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Beiträge

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Brazilian Native useful plants in Humboldt and Bonpland's travel records and works: biodiversity and traditional knowledge beyond borders

ABSTRACT

Alexander von Humboldt and Aimé Bonpland were unable to cross into Brazil during their American expedition (1799–1804). The Portuguese Crown strictly controlled Brazil's borders during the colonial period, banning entry of most foreign travelers, and Brazilian ports were opened to friendly nations only in 1808. Though they never officially entered Brazil, Humboldt and Bonpland influenced later travelers and described many native Brazilian plant species, like *Bertholletia excelsa, Fridericia chica,* and *Paullinia cupana.* Since Venezuela, Colombia, and Peru share borders with Brazil, these countries possess vast shared biodiversity, especially in the Amazon. Studying the plants described by Humboldt and Bonpland in their travel journals and *Plantes Équinoxiales* provides insights into Brazilian flora, particularly regarding traditional uses, bioeconomy, and conservation strategies.

RESUMEN

Alexander von Humboldt y Aimé Bonpland no pudieron cruzar a Brasil durante su expedición americana (1799–1804). La Corona portuguesa controlaba estrictamente las fronteras de Brasil durante el período colonial, prohibiendo la entrada de la mayoría de los viajeros extranjeros. Los puertos brasileños solo se abrieron a naciones amigas en 1808. Aunque nunca ingresaron oficialmente a Brasil, Humboldt y Bonpland influyeron en viajeros posteriores y describieron muchas especies de plantas nativas brasileñas, como *Bertholletia excelsa, Fridericia chica* y *Paullinia cupana.* Dado que Venezuela, Colombia y Perú comparten fronteras con Brasil, estos países poseen una vasta biodiversidad compartida, especialmente en la Amazonía. El estudio de las plantas descritas por Humboldt y Bonpland en sus diarios de viaje y en *Plantes Équinoxiales* ofrece valiosos conocimientos sobre la flora brasileña, en particular sobre sus usos tradicionales, la bioeconomía y las estrategias de conservación.

ZUSAMMENFASSUNG

Alexander von Humboldt und Aimé Bonpland konnten während ihrer amerikanischen Expedition (1799–1804) nicht nach Brasilien einreisen. Die portugiesische Krone kontrollierte die Grenzen Brasiliens während der Kolonialzeit streng und verbot den meisten ausländischen Reisenden die Einreise. Erst 1808 wurden die brasilianischen Häfen für befreundete Nationen geöffnet. Obwohl Humboldt und Bonpland Brasilien nie offiziell betraten, beeinflussten sie spätere Reisende und beschrieben zahlreiche einheimische brasilianische Pflanzenarten wie *Bertholletia excelsa, Fridericia chica* und *Paullinia cupana.* Da Venezuela, Kolumbien und Peru an Brasilien grenzen, teilen diese Länder eine große Biodiversität, insbesondere im Amazonasgebiet. Die Untersuchung der von Humboldt und Bonpland in ihren Tagebüchern und in *Plantes Équinoxiales* beschriebenen Pflanzen bietet wertvolle Einblicke in die brasilianische Flora, insbesondere in Bezug auf traditionelle Nutzungen, Bioökonomie und Naturschutzstrategien.

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Introduction

The expedition to the Americas between 1799 and 1804 by the German naturalist Alexander von Humboldt (1769–1859) and the French botanist Aimé Bonpland (1773–1858) is renowned for its immense contribution to botanical sciences. Over the course of five years, traveling through the present-day territories of Venezuela, Cuba, Colombia, Peru, Ecuador, and Mexico (Sprague 1924; Sandwith 1925; Sandwith 1926; Sprague 1926), the two naturalists collected more than 6,000 plant species, approximately 3,600 of which were new to science (Dobat 1987).

The botanical findings were published in six major works: *Plantes Équinoxiales* (1805–1817), *Monographie des Melastomacées* (1806–1823), *Nova Genera et Species Plantarum* (1815–1825), *Mimoses et autres plantes légumineuses du Nouveau Continent* (1819–1824), *Révision des Graminées* (1829–1834), and *Synopsis Plantarum* (1822–1826) (Fiedler & Leitner 2000). However, the original botanical descriptions and uses of the collected plants were meticulously documented in travel journals: Humboldt's *American Travel Journals* (ATJ) in nine volumes and Bonpland's *Journal Botanique* (JB) in seven booklets, which were later bound together (Lack 2004).

It is also well known that Humboldt and Bonpland were unable to cross into Brazil. During the colonial period, the borders of Brazilian territory were strictly controlled by the Portuguese Crown. Foreign travelers were generally prohibited from entering the country, with a few rare exceptions, such as the British naturalists John Mawe and Thomas Lindley or the German botanist Friedrich Wilhelm Sieber. The opening of Brazilian ports to friendly nations occurred only in 1808, four years after Humboldt and Bonpland returned to Europe. This policy shift coincided with the relocation of the Portuguese royal family, led by King Dom João VI, to Rio de Janeiro as they fled Napoleon Bonaparte's expansion across Europe (Andrä 1962; Lahuerta 2007; Lima 2010, Santos 2014).

Since the discovery of gold mines in Minas Gerais at the end of the 17th century, Portugal has sought to restrict foreign travelers' access to Brazilian territory to protect its natural resources. A few expeditions were funded by the Portuguese Crown to survey borders, assess economic resources, and create maps (Holanda 2006; Lima 2013; Santos 2014). A clear rivalry existed between Portugal and Spain in their pursuit of highly profitable resources. One notable example is the exploitation of "quina" bark (*Cinchona* spp., Rubiaceae), native to the Andean regions of Peru and Ecuador. The extraction and trade of this valuable resource by the Spanish colonies to Europe were considered even more lucrative than silver mining (Gänger 2015). Portugal, in response, initiated an internal competition in Brazil by offering a monetary prize to anyone who could identify a substitute plant for "quina" to compete with Spanish trade. Consequently, more than thirty species of false "quinas" emerged, since no other species containing quinine – the alkaloid with antimalarial properties – was ever discovered, leading to ongoing issues with the adulteration of this raw material to this day (Cosenza 2013).

In 1800, Humboldt and Bonpland navigated from the Orinoco to the Rio Negro river to confirm whether the Casiquiare river connected these two major waterways. The travelers reached the southernmost Spanish fortification on the banks of the Rio Negro, named San Felipe, located opposite the settlement of San Carlos. Downstream, not far from the Spanish outpost, the Portuguese had established their northernmost military post, São José dos Marabitanos. Humboldt briefly considered taking the simpler route of descending the Rio Negro and the Amazon rivers to reach the Atlantic Ocean, as the French naturalist Charles-Marie de La Condamine had done decades earlier. However, he abandoned this plan after being expressly warned in San Carlos that, due to the tense relations between Spain and Portugal, any foreigner entering Brazilian

territory without the permission of the Portuguese government would be viewed with suspicion and face significant risks (Andrä 1962). Humboldt described this event in his Personal Narrative:

> The passage from the mouth of the Rio Negro to Grand Para took only twenty to twenty-five days, so we could have gone down the Amazon as far as the Brazilian coast just as easily as returning by the Casiquiare to Caracas. We were told at San Carlos that political circumstances made it difficult to cross from Spanish to Portuguese colonies, but we did not know until our return to Europe what danger we would have been exposed to had we gone as far as Barcellos. It was known in Brazil, probably through newspapers[1], whose indiscretion is not helpful for travelers, that I was going to visit the Rio Negro missions and examine the natural canal uniting the two river systems. [...] Orders had been issued to arrest me, seize my instruments, and especially my astronomical observations, so dangerous to the safety of the State. We were to be led along the Amazon to Grand Para, and then back to Lisbon (Humboldt 1995, 239).

Indeed, the Portuguese government had issued an official notice on June 2, 1800, addressed to the governors of Grão-Pará and Ceará in Brazilian lands, stating that:

> [...] the journey of such a foreigner is considered suspicious [...] the entry into its domains is prohibited to any and all foreigners not authorized with special orders from His Majesty: His Most August Majesty expressly orders that Your Excellency conduct the most thorough and scrupulous examination to verify whether the said Baron von Humboldt or any other foreign traveler has traveled or is currently traveling through the territories of this captaincy, as such occurrences would be extremely detrimental to the political interests of the Crown of Portugal if confirmed[2] (Andrä 1962).

