the sample was washed a few times with distilled water, then with 50% ethanol, and finally stained with 1% Safranin. All slides were photographed with a digital camera coupled to an optical microscope (Leica Microsystems).

The reference samples of *peroba* woods belong to the Xylotheque Nanuza Luiza de Menezes (SPFw) and Xylotheque Calvino Mainieri (BCTw).[61] Previously prepared samples were used for comparison, as well as samples of *peroba-rosa* exclusively prepared for this purpose, using traditional methods of wood anatomy similar to the one explained above, but without the need for inclusion in PEG. Images from an international and collaborative database for wood identification were also used; this database is named InsideWood and based in the North Caroline State University.[62]

The results of the anatomical analyses and comparisons with images from virtual collections and blades from xylotheques of São Paulo indicate with certainty that it is a trunk of *peroba-rosa*, *Aspidosperma polyneuron* Muell. Arg. (family

58. Cf. Barbosa et al. (2010).

59. Cf. Kraus; Arduim (1997).

60. Personally communicated by A.C.F. Barbosa, modified from Franklin (1945).

61. There were 461 samples available, being 264 samples of 28 names accepted as correct for the genus. Of the eight species that occur in the state of São Paulo available in xylotheques, the only one we did not examine was *Aspidosperma redelii*, unavailable in any collection of the world.

62. Cf. InsideWood (2004-onwards), Wheeler (2011).

Apocynaceae) (Figure 18). This wood is characterized by presenting visible growth rings delimited by a fibrous zone, with thicker wall fibers and radially flattened, diffuse porosity, vessels without characteristic arrangement and predominantly solitary (> 90%), with average density of 54 vessels per mm^2. The average diameter of vessels is 40 µm (9 µm–80 µm). The average length of vessel elements is 295 µm (161 µm–547 µm), the perforation plates are always simple and the inter-vessel pits are alternate and shielded. Radiovascular pits are similar to inter-vessel ones. Vessel elements are often obstructed by till, and some tracheids are present near the vessels. There are non-septate fibers with 987 µm (172 µm – 1,324 µm) in average length, very thick walls and areolated pits in the radial and tangential planes. The parenchyma is diffuse axially and sparse. The radius is one to three cells wide – predominantly two – and radius height ranging from 113 µm to 260 µm, with 191 µm on average. Its composition is monocellular, being composed only by procumbent cells. There are prismatic crystals in subdivided cells of the axial parenchyma.

Considering the anatomical characteristics observed, the wood is absolutely not a *ximboúva*, as suggested by Holanda. The *ximboúva* (an alternate name of *timboúva*) is a leguminous, of the genus *Enterolobium*, possibly *E. contortisiliquum* (Vell.) Morong. or *E. timbouva* Mart., which has very wide vessels (>300 µm) and vasicentric axial parenchyma, both visible to the naked eye. *Peroba* vessels are of difficult observation even under 10x magnification lens. Regarding *Enterolobium* woods, all species present average density under 500 kg/m^3, light coloration, low mechanical resistance and low resistance to rotting. These woods would hardly have been conserved in the conditions that the *canoão* was observed due to being highly susceptible to several xylophagy.[63]

Another aspect of the musealized *canoão* to be highlighted is that it is a piece carved into a single trunk, that is, a monoxylon. To be able to carve a canoe of this size, a very large and very straight trunk of a tree had to be used, one with a diameter greater than 1.5 m. This diameter is yet to be calculated, but we are searching for other anatomical methods that are being improved. Based on field observations, to achieve a canoe longer than 14 meters from a single wood, one would require an adult *peroba* tree about 25 meters high and point of morphological inversion[64] higher than 15 meters.

Moreover, one more conclusion obtained by the morphological analysis of the bow is that the observed marks suggest the probable use of the traditional *caiçara* method for its manufacture, involving notching with an axe and a cutting tool similar to a short hoe, the adze.[65] This method is common to this day for monoxylon trunks and, in some cases, may also present the alternation between notching and using fire on the internal parts.

63. Cf. Mainieri; Chimelo (1989).

64. The point of morphological inversion is the region of a tree where the trunk ends and the canopy begins.

65.Cf. Németh (2011).