Unofficially, Humboldt and Bonpland very likely set foot on Brazilian soil, as the borders of the Upper Rio Negro and Upper Amazon regions within Spanish and Portuguese territories had not yet been clearly established at that time. In any case, although unable to officially enter Brazilian territory, Humboldt profoundly influenced the travelers who visited Brazil in the years following his return to Europe. His impact can be seen in the expeditions and works of other naturalists, including German figures such as Friedrich Wilhelm Sieber, Carl Friedrich Philipp von Martius, Friedrich Sellow, Ignaz von Olfers, Wilhelm Christian Gotthelf Feldner, Karl Ferdinand Appun, Prince Adalbert of Prussia, Robert Christian Avé-Lallemant, Hermann Burmeister, Wilhelm Ludwig von Eschwege, Prince Maximilian Wied-Neuwied, Robert and Richard

1 Humboldt mentioned a note published in the newspaper Gazeta de Lisboa on May 13th, 1800, which was a reproduction of an original publication in Koelnische Zeitung on April 1st, 1800. In fact, the German newspaper was not referring to the Brazilian area known as “Maranhão”, but rather to the region of “Marañón” administered by Spain in the Upper Amazon (Andrä 1962; Soethe 2024).

2 Original quote: “[...] suspeita a viagem de um tal estrangeiro [...] é proibida a entrada nos seus domínios a todo e qualquer estrangeiro não autorizado com especiais ordens de S. Majestade: Ordena muito expressamente o Mesmo Augusto Senhor, que V. Sa. faça examinar com a maior exação e escrúpulo, se com efeito o dito Barão de Humboldt, ou outro qualquer viajante estrangeiro tem viajado, ou atualmente viaja pelos territórios dessa capitania, pois que seria sumamente prejudicial aos interesses políticos da coroa de Portugal, se se verificassem semelhantes fatos.”

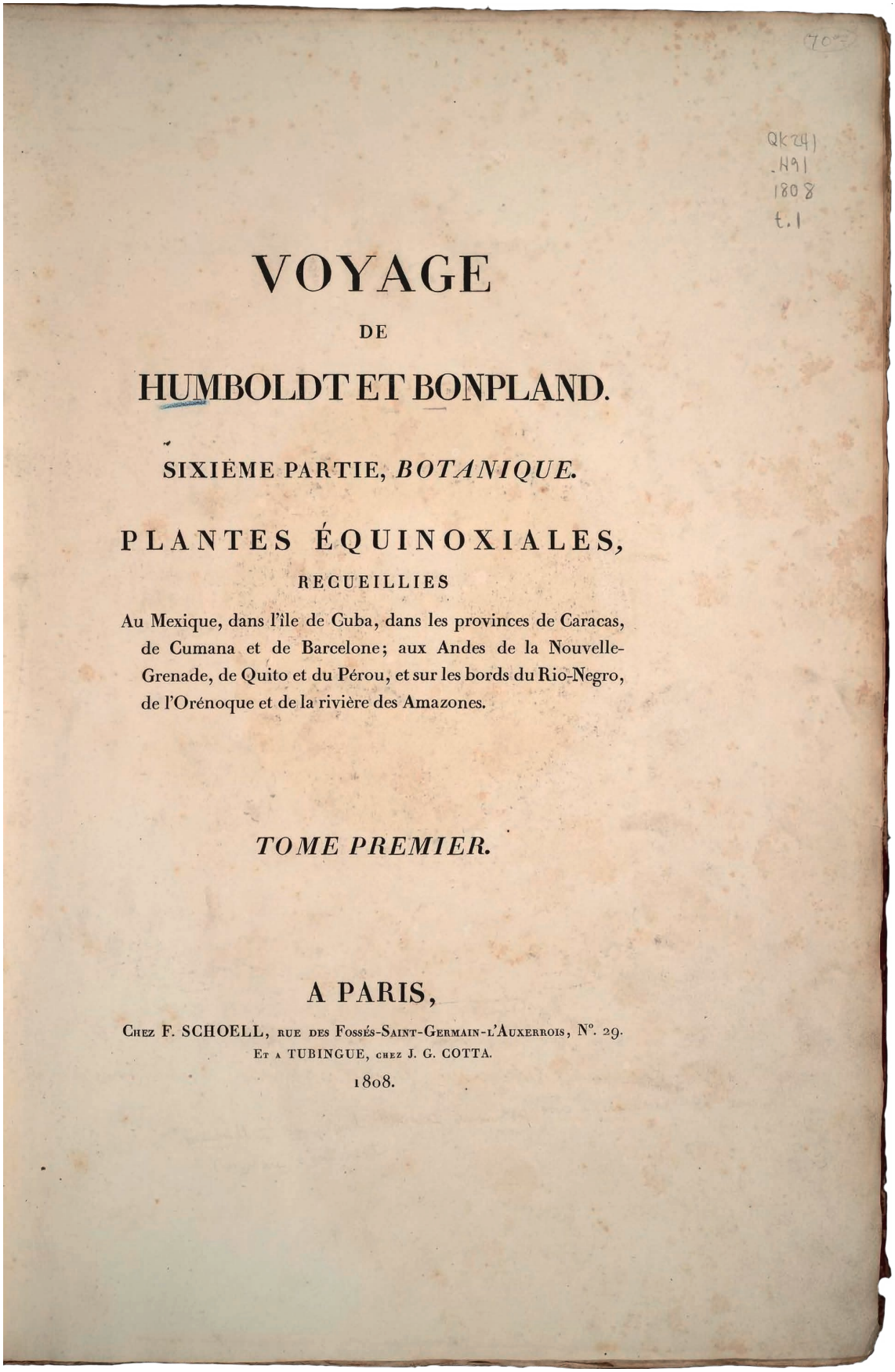
Schomburgk, Eduard Poeppig, Karl von den Steinen, as well as the Frenchman Auguste de Saint-Hilaire, the Dane Peter Wilhelm Lund, the Swiss Louis Agassiz, and the renowned Englishman Charles Darwin (Andrä 1962; Lisboa 2020).

Moreover, Humboldt and Bonpland collected and described numerous species of plants native to Brazil. Since Venezuela, Colombia, and Peru share borders with Brazil, these countries possess a vast shared biodiversity, particularly in the Amazon region, where many of these plants are found across multiple countries. Therefore, studying the plants described by Humboldt and Bonpland also means exploring, in some way, the potential of Brazilian plants.

Brazilian native species in Humboldt and Bonpland's reports and works

In my research group in the Laboratory of Historical and Applied Studies in Pharmacognosy at the Federal University of Rio de Janeiro, Rio de Janeiro city, Brazil, Humboldt and Bonpland's travel journals, correspondence, and published works are investigated in a historical ethnobotanical perspective[3]. Analysis started with the book *Plantes Équinoxiales* (Figure 1), the first botanical work they conceived after returning to Europe, published between 1805 and 1817. Following that, I have dedicated efforts to examining the travel journals, searching for original information that served as the basis for their later publications. From 130 different species described in *Plantes Équinoxiales,* 27 of which are natives to Brazil (Table 1). Among these species, 4 were described for medical purposes, 4 for construction, 3 as edible plants, 3 as ornamental plants, 2 for furniture, 1 for dyeing, and 15 for other or non-reported uses (Baratto 2022).

3 Methodological procedures included a full reading of the original sources (digitized versions are available online or as printed books) and the systematic collection of information (botanical and vernacular names, place of collection, medicinal or other uses, plant parts used, and other relevant observations). For the analysis of the American travel journals of Humboldt (ATJ), a list of scientific and/or vernacular names from the index organized by Margot Faak (Humboldt 2000, 635–667) was consulted and used as keywords to locate information about the plant species. The original ATJ, digitized by the Staatsbibliothek zu Berlin, as well as the transcribed version in *edition humboldt digital,* were accessed. For this article, specific doubts regarding handwritten texts – such as those in Bonpland's *Journal Botanique* (JB) – or transcribed texts in German – as in ATJ – were clarified with the assistance of Dr. Ulrich Päßler (BBAW). Part of this work was carried out by the author between October 2024 and January 2025 during a short research stay at BBAW, sponsored by DAAD, where he had access to transcribed versions of Humboldt's travel journals in the *edition humboldt digital* (some transcriptions are not publicly available yet).



VOYAGE

DE

HUMBOLDT ET BONPLAND.

SIXIÈME PARTIE, *BOTANIQUE.*

PLANTES ÉQUINOXIALES,

RECUEILLIES

Au Mexique, dans l'île de Cuba, dans les provinces de Caracas, de Cumana et de Barcelone; aux Andes de la Nouvelle-Grenade, de Quito et du Pérou, et sur les bords du Rio-Negro, de l'Orénoque et de la rivière des Amazones.

TOME PREMIER.

A PARIS,

Chez F. SCHOELL, rue des Fossés-Saint-Germain-l'Auxerrois, N°. 29.
Et a TUBINGUE, chez J. G. COTTA.

1808.

Fig. 1: Alexander von Humboldt & Aimé Bonpland. *Plantes Équinoxiales,* volume 1, 1808. Biodiversity Heritage Library, Public Domain, https://www.biodiversitylibrary.org/item/9696#page/8/mode/1up.

Table 1. Brazilian native plants described in Humboldt and Bonpland's *Plantes Équinoxiales* volumes I and II (Humboldt & Bonpland 1808–1809, vols. I and II).

Family and botanical name* [Vernacular name]	Volume/ Page
Abolboda pulchella Humb., Xyridaceae	II–110
Alchornea castaneifolia (Humb. & Bonpl. ex Willd.) A.Juss. (= *Hermesia castaneifolia* Humb. & Bonpl. ex Willd.), Euphorbiaceae [Sauso]	I–161
Angelonia salicariifolia Bonpl., Plantaginaceae [Angelon]	II–92
Apalanthe granatensis (Bonpl.) Planch. (= *Elodea granatensis* Bonpl.), Hydrocharitaceae	II–150
Bertholletia excelsa Bonpl., Lecythidaceae [Castanha do Brasil, almendrón, luvia (native indigenous people), castañas de Marañon (Lisbon), çapucaya (Brazilians), tuka (Portuguese spoken in Cayenne), castanha do Pará (British), #juvia]	I–122
Combretum mexicanum Bonpl. (= *C. laxum* Jacq.), Combretaceae	II–159
Eugenia biflora (L.) DC. (= *E. albida* Bonpl.), Myrtaceae	II–107
Fridericia chica (Bonpl.) L. G. Lohmann (= *Bignonia chica* Bonpl.), Bignoniaceae [Chica]	I–107
Guadua latifolia (Bonpl.) Kunth (= *Bambusa latifolia* Bonpl.), Poaceae	I–73
Gynerium sagittatum (Aubl.) P.Beauv. (= *Gynerium saccharoides* Humb.), Poaceae [#Lata, caña brava]	II–112
Heisteria acuminata (Bonpl.) Engl. (= *Rhaptostylum acuminatum* Bonpl.), Olacaceae	II–139
Isertia verrucosa (Bonpl.) Standl. (= *Cassupa verrucosa* Bonpl.), Rubiaceae [Cassupa, #cassupo]	I–42
Jacaranda obtusifolia Bonpl., Bignoniaceae [Arbol roseto, #Arbol de roseto]	I–62
Ladenbergia oblongifolia (Humb. ex Mutis) L.Andersson (= *Cinchona magnifolia* Bonpl.), Rubiaceae [Cascarilla bora, #cascarilla bova]	I–136
Lessingianthus rubricaulis (Bonpl.) H.Rob. (= *Vernonia rubricaulis* Bonpl.), Asteraceae	II–66
Limnocharis flava (L.) Buchenau (= *Limnocharis emarginata* Bonpl.), Alismataceae	I–116
Ludwigia helminthorrhiza (Mart.) H.Hara (= *Jussiaea natans* Bonpl.), Onagraceae	I–16
Ludwigia sedioides (Bonpl.) H.Hara (= *Jussiaea sedioides* Bonpl.), Onagraceae	I–13
Machaonia acuminata Bonpl., Rubiaceae [Caiba blanca, #ceiba blanca]	I–101
Marathrum foeniculaceum Bonpl., Podostemaceae	I–39
Mikania guaco Bonpl., Asteraceae [Guaco or vejuco del guaco]	II–84
Quararibea cordata (Bonpl.) Vischer (= *Matisia cordata* Bonpl.), Malvaceae [Chupachupa (Magdalena river, Colombia), sapote (Peru)]	I–9
Retiniphyllum secundiflorum Bonpl., Rubiaceae	I–86
Ronabea emetica (L.f.) A.Rich. (= *Psychotria emetica* L.f.), Rubiaceae [Ipecacuanha, raicilla ("small root" in Spanish. The word "ipecacuanha" is unknown to the natives of New Granada)]	I–142
Theobroma bicolor Bonpl., Malvaceae [Bacao]	I–104
Trichanthera gigantea (Bonpl.) Nees (= *Ruellia gigantea* Bonpl.), Acanthaceae [Cajeto or nassedero]	II–75
Triglochin scilloides (Poir.) Mering & Kadereit (= *Lilaea subulata* Bonpl.), Juncaginaceae	I–221

* Updated botanical names according Kew's Plants of the World online (POWO) (in parenthesis= terminology as originally described in the book), botanical family [vernacular names, when available]; # vernacular names described in *Nova Genera et Species Plantarum* (Kunth 1815; 1818; 1825).

"Juvia"

Among these plants, the Brazil nut (*Bertholletia excelsa* Bonpl.), also known as "castanha-do-Pará" or Pará nut, is perhaps one of the most iconic species of the Brazilian Amazon. In his ATJ, Humboldt briefly mentions the great importance attributed to "juvia" (indigenous name) or "almendrón" (Spanish name) by the indigenous people of Esmeralda, along the Orinoco river in Venezuela. He noted that they celebrated a festivity after collecting the fruits: "While we were in Esmeralda, the indigenous people (4 piraguas[4]) arrived from the Rio Gehette bringing the 'almendróns'. They celebrated the Festival of Juvia for two days" (Humboldt 1800–1801, 84r–84v; Humboldt 2000, 307)[5].

Curiously, in *Plantes Équinoxiales,* Bonpland provides a long-detailed description of this species, referring to it as a "precious plant". This is an interesting example, because considering the brief mention of *B. excelsa* in the travel journals, such observations suggest that Humboldt and Bonpland likely maintained additional annotations and copies beyond the original travel journals.

Bonpland described that "juvia" was originally from Pará, Brazil, but they certify that the trees were in Spanish America territory, forming forests along the borders of the Orinoco river (Humboldt & Bonpland 1808–1809, vol. I). Mori and Prance (1990) discuss that trees that the naturalists gathered for their collection and identification might have been raised from seeds introduced from Brazil.

Bertholletia was regarded as one of the most fascinating plants of the New World, cultivated throughout the warm climates of the Americas with the same care that walnut and almond trees received in Europe. Its fruits were abundant, each containing fifteen to twenty large edible seeds with a refined taste, especially when fresh, and noted that it also produced a highly valued oil, which was excellent for burning as fuel in Brazil:

> During our journey through the Orinoco, Humboldt and I were immensely pleased to find these almonds. We had spent three months living on bad chocolate and rice cooked in water, always without butter and often without salt. Finally, we received a large quantity of fresh *Bertholletia* fruits, harvested by the indigenous people in June, during the harvest season[6] (Humboldt & Bonpland 1808–1809, vol. I, 126).

Curiously, in the same monograph, impressed by the full potential of this plant species, Bonpland described what today could be interpreted as biopiracy. He stated that it would be very easy and inexpensive for the Spanish on the borders of the Orinoco and throughout the entire province of Nueva Andalucía to propagate this tree. A judgmental tone regarding the intellectual capacity and abilities of the indigenous people to execute simple, but impor-

4 Indigenous word that means "canoes".

5 Original quote: "Indem wir in Esmeralda waren, gelangten eben die Indianer (vier piraguas) von dem Rio Geheta und [mit] Almendronen an. Sie feierten zwei Tage lang das Fest der Juvia."

6 Original quote: "Nous avons été très-heureux, M. de Humboldt et moi, de trouver de ces amandes dans notre voyage sur l'Orénoque. Il y avait trois mois que nous ne vivions que de mauvais chocolat, de riz cuit dans l'eau, toujours sans beurre et souvent sans sel, lorsque nous nous procurâmes une grande quantité de fruits frais du *Bertholletia.* C'étoit dans le courant de juin, les Indiens venoient d'en faire la récolte."

tant tasks was used by Bonpland in this passage, considering local native people "intelligent enough" to "collect" the seeds and navigate the river. Bonpland reinforced in his argument a colonialist perspective and a reductionist and utilitarian vision of indigenous people as tools to facilitate the appropriation and exploitation of natural resources:

> It would be easy and inexpensive for the Spaniards living along the banks of the Orinoco and throughout the province of New Andalusia to multiply a tree whose usefulness is so evident. The best method, in my opinion, would be to send a few intelligent and willing men to the places where this tree naturally grows [possibly Brazilian territory]. There, they would collect thousands of seeds whose germination would already have begun and place them in nurseries inside boxes filled with the same soil where they started to sprout. The transport would be easy and without any inconvenience; it would be done on rafts, with the precaution of covering them with palm leaves to protect the young plants from the scorching rays of the sun. The natives, skilled at navigating the Orinoco and accustomed to piloting rafts, would serve as pilots; they are intelligent enough to be entrusted with this task and are also well aware of the great utility of this plant, as they undertake very long journeys every year to obtain its fruits. The missionaries and the indigenous people living along the banks of the Orinoco and its neighboring rivers would each receive a quantity of young *Bertholletia* trees, which they would no doubt cultivate with as much care as they do sugarcane, banana, pineapple, and manioc, from which they derive their main sustenance[7] (Humboldt & Bonpland 1808–1809, vol. I, 126).