66. Collection: G. Ceccantini 3983 and P. Alécio, Sept. 2013, Estação Ecológica de Caetetus, Gália, SP.

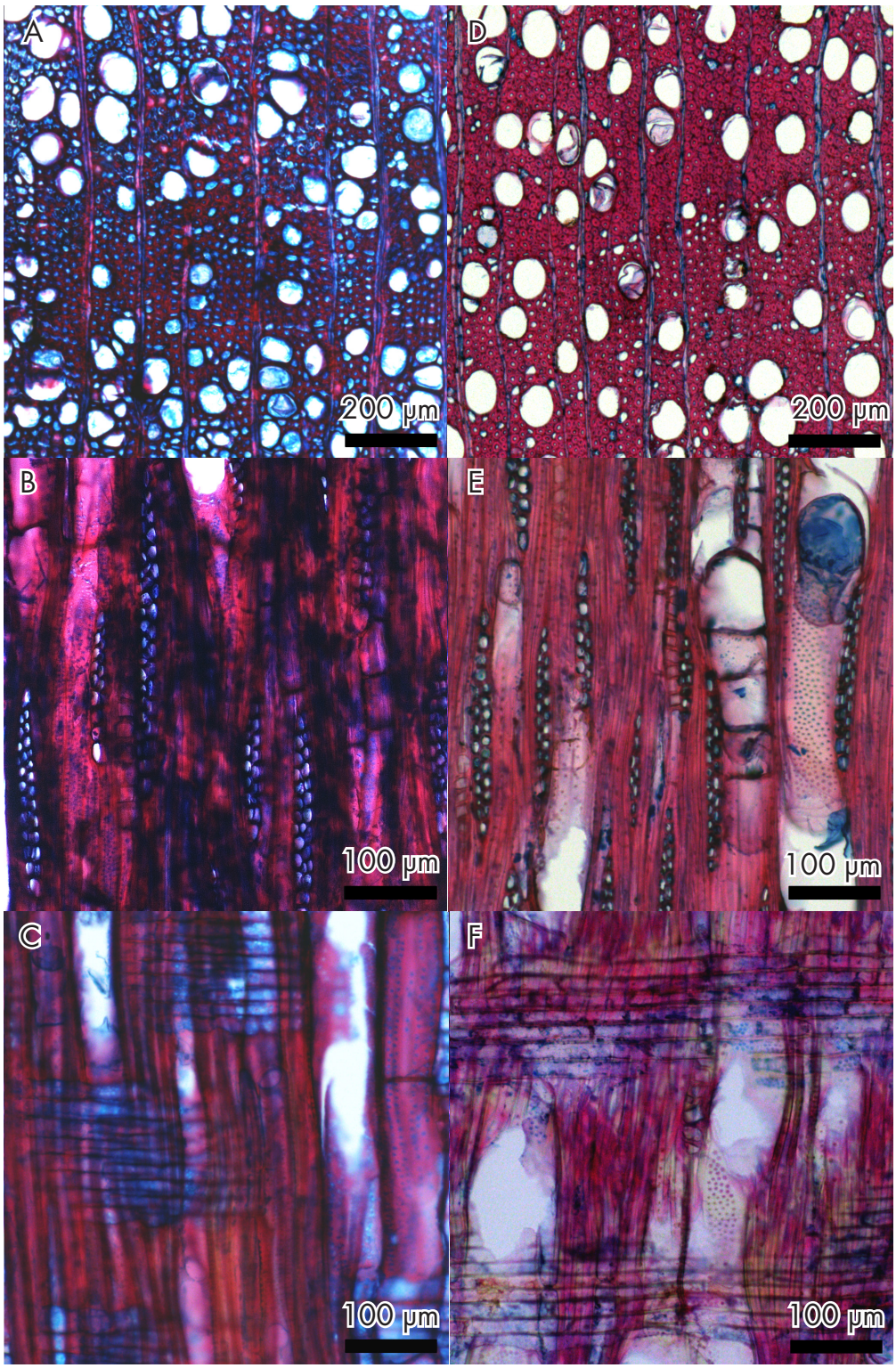


Figure 18 – Histological sections of *peroba-rosa* (*Aspidosperma polyneuron*) of the *canoão* wood and of a current wood: A, B and C – transverse, tangential longitudinal and radial longitudinal sections of the *canoão* wood; D, E and F – same section planes of a current *peroba-rosa* wood (SPFw-5379).[66]

Figure 19 – *Peroba* trees at Parque Estadual de Porto Ferreira, demonstrating the large size of the trees. A) tree with 35 m high; B) tree with about 1.65 m in diameter. Levi Itepan appears as a reference to the trunk size. Photograph by Gregorio Ceccantini.

THE *CANOÃO* IN ITU, FORMERLY THE ENTRANCE TO *SERTÃO* AND THE MONSOON EXPEDITIONS

A new exhibition on the monsoons was finally assembled on September 23, 2017 – one hundred years after the first negotiations for the coming of the *canoão* to Museu Paulista –, under the curatorship of Maria Aparecida de Menezes Borrego and Rodrigo da Silva, entitled *Viagens fluviais: homens e canoas na rota das monções* (River journeys: men and canoes in the path of the monsoons) at Museu Republicano de Itu – the region where it was previously used.

Interdisciplinary efforts meant that the *canoão* was a protagonist in relation to its materiality. The results of the investigations conducted by the historians, engineers and biologists of Universidade de São Paulo were integrated into the very design of the exhibition and to its museographic project; there are two infographics

near the vessel – prepared by Cláudio Rother and Ricardo Bogus – on the wood of which it is made, its size, load capacity, and comparison with other modes of transport, in addition to a brief documentary on the photogrammetry process, displayed uninterrupted (Figure 20).