In Brazil, due to intense deforestation of native habitats for soy plantations and cattle production, *B. excelsa* is protected by national laws but remains at risk of extinction (WWF 2020). Brazil nuts are an emblematic example of a non-timber forest product embedded in the context of the bioeconomy, a concept that generally seeks to combine income generation with the sustainable use of biodiversity, often rooted in traditional knowledge and legacy. In the Brazilian Amazon, the extraction of Brazil nuts not only plays a crucial role for Amazonian traditional communities as an economic activity but also serves as an integrative element that connects collectors, intermediaries, and end consumers in small local, national and international markets, and pharmaceutical and cosmetics industries. This value chain promotes income generation, creates jobs, and fosters environmental conservation while simultaneously reinforcing sustainability and valuing the traditional management of forests, contributing to the preservation of the Amazon biome (Viteri et al. 2023; Silva et al. 2024a).

7 Original quote: "Il seroit facile et peu coûteux aux Espagnols habitant les bords de l'Orénoque et toute la province de la Nouvelle-Andalousie, de multiplier un arbre dont l'utilité est si marquée. Le meilleur moyen, à mon avis, seroit d'envoyer quelques hommes intelligens et de bonne volonté, dans les lieux même où croit naturellement cet arbre; là ils ramasseroient des milliers de graines dont la germination seroit déjà commencée, et les mettroient en pépinière dans des caisses remplies de la même terre où elles ont commencé à végéter. Le transport seroit facile, et n'offre aucun inconvénient; il se feroit sur des trains en forme de radeau, qu'il faudroit avoir la précaution de couvrir avec des feuilles de Palmier, afin de préserver les jeunes plantes des rayons brûlans du soleil. Les naturels, adroits à naviguer sur l'Orénoque et accoutumés à conduire des trains, seroient les pilotes; ils sont assez intelligens pour qu'on puisse leur en confier le soin, et connoissent d'ailleurs l'extrême utilité de cette plante; car ils font tous les ans des voyages très-longs pour s'en procurer les fruits. Les Missionnaires et les Indiens qui habitent les bords de l'Orénoque et des rivières voisines, recevroient chacun une quantité de jeunes *Bertholletia,* qu'ils cultiveroient sans doute avec autant de soins que la canne à sucre, le Bananier, l'Ananas et le Manyot, d'où ils tirent leur principale nourriture."

"Guaco"

Mikania guaco Bonpl., known as "vejuco del guaco" or simply "guaco", was seen by Humboldt and Bonpland in Colombia, in the small village of Turbaco, located a few leagues south of Cartagena de Indias, cultivated in the garden of Don Ignacio Pombo, who had obtained seeds of it from Santa Fé de Bogotá (currently, Bogotá). They knew the medicinal properties directly from conversations with the botanist José Celestino Mutis[8], which antiophidian properties of the leaves were tested in many experiments by him and other naturalists like Francisco Antonio Zea, Pedro Vargas and Francisco Javier Matís (Humboldt & Bonpland 1808–1809, vol. II, 86).

Local Colombian legends about the medical properties of *M. guaco* claimed that a black man observed an eagle called "guaco" eating *Mikania* leaves just after being bitten by a snake. This man told his secret to Matís, who proved for himself the *Mikania* properties using crushed leaves after being bitten by a snake (Perez-Arbeláez 1978).

In ATJ, Humboldt reported the difficulty of observing this species occurring spontaneously in nature since they observed it cultivated in gardens:

> Since Mutis gave so much fame to the "vejuco del guaco", everyone claims to have discovered it everywhere. They claim to have it in Caracas and on the Guayaquil River. But it is another plant, *Eupatorium.* We have not seen the true "guaco" on the Guayaquil river nor throughout the route from Almaguer to Lima[9] (Humboldt 2003, 291).

The juice or the decoction of "guaco", when taken internally, nullifies the harmful effects of snake bites. The amount to be taken of this juice or decoction has not been determined; however, when one needs to use it after being bitten by a venomous animal, it is very useful to also apply a poultice made from the leaves of this plant to the injured area and to renew it frequently (Humboldt & Bonpland 1808–1809, vol. II, 86).

Bonpland described the most prominent characteristic of the plant as its strong, penetrating, and nauseating aroma, attributing its medicinal properties to this odor (Humboldt & Bonpland 1808–1809, vol. II, 86). And he was right! The aroma is caused by a compound called coumarin (1,2-benzopyrone), which possesses anticoagulant properties, partially explaining its antiophidian efficacy (Mourão et al. 2014; Della Pasqua et al. 2019).

In Brazil, the most common species known as "guaco" are *Mikania glomerata* Spreng and *M. laevigata* Sch.Bip. ex Baker, widely used as ingredients in traditional remedies and phytomedicines to treat respiratory diseases due to their expectorant, mucolytic, and bronchodilator properties. Interestingly, both species have been historically documented by many 19th-century naturalists as antiophidian plants. However, there is no historical evidence linking them to respiratory benefits, even though pharmacological studies have confirmed their efficacy and safety in this regard (Maiorano et al. 2005; Napimoga & Yatsuda 2010; Collaço et al. 2012; Bertol et al. 2024).

8 Humboldt and Bonpland visited Mutis in Bogotá during July and September of 1801.

9 Original quote: "Depuis que M[onsieu]r Mutis a donné tant de réputation au Vejuco del Guaca on veut l'avoir découvert partout. On prétend l'avoir à Caracas, ici au Río de Guayaquil. Mais c'est une autre, Eupatorium. Nous n'avons pas vu le vrai Guaca ni au Río de Guayaquil ni dans toute la route depuis Almaguer à Lima."

"Chica"

Indigenous people in Venezuela referred to *Fridericia chica* (Bonpl.) L. G. Lohmann as "chica," while in Brazil it is known as "crajirú". In his JB, Bonpland described how the Piaroa Indians cooked the leaves in water with other plants and the bark of a tree similar to the "chaparro de manteca" (Bonpland supposed to be a *Malpighia* species) to create a type of paste (Bonpland 1799–1804, 148). This paste, with its dark red color, was highly prized by various indigenous groups, particularly the Otomacos, Caribes, and Salivas. The Caribes used "chica" diluted in water to color their heads, the Salivas covered their entire bodies with it, and the Otomacos applied it to their faces while painting bluish spots on their chests and arms using the fruits of *Genipa americana* L. (Rubiaceae) (Humboldt & Bonpland 1808–1809, vol. I, 109–110).

From Humboldt's notes, it is evident that there was a local trade among different indigenous ethnic groups involving this highly esteemed natural product. Those who could afford it painted their bodies red using "chica":

> All Caribe people are dyed red with Onoto *(Bixa),* and wealthier ones with Chica *(Bignonia).* Thus, a profitable trade exists with Chica cakes, which, out of self-interest, certain missionaries from Atabapo and Alto-Orinoco send to Bajo-Orinoco. A Caribe needs one peso's worth of Chica cake to fully dye himself – an expensive "clothing" that is ruined by a single rain shower[10] (Humboldt 1798–1805, 88v; Humboldt, 2000, 345).

Indigenous people of San Fernando de Atabapo also made "chica", but it was of inferior quality and much less esteemed. The way they made it and the ingredients they used were also different. Only the leaves of *F. chica* formed an ideal paste (Bonpland 1799–1804, 148).

The red color given by "chica" is related to the anthocyanidins named carajurin and carajurone, which stains the skin with a brilliant red shade (Chapman et al. 1927; Zorn et al. 2001; Silva-Silva et al. 2021).

Regarding medicinal properties, Bonpland described that the Spanish colonizers living in the city of Angostura (currently Ciudad Bolívar, Venezuela), then the capital of Spanish Guayana, symbolically referred to it as the "capital of the Orinoco", used "chica" as diuretic activity after diluting it in water; such activity confirmed nowadays (Amaral et al. 2012). At the same time, diluted "chica" was used as a refreshing beverage (Humboldt & Bonpland 1808–1809, vol. I, 110; Bonpland 1799–1804, 148).

In traditional Brazilian medicine, the leaves of *F. chica* are used to treat intestinal colic, diarrhea, uterine inflammation, anemia, and as a healing agent for skin diseases. Additionally, they are used for their insect repellent and photoprotective properties. Preliminary pharmacological studies have demonstrated the anti-inflammatory, wound healing, and antioxidant properties of this species (Behrens et al. 2012; Batalha et al. 2022).

10 Original quote: "Alle Cariben sind roth gefärbt durch Onoto *(Bixa),* reichere durch Chica *(Bignonia);* deshalb ein einträglicher Handel mit den Chica-Kuchen welche aus Eigennutz der Malern günstige Missionäre von Atabapo und Alto-Orinoco nach Bajo-Orinoco senden. Ein Caribe bedarf für einen peso Chicakuchen, um sich ganz zu färben; kostbare Kleidung und in einem Regenguß verdorben."

Same plant species and same uses, but different names in different territories

"Cupana"

"Guaraná", *Paullinia cupana* Kunth (Sapindaceae), is a Brazilian Amazonian native species, whose seeds are very appreciated for their stimulant properties in Brazil due to their high caffeine content (average 5%) (Marques et al. 2019). The English naturalist Richard Spruce reported that Humboldt and Bonpland described for the very first time *P. cupana* and discovered another very limited habitat for this species in Venezuela, between the Orinoco and Negro rivers. The German naturalist Carl F. P. von Martius also described this plant years later and named it *P. sorbilis,* but recognized the former name described by Humboldt, Bonpland and Kunth (Cruls 2003; Spruce 2006).

Indigenous people living on the banks of the Orinoco River, Venezuela, named this species "cupana" as well as the beverage prepared with its seeds. In his ATJ, Humboldt described the stimulant effect drinking "cupana" caused in the indigenous people, an effect directly related to the psychostimulant activity of caffeine:

> A little Cupana is distributed among 8–12 people. (...) voices came from every corner, as the Indians greatly enjoy conversation before and after sleep. Only from 8 to 1 o'clock does everyone sleep; during the remaining time, they climb in and out of their hammocks, light fires, and prepare Cupana ...[11] (Humboldt 1800–1801, 78r, 82v–83r; Humboldt 2000, 300, 304–305).

Bonpland described the method of preparation of "cupana" in JB, which consisted basically in a fermentative process, named by him as "putrefaction":

> The Indians grate the seeds, (...) wrap them in palm or banana leaves and put them in water until the mass acquires a certain degree of putrefaction. Then they pull it out (it has turned saffron yellow) and dilute it in water to drink. It's a very bitter drink[12] (Bonpland 1799–1804, 84).

The stimulant use by indigenous people from the Sateré-Mawé ethnicity in the Brazilian Amazonian rainforest is well documented by many travelers and naturalists, including the first reports by the missionary João Felipe Bettendorf in 1699 and also by von Martius, author of the monumental *Flora brasiliensis* (Schimpl et al. 2013). In this ethnic culture, the preparation of "guaraná" beverages was an exclusively female task, intended to provide strength and vigor to indigenous male warriors (Smith & Atroch 2010). The Brazilian propagandist Baron de Santa-

11 Original quote: "Ein bißchen Cupana wissen sie unter acht bis zwölf Personen zu vertheilen. (...) aus allen Ecken sprach es, denn die Indianer lieben sehr die Conversation vor und nach dem Schlaf. Nur von 8–1 Uhr schlafen alle, in [der] übrigen Zeit steigen sie in die Hamake ein und aus, machen Feuer an, bereiten Cupana ...".

12 Original quote: "Les indiens râpent les Semences[,] les unissent à du Cassavé pur les envelop[p]er ensuitte dans des feuilles de palmiers ou de bananiers et les mettre dans l'eau jusqu'à ce que la masse acquière un certain degré de putréfaction. Alors ils la tirent (elle est devenue jaune du safran) et la délayent dans l'eau pour la boire. C'est une b[oisson] très amère."

Anna Nery reported Brazilian indigenous procedure for preparing “guaraná” for stimulant purposes in his book “Les Pays des Amazones” (Silva et al. 2024b):

> Its seeds are used to create a stimulating beverage (...) by lightly roasting the beans, after drying them in the sun, and reducing them, with the addition of a small amount of water, to a paste to which whole or crushed seeds are added as desired. The guaraná paste is exported in the form of very hard sticks, with a reddish-brown color. (...) The inhabitants of the region prepare the beverage by grating the guaraná with the dried tongue of the pirarucu fish *(Arapaima gigas)*[13] (Figure 2) (Santa-Anna Nery 1885, 92).

Fig. 2: “Cupana”/“Guaraná” *(Paullinia cupana)*: 1) pirarucu fish tongue; 2) “guaraná” stick; 3) dried “guaraná” seeds. (Leopoldo C. Baratto).

13 Original quote: “Avec ses graines on compose une boisson stimulante (...). On le prépare en torréfiant légèrement ses graines après les avoir séchées au soleil, et en les réduisant par l’addition d’une petite quantité d’eau en une pâte dans laquelle on introduit des semences entières ou concassées, ad libitum. La pâte de guarana est exportée sous forme de saucissons très durs, d’un brun rouge, foncé extérieurement. (...) Les gens du pays le préparent en le râpant avec la langue desséchée du pirarucú.”

“Onoto”

The Amazonian species *Bixa orellana* L. (Bixaceae) (Figure 3) is known in Brazil as “urucum” and as “achiote” in Spanish-speaking countries. In addition to “chica”, many indigenous people from different ethnicities in Amazonia paint their bodies red using “urucum” seeds – together with the black pigment from jenipapo *(Genipa americana),* as part of cultural traditions.

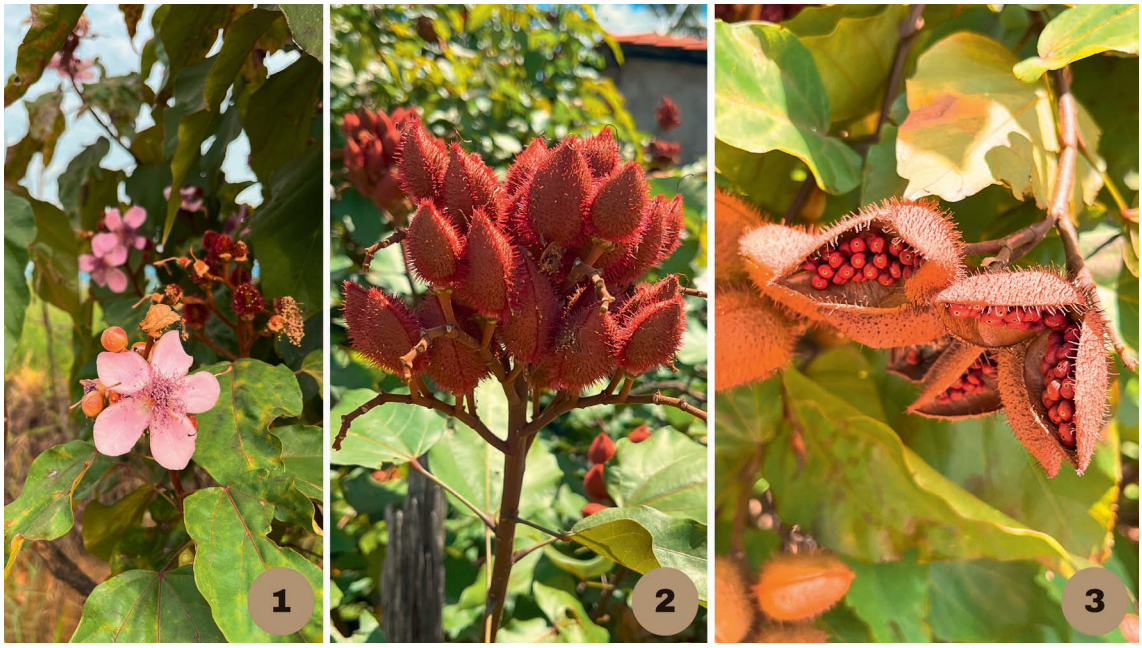


Fig. 3: “Onoto”/”Urucum” *(Bixa orellana)*: 1) flower; 2) a branch with fruits; 3) opened fruit and seeds. (Leopoldo C. Baratto).

Humboldt described in many entries of his ATJ that the indigenous people used a preparation known as “onoto”, made of *B. orellana* seeds and crocodile fat[14], used to spread over the body due to repellent and photoprotective activities.

> Otomacos, Yaruros, and Caribes – only these three nations – have we seen so far painting their entire bodies red, always with Onoto (i.e., *Bixa* and Caimán fat), [it is used] for soothing, against insects and during festivities[15] (Humboldt 1800–1801, 51v/52r; Humboldt 2000, 274).