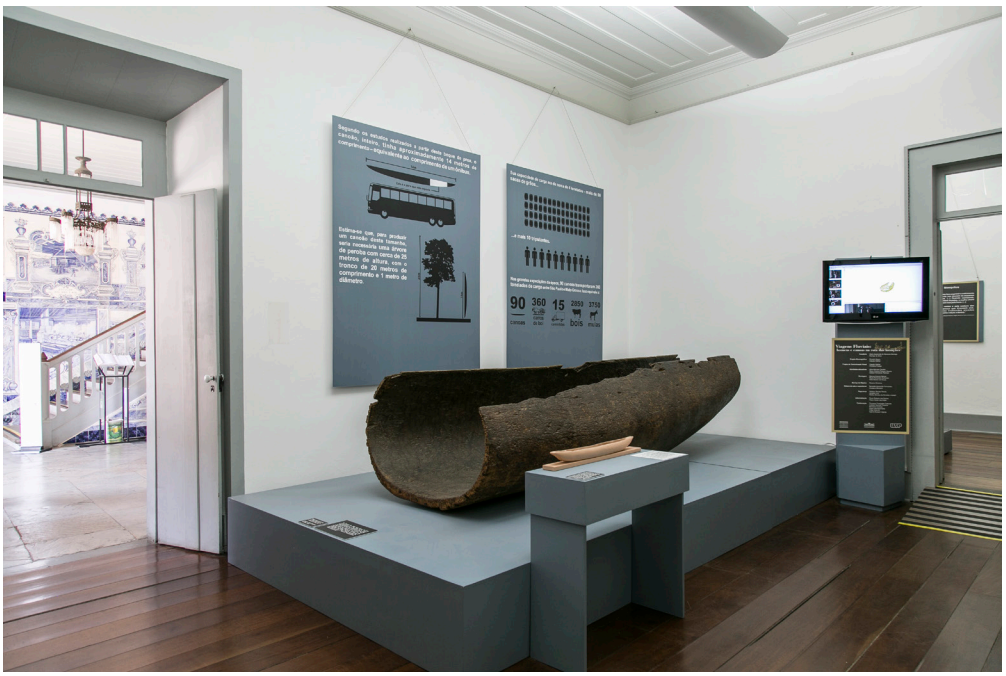


Figure 20 – Partial view of the exhibition V*iagens fluviais: homens e canoas na rota das monções*, having the canoão in prominence, 2017. Museu Republicano Convenção de Itu, MP, Itu, SP. Photograph by Helio Nobre.

Unlike Taunay's exhibition proposals at Museu Paulista, the bow had no scenographic role to ratify what was shown on the paintings he commissioned based on Florence's drawings. In any moment the exhibition claimed that the *canoão* fragment participated of Langsdorff's expedition or of any specific monsoon expedition; there was the suggestion that it is perhaps similar to the canoes used in journeys that departed from Porto Feliz in the eighteenth and nineteenth centuries.

From the results obtained, it was possible to suppose that, in the large expeditions that traveled the monsoon route, 90 canoes could carry 360 metric ton of cargo between São Paulo and Mato Grosso. This number of canoes corresponded to 360 bullock carts, or 15 trucks, or 2,850 oxen or 3,750 mules. Such fabulous capacity makes us understand why river journeys remained active during the eighteenth century despite a land path between São Paulo to Goiás – and from there to Cuiabá – existing since the 1730s.

Paintings commissioned by Taunay in the early twentieth century – *Carga das canoas*, by Oscar Pereira da Silva, *Bênção das canoas* and *Pouso no sertão – Queimada*, by Aurélio Zimmermann – and the reproductions of Hercule Florence's drawings from the 1820s – belonging to Cyrillo Florence's collection – were moved to Museu Republicano to compose the exhibition rooms (Figures 21 and 22).

Figure 21and 22 – Partial view of the rooms of the *Viagens fluviais: homens e canoas na rota das monções* exhibition, 2017. Museu Republicano Convenção de Itu, MP, Itu, SP. Photograph by Helio Nobre.

For the first time, paintings and drawings were exposed side by side, informing the public about the Langsdorff expedition and explaining the perspective of Afonso Taunay in the construction of the visual narrative of the monsoons. Although many elements present in the two temporally distant supports are considered traces of the monsoon expeditions that preceded the Langsdorff expedition, we seek not to confuse the two periods, overlapping each other. After all, there were different men and different goals that guided them.

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APPENDIX 1 – COMPARATIVE ANALYSIS OF CONTINUITY AND CURVATURE FOR DIFFERENT COMMAND CONFIGURATIONS IN THE CAD SOFTWARE