14 Humboldt mentioned in ATJ “caiman”, which refers to a crocodile species: “Eine indische Nazion am Orinoco nährt sich hauptsächlich vom Fett der Caimans *(Crocodilus alligator)* das sie mit einer Thonerde mischen und in Kugeln essen (…).” (Humboldt 1799, 50r). The same information was consulted in the transcribed version in edition humboldt digital (https://edition-humboldt.de/v10/H0016412/50r). Seijas (2001) and Otto & Hoogesteijn (2017) discussed Humboldt’s descriptions and impressions about “Caimans”.

15 Original quote: „[…] haben wir bisher nur bemalt gesehen drei Nazionen: Otomacos, Yaruros und Caribes […], nur diese drei, aber diese [haben] den ganzen Körper roth, stets mit Onoto (i. e. *Bixa* und Manteca de Caimán); Kühlung und gegen Insekten, und an Festtagen …“.

> He, his people, with their arrows and canoe, stained everything with Onoto (...), partly out of vanity, partly for protection against insects and the sun[16] (Humboldt 1800–1801, 28; Humboldt 2000, 254).

Onoto was also used as red pigment for dyeing fabrics or even for an ancestral tradition of the Indians of the Atures region for dyeing the bones of the skeletons of the dead stored in baskets made from palm leaves called "mapiro" (Humboldt 1800–1801, 106r; Humboldt 2000, 324).

The red pigment extracted from "urucum" seeds is attributed to bixin, a carotenoid compound with prominent antioxidant activity. This dye is broadly used in the pharmaceutical, cosmetics, food, ornamental, and textile industries, accounting for approximately 70% of all-natural coloring agents consumed globally. Bixin has anti-aging potential by inhibiting enzymes like collagenase, elastase, and hyaluronidase, which degrade structural components of the skin; photoprotective properties preventing UV-damages to the skin; and anti-inflammatory activity, reducing the synthesis of pro-inflammatory substances, and for that reason, nowadays is a prominent ingredient of anti-aging cosmetics, makeups, and sunscreen formulations (Ashraf et al. 2023; Kapoor et al. 2023).

"Caruto"

Genipa americana L. (= *Genipa caruto* Kunth; *Genipa americana* var. *caruto* (Kunth) K. Schum.), in its turn, was known as "caruto" in the Orinoco region, while in the Brazilian Amazonian rainforest the plant is known as "jenipapo". The fruit of this species was used as black body pigment by indigenous people of the upper Orinoco and Rio Negro, while from the leaves, according to Bonpland, they extracted a substance used to dye blue, primarily for painting their faces (Bonpland 1799–1804, 152). The Caribes painted their faces black, especially their eyebrows, merging them into one, giving them a sinister appearance (Humboldt 1798–1805, 88v; Humboldt 2000, 345).

It is known that the unripe fruits of "jenipapo" provide a blue pigment called genipin, an iridoid formed through the hydrolysis of its glycoside geniposide. Upon contact with skin proteins and exposure to air, it oxidizes and turns black. Body paintings made with "jenipapo" resemble tattoos, and due to the interaction of the dye with skin proteins, the pigment can last up to 20 days (Vanuchi & Braibante 2018).

"Yuca"

Manihot esculenta Crantz (= *Janipha manihot* (L.) Kunth) (Euphorbiaceae), described as "yuca", "jucca", "jucca amarga", "manihot", "manioc" or "cassava", was a very popular edible root, very common in the whole Amazonian region. The plant was considered poisonous when consumed fresh; that is the reason it was necessary to boil or cook the plant parts. The juice of "yuca amarga" was known as "jahre" ("yare"), consumed just after boiling. In Jamaica, an antidote was learned from pigs: they died if they ate washed "cassava", but if they ate it with soil, they did not. Common soil was given with water, and the convulsions stopped within half an hour. Finally, castor oil was given so that the soil expanded. The Scottish doctor George Faquhar saw

16 Original quote: "Er, seine Leute mit Pfeilen und seine Curiara, alles mit Onoto bestrichen. [...] Theils Eitelkeit, theils um sich gegen Ungeziefer und Sonne zu schützen."

many hundreds of people cured this way who experienced truly violent convulsions, intermittent pulses, and cold, clammy sweat (Humboldt 1799, 55r[17]).

A hundred years earlier, the German naturalist Maria Sibylla Merian, during her expedition to Suriname (1699–1701), reported that the juice of *M. esculenta* was a deadly poison. In the same manner as reported by Humboldt, native and local people of Suriname informed Merian that the juice after boiling became an extraordinary beverage (Mariath & Baratto 2023). It is known that cyanogenic glycosides are found in high percentages in their roots and leaves, such as linamarin and lotaustralin. These active constituents have neurotoxic and neurological effects because, after undergoing hydrolysis, they release cyanide derivatives. Cyanogenic compounds need to be removed by peeling, boiling, fermenting, and cooking the plant, with a loss of up to 70% of these toxic substances (Rivadeneyra-Domínguez & Rodríguez-Landa 2020).

In Brazil, *M. esculenta* is a part of the daily nutritional diet of the Brazilian people, known as "mandioca", "macaxeira" or "aipim", vernacular names of indigenous origins. The roots are a rich source of carbohydrates, eaten cooked or as flour and tapioca. Indigenous ethnicities used to prepare a fermentative alcoholic beverage called "cauim" from the roots. "Tucupi" is another product derived from "cassava" roots, obtained after grating and compressing the raw material and boiling the liquid that can be used in many different recipes. The leaves are also eaten, after cooking, in a very traditional recipe from Pará called "maniçoba" (Mohidin et al. 2023; Silva et al. 2024b).

Same name and same use, but different plants

"Curare"[18]

Humboldt annotated in ATJ that curare seems to have been known in the American river lands for millennia (Humboldt 1800–1801, 116r; Humboldt 200, 337). Curare was a kind of poison prepared by indigenous people from the barks of stems and roots of "vejuco de mavacure", the liana species *Strychnos guianensis* (Aubl.) Mart. (Loganiaceae). Curare was applied in arrow tips for hunting small animals that died paralyzed due to the acetylcholine receptor-blocking effect of compounds like guiaflavine (Penelle et al. 2001).

According to Humboldt, the best curare was made by the indigenous people of Mandavaca, at the Casiquiare River, and the areas above Esmeralda. Humboldt was the first European to watch curare preparation step-by-step in Esmeralda (Venezuela) (Figure 4):

> As the indigenous people had just returned from the 'juvia' harvest, they also brought large bundles of mavacury (as they also call 'curare de vejuco') along with the famous caricas, blowgun tubes. (…) The leafless vine, with branches about a quarter-inch thick, is

17 The same information was consulted in the transcribed version in edition humboldt digital (https://edition-humboldt.de/v10/H0016412/55r).

18 It is important to highlight that the descriptions of curare in Humboldt's travel journals and in his *Personal Narratives* have already been extensively analyzed by many other authors. I recommend consulting some of the references I have used to discuss this topic in the present article, such as the insightful book chapter by Hein (1987) and the articles published by Bisset (1992), Sánchez (2005), and Lienhart (2009).

> used either fresh or dried. The bark (epidermis and cortex) is scraped off with a knife, and only this, along with a part of the sapwood, contains the lethal poison. The scraped bark is crushed in a stone mortar (a type of grinding stone), and this fibrous material is placed into a funnel. This funnel, about 4 inches wide and 9 inches tall, is the most ingenious element of the entire operation, and the indigenous man was very proud of its construction. It was made of rolled palm leaves and reinforced with thin sticks (palm petioles or, more often, leaf rachises). Into the funnel, water is poured over the crushed mavacury bark, and this water slowly drips out over 1 to 2 hours. This yellowish water (a cold infusion) is the venom itself. It is then boiled (like molasses or sugar juice), but even when concentrated, the curare would still be too liquid to adhere to arrows. For this reason, the juice extracted from the 'kiracaguero' is prepared in a separate container – a sticky juice from a tree with large leaves that we could not see fresh (as it was far away and without flowers). While the curare infusion is being boiled, the sticky juice ('jugo pegajoso') from the 'kiracaguero' is poured into the boiling mass. Immediately, the curare thickens and is then cooked until it becomes a black substance[19] (Humboldt 1800–1801, 113r–113v, 116r; Humboldt 2000, 336–337).

It is interesting to note how Humboldt described the personality of the master of curare with a certain disdain, how the preparation of the poison was considered something special in a hierarchical local context, and how resistant the indigenous man was to sharing this knowledge with a foreigner:

> With great effort, we managed to convince an Indigenous man, who mysteriously called himself 'Amo del Curare' [Master of Curare] and asked us to write his name to the king so that the king would know who, in Esmeralda, was the only one who knew how to prepare curare (which he considered superior to any gunpowder), to begin the process. (…). Finally, the process began, and despite all the praises that the vain chemist lavished upon himself, it is extremely simple[20] (Humboldt 1800–1801, 113v; Humboldt 2000, 336).

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19 Original quote: "Da [die] Indianer eben von der Juvía-Erndte zurükkamen, so brachten sie ebenfalls ganze Bündel von Mavacury (so nennt man hier auch den Curare de Bejuco) mit, wie auch die berühmten Carices, Röhre (Cannes) zu Cervatanas. (…) Der blattlose Bejuco, ein viertel Zoll dicke Zweige, dient frisch und alt. Man schabt mit einem Messer die Rinde (epidermis und cortex ab), und diese alleine mit einem Theil des Splintes enthält den fürchterlichen Saft. Die geraspelte Rinde wird in einem steinernen Mörser ([eine] Art Reibstein) zerquetscht und dieses Fasergewebe in einen Trichter geschüttet. Dieser Trichter, 4 Zoll weit und 9 Zoll hoch ist das künstlichste der ganzen Operation, und der Indianer wußte sich nicht wenig mit der Verfertigung dieses Trichters. Er war von Palmblättern zusammengerollt, die durch feine Stäbe (petioli palmarum oder mehr rhachides foliorum) unterstützt waren. In den Trichter wird auf die zerquetschte Mavacuririnde Wasser gegossen, und dieses tröpfelt in 1–2 Stunden durch. Dieses gelbliche Wasser (ein kaltes infusum) ist das Gift selbst. Man kocht es (wie Melado oder Zuckersaft) ein, aber verdickt wäre der Curare noch zu flüssig, um auf den Pfeilen zu haften. Man bereitet deshalb in einem besonderen Gefäße den ausgepreßten Saft des Kiracaguero, ein klebriger Saft von einem großblättrigen Baume, den wir (der Entfernung wegen, in der man ihn holte, und da er ohne Blüthe war) nicht frisch sahen. Indem man den Curare, das Infusum, einkocht, wird in die kochende Masse der klebrige Saft (jugo pegagoso) des Kiracaguero gegossen. Augenbliklich verdickt sich der Curare, und man kocht ihn nun zu einem schwarzen klebrigen Brei an (…)."

20 Original quote: "Mit großer Mühe erlangten wir es, daß der Indianer, der sich sehr mysterieus den 'amo del Curare' nannte und uns bat, seinen Namen dem König zu schreiben, damit dieser wisse, wer allein in Esmeralda den Curare (den er über alles Schießpulver erhob) zu bereiten ver-

Fig. 4: Preparation of curare according to Humboldt's description: 1) The stem barks of *Strychnos guianensis* are scraped; 2) The scraped bark is crushed in a mortar; 3) The crushed plant material is placed into a funnel, and water is poured over it; 4) After 1 to 2 hours, a yellowish liquid drips slowly, which is then boiled; 5) The latex ("sticky juice") from "kiracaguero" is added to the boiling yellowish liquid; 6) The curare mixture thickens and darkens; 7) Indigenous people apply this dark, sticky mass to arrow tips for hunting small animals (Leopoldo C. Baratto. Artificial intelligence images were created with ChatGPT 4.0, and the scheme was edited using Canva).

In his *Personal Narrative,* Humboldt elaborated further on the personality of the Master of Curare, who appeared to be highly aware of the significance of his knowledge, which had been passed down through generations:

> He had that self-sufficient air and tone of pedantry, of which the pharmacopolists [sic] of Europe were formerly accused. "I know," he said, "that the whites have the secret of fabricating soap, and that black powder, which has the defect of making a noise, and killing animals, when they are wanted. The curare, which we prepare from father to son, is superior to anything you can make down yonder (beyond sea). It is the juice of a herb, which kills silently (without anyone knowing whence the stroke comes) (Humboldt et al. 1821, 517).

These passages from the ATJ and *Personal Narrative* show us some interesting aspects. First, Humboldt's judgment regarding the complexity of the method. In a so-called civilized position as a European man of science, the description of the indigenous person was underestimated. But on the other hand, from a possible point of view, Humboldt defined that person as a chemist, even though it may sound ironic, perhaps because he knew that the preparation of the poison was a chemical extraction process. But the most fascinating thing is the consciousness of the indigenous man about his knowledge, as the real owner, ordering Humboldt to tell the king he was the possessor of that information.

> stehe, wir erlangten mit Mühe, daß dieser Chymist seinen Proceß anfing (...) Endlich begann der Proceß, der überaus einfach ist, so viel Rühmens der aufgeblasene Chemist auch davon machte."

Humboldt reported that curare remains equally potent and effective for 3 to 4 years, hardens, and must be moistened with water to be reactivated. Even without any knowledge of physiology at the time, people knew that curare was toxic only when it came into direct contact with the bloodstream. If ingested, no poisoning was observed. On the contrary, people who wanted to purchase curare needed to taste its bitterness, as the more bitter it was, the better its quality (Humboldt 1800–1801, 116r, 116v; Humboldt 2000, 337–338). Actually, curare was used by the indigenous people in Esmeralda as an excellent stomachic when administered internally (Humboldt et al. 1821, 522).

There was a general belief that salt served as an antidote to curare intoxication, which Humboldt described as false. People believed salt could help partly prevent intoxication from weak curare if ingested, and especially if applied to the arrow wound very soon after the injury. However, for properly prepared curare, there was no cure. The symptoms were similar to those of a snake bite: immediate dizziness, nausea, an urge to vomit, stomach pain, and numbness in the wounded limb (Humboldt 1800–1801, 116r; Humboldt 2000, 337).

> While we were in Maypure, a carpenter as strong as a tree (Zambe) fainted from dizziness after touching curare with injured fingers while poisoning arrows. Since the curare was weak, he recovered by drinking brandy – stimulation using asthenic means against complete paralysis and the death of irritability[21] (Humboldt 1800–1801, 116v; Humboldt 2000, 338).

Even Humboldt himself faced danger when he was on the Orinoco River, between San Fernando and Atures:

> A 'tapara' with curare had been moistened, opened, and spilled onto my clothes. We immediately washed all the clothes but did not notice that the inside of the nankin trousers was also stained with curare. I had four open, bleeding wounds from sand fleas on one of my toes and was about to put on the trousers when, by chance and to my salvation, I felt the sticky curare with my hand. Great care must be taken when storing curare[22] (Humboldt 1800–1801, 116v; Humboldt 2000, 338).

Humboldt and Bonpland also learned about the poisons made by the Tikunas, Yaguas, Pebas, and Jivaros, previously encountered by 18th-century explorers such as La Condamine (Bisset 1992). Tikunas indigenous people, who lived independently on Spanish territory and some inhabited Portuguese missions, used to prepare curare using the juice of a plant called "vejuco de ambihuasca" mixed with other vegetal materials (Humboldt et al. 1821, 524). According to Bisset (1992), "vejuco de ambihuasca" was the species *Chondrodendron tomentosum* Ruiz &

21 Original quote: "Während wir in Maipures waren, fiel in Schwindel ein baumstarker Zimmermann (Zambe) nieder, weil er mit verwundeten Fingern Curare berührt, um Pfeile zu vergiften. Da [der] Curare schwach war, so heilte er sich bloß durch Brandtweintrinken; also bloß Reiz, sthenischer Mittel gegen völlige Lähmung, gegen Tod der Reizbarkeit."

22 Original quote: "Ich lief im Orinoco zw[ischen] S[an] Fernando und Atures große Gefahr. Ein[e] tapara de Curare war befeuchtet, hatte sich geöfnet und floß in Wäsche aus. Wir ließen sogleich alle Wäsche reinigen, aber wir bemerkten nicht, daß der Fuß Nankinner pantalons ebenfalls inwendig mit Curare beschmiert war. Ich hatte vier ofne blutige niguas-Wunden in einem Zeh und wollte eben die Pantalons anziehen, als ich zufällig und zu meiner Rettung den klebrigen Curare mit der Hand fühlte. Große Vorsicht ist bei [der] Aufbewahrung des Curare nöthig."

Pav. (Menispermaceae). Indigenous people in Brazilian Amazonia prepared their curare by mixing many different toxic species with stems of *C. tomentosum,* whose main compound is tubocurarine, a quaternary alkaloid that is an acetylcholine blocker receptor, causing paralysis and death (Lüllmann et al. 2000, 184–185).

The discovery of the mechanism of action of quaternary alkaloids from curares, like tubocurarine from *C. tomentosum* and guiaflavine from *S. guianensis,* was fundamental for the development of physiology and pharmacology as scientific areas starting in the 19th century. Tubocurarine, for instance, was isolated in 1935, and it was used as a muscle relaxant agent in pre-surgery procedures, but the side effects led scientists to change chemically this compound to find new, more effective and safer drugs, like decamethonium, suxamethonium and atracurium (Penelle et al. 2001; Bolzani et al. 2012; Barreiro 2019).

The list of Brazilian native plants mentioned in the ATJ and JB by Humboldt and Bonpland could be longer. To date, I have collected and systematized information on approximately 300 useful species, among which many Brazilian species have been recognized. Interestingly, Bonpland focused much of his efforts on detailed botanical descriptions, with tentative botanical identifications in the field, including a reasonable number of traditional uses. Notably, the JB also contains a few handwritten notes and drawings by Humboldt. In contrast, ATJ reflects Humboldt's attentiveness to documenting the traditional knowledge he encountered, consistently mentioning the uses of plants according to indigenous tribes or Spanish-descendant settlers. Most of the time, the plants in ATJ were identified by their vernacular names or by their genus without epithets. Remarkably, the same plants mentioned in ATJ and described in JB often share similar observations regarding traditional uses, demonstrating that both naturalists indeed exchanged and worked together. In this sense, to gather information on useful plants collected during the American expedition, it is essential to analyze both travel journals concurrently.

A preliminary list of other Brazilian useful plants[23] registered in the ATJ and JB is given below:

a. *Baccharis sagittalis* (Less.) DC. (= *Baccharis genistelloides* Poepp. ex DC.), Asteraceae. [Brazil = "carqueja"] – JB 2097;
b. *Carapichea ipecacuanha* (= *Cephaelis ipecacuanha* (Brot.) Willd.), Rubiaceae. "Raicilla" [Brazil = "ipeca", "ipecacuanha", "poaia"] – JB 1551;
c. *Cissus verticillata* (L.) Nicolson & C.E.Jarvis subsp. *verticillata* (= *Cissus smilacina* Kunth; *Cissus sicyoides* L.), Vitaceae. "Fuente" [Brazil = "cipó-pucá", "insulina"] – ATJ IV 38v; JB 35;
d. *Dipteryx odorata* (Aubl.) Forsyth f., Fabaceae. "Falsa cimaruga", "falsch cimaruva", "serape", "jape", "yape" (indigenous people in Carichana), "cimarubajape" (Salivas), "guavi" (Caroni) [Brazil = "cumaru"] – ATJ IV 38v, JB 827;
e. *Erythrina velutina* Willd., Fabaceae= "Bucare", "bucaré de anaoucho" [Brazil = "mulungu"] – ATJ III 66r, JB 653;

23 Plant species are designated by their updated botanical names according to Kew's Plants of the World online (POWO) (in parenthesis, synonyms used by Humboldt or Bonpland), followed by the botanical family. Original vernacular names cited by both naturalists are in quotation marks and Brazilian vernacular names are in brackets. Sources of the species in travel journals are specified as ATJ (Humboldt's American Travel Journal) and JB (Bonpland's Journal Botanique), followed by folio or collection number, respectively.

f. *Hevea brasiliensis* (Willd. ex A.Juss.) Müll.Arg. (= *Siphonia brasiliensis* Willd. ex A.Juss.), Euphorbiaceae. "Iacio", "jacio", "dapicho" (Indians of the Orinoco), "guamaqui" (Spanish), "payra" (Caribes), "chaabi" (Maravitanos and Maypure's Indians), rubber tree [Brazil = "seringueira"] – JB 948, 1022;
g. *Hymenaea courbaril* L., Fabaceae. "Algarrobo" [Brazil= "jatobá"] – ATJ III 62v, ATJ IV 52 r, JB 828;
h. *Dianthera pectoralis* (Jacq.) J.F.Gmel. (= *Justicia pectoralis* Jacq.), Acanthaceae. [Brazil = "chambá"] – JB 1438, 1567;
i. *Maclura tinctoria* (L.) D.Don ex G.Don (= *Broussonetia tinctoria* (L.) Dum.Cours.), Moraceae. "Chyaragouaja", "charaguanaye" [Brazil = "tatajuba-de-tinta"] – ATJ I 38r, JB 37;
j. *Leopoldinia piassaba* Wallace, Arecaceae. "Chiquichiqui" [Brazil = "piaçava"] – ATJ IV 78r, 102v, 201;
k. *Mauritia flexuosa* L.f., Arecaceae. "Morichi", "moriche", "merichi", "murichi", "jaraumo", "árbol de vida de los Guaraunos" [Brazil = "buriti"] – ATJ IV 28, ATJ I 55r, ATJ III 53r, ATJ II and VI 211v, 213r; JB 1068;
l. *Oenocarpus bataua* Mart., Arecaceae. "Seje", "sege" ("Quanamari" and "Chimu" in Tamanac language; "Puperri" in Maypurensium language)[24] [Brazil = "patuá", "patauá"] – ATJ IV 78r, 86v, 104r;
m. *Piper marginatum* Jacq. var. *marginatum* (= *Piper anisatum* Kunth), Piperaceae. "anisillo", "anicilo", "anis sauvage" – JB 1056;
n. *Schinus molle* L., Anacardiaceae. "Árbol del Peru" [Brazil = "aroreira-mansa", "aroeira-folha-de-salso"] – ATJ 344[25]; JB 2198;
o. *Spigelia anthelmia* L. (Loganiaceae). "Hierba (yerba) de lombrices" [Brazil = "erva-lombrigueira"] – JB 144, 174;
p. *Spondias mombin* L. (= *Spondias myrobalanus* L.), Anacardiaceae. "Jobo", "ciruela" [Brazil = "cajá", "taperebá"] – ATJ I 38r, JB 750;
q. *Theobroma cacao* L. (Malvaceae). "Cacao", "kakao", "cacavua" (Pareni Indians) [Brazil = "cacau"] – ATJ III 7r, 43v, 68v, ATJ IV 18r, 85v, JB 1102.

Naming the plants after traditional knowledge

Among these Brazilian native plants, the epithets or genera attributed by Bonpland or Kunth to some species draw attention. Although there are very few examples, it is curious that these botanists chose to incorporate the vernacular names used locally in South America into the scientific taxonomy of such species. For instance, species like *Fridericia chica, Mikania guaco, Paullinia cupana,* and *Angelonia salicariifolia* retained their vernacular names – "chica," "guaco," "cupana," and "angelon," respectively.

This fact raises curiosity about why they specifically selected these species and preserved their vernacular names as scientific ones, especially considering that many other species were named after prominent European male naturalists and scholars. For example, *B. excelsa,* known by traditional people in Venezuela as "juvia," was named *Bertholletia* by Bonpland after the chemist Claude-Louis Berthollet, "to whom they owed so many discoveries and whose current

24 Kunth, Carl S. (1815): Nova Genera et Species Plantarum. Tomus Primus. Lutetiae Parisiorum: Sumtibus Librariae.

25 Humboldt, Alexander von (2003): Reise auf dem Río Magdalena, durch die Anden und Mexico. Aus seinen Reisetagebüchern. Teil I: Texte. (Faak, Margot, ed.) Berlin: Akademie Verlag.

works promise so much in the physiology and chemistry of plants" (Humboldt & Bonpland 1808–1809, vol. I, 125).

Using vernacular names as a basis for creating scientific names is, in a certain way, an acknowledgment of the traditional knowledge of the indigenous peoples who lived in the regions where Humboldt and Bonpland collected these species. In his ATJ, most of the time, Humboldt registered the names of indigenous tribes in a general way (i. e. Caribes, Salivas, Otomacos etc.) and the uses of the plants by them, as well as Bonpland did in JB. Nevertheless, they usually did not register or recognize the exact names of the indigenous, creoles, non-scholar or low social class informants, differently from what they used to do when citing European-descendant, scholar, or rich men. For instance, Bonpland cited the complete name of Don Ignacio Pombo – "a learned merchant and friend of science", in the monograph of *M. guaco* in *Plantes Équinoxiales* (Humboldt and Bonpland 1808–1809, vol. II, 86). In contrast, in ATJ Humboldt mentioned a carpenter in Maypures who almost died with curare, citing him only as Zambe (Humboldt 1800–1801, 116r).

Conclusion

As briefly analyzed, even though Humboldt and Bonpland were not allowed to travel in Brazil, they described in their travel journals and works many examples of useful species from the biodiversity shared by boundary countries. Traditional uses associated with species like *Bertholletia excelsa, Bixa orellana, Fridericia chica, Genipa americana, Manihot esculenta, Mikania guaco, Paullinia cupana* and *Strychnos guianensis,* especially in Venezuela, are described in detail and provide insights to understand the relationship between people and plants at that time. Furthermore, recognizing the uses in former Spanish colonial territories can teach us new possibilities to use these species considering bioeconomy perspectives and conservation strategies in Brazilian territory.

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