Legacies of boldness: Caldas, Humboldt and knowledge about cinchonas, 1801-1821

Legados de la audacia: Caldas, Humboldt y el conocimiento sobre las quinas, 1801-1821

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Abstract

This article examines the circulation of knowledge about *Cinchona* plants. Francisco José de Caldas and Alexander von Humboldt were interested in their taxonomy, distribution, trade, exploitation, production and conservation. The former's observations were better, but his contributions were silenced by Humboldt and other actors such as José Celestino Mutis. Caldas changed from a passive position of accepted subordination to one of self-advocacy, but his arguments were not widely publicized, in part because his results did not favor commercial interests and he lacked connections. Caldas used similar techniques to Humboldt to appropriate and systematize knowledge about cinchonas, silencing various sources.

Keywords: *Cinchona*; botany; biogeography; colonialism; history.

Resumen

El artículo reflexiona sobre la circulación de conocimiento en torno a las plantas de quina. Francisco José de Caldas y Alexander von Humboldt se interesaron por su taxonomía, distribución, comercio, explotación, producción y conservación. Las observaciones del primero fueron mejores, pero sus aportes fueron silenciados por el segundo y por otros actores como José Celestino Mutis. Caldas cambió desde una posición pasiva y de aceptada subalternidad, hasta una de reclamo, pero sus argumentos no tuvieron mayor difusión, en parte porque sus resultados no favorecían intereses comerciales y carecía de redes. Caldas usó dispositivos similares a los de Humboldt para apropiar y sistematizar conocimientos sobre las quinas, silenciando a varias fuentes.

Palabras clave: Cinchona*; botánica; biogeografía; colonialismo; historia.*

> In the history of sciences, it often happens that the person who knows how to diffuse, with a certain degree of boldness, the discovery of another, passes for the discoverer himself, instead of him who made that discovery (Humboldt, 1821, p.28-29).

This article examines the construction of layers of colonialism in the circulation of knowledge, in the case of research on *quina* trees (*Cinchona* spp.) by Francisco José de Caldas (Popayán, 1768 – Santafé de Bogotá, 1816) and the Prussian Alexander von Humboldt (Berlin, 1769 – Berlin, 1859). Caldas was a Creole scientist, who had taught himself geography, botany and astronomy. A disciple of the Spaniard José Celestino Mutis (1732-1808), he actively participated in the Royal Botanical Expedition of the New Kingdom of Granada that ended up in 1810. From 1811 on, he became involved in the struggle for independence, as an engineer; a few years later he was captured and shot. His publications include the *Semanario del Nuevo Reyno de Granada*. Humboldt was a Prussian baron and mining specialist who obtained a passport from the Spanish Crown to travel through its American colonies and assess their mining potential. From 1799-1804, he traveled through what is now Cuba, Venezuela, Colombia, Ecuador, Peru, Mexico and the USA. He carried out geographic exploration, collected botanical and zoological specimens and compiled economic and social observations that he published in various works.

Both men observed and analyzed the taxonomy, phytogeography, history, exploration, production, trade and preservation of the *Cinchona* trees. However, as in other cases, Humboldt did not acknowledge the contributions of his Creole colleague, while Caldas did not acknowledge either the bark-collectors and other local actors who guided him and provided information during his various explorations. There were other actors who appear tangentially in the history covered by this article, especially Mutis, Caldas's superior and mentor, who directed the Royal Botanical Expedition of the New Kingdom of Granada, and who was involved in trading *Cinchona* bark.

This analysis is framed by critical studies of colonialism. It follows the approach laid out by Quijano (2000) on the coloniality of knowledge and various studies of the history of the sciences aimed at constructing narratives that include local actors and their leading role in the processes of technoscience circulation. The idea of circulation is an alternative to the categories of "diffusion" and "reception," among others, in that it acknowledges the complexity of the creation and movement of bodies of knowledge and makes visible the leadership of certain actors who have been usually buried in these narratives.

As regards the circulation of technoscience (which includes innovation, transfer, movement and appropriation of ideas, plants, artifacts and procedures among other aspects), I believe that this occurs as part of a broader process, the colonial fact, which is structured in layers, like the bark of a tree. The layers of colonialism appear throughout this history and new layers are added to existing ones, increasing the complexity of colonialism (Cuvi, 2018). These layers can be long-lasting, as Braudel (nov. 2006) has shown, when they persist over time or recur repeatedly. Even today, layers of colonialism emerge or reemerge in processes of technoscience circulation, adapted to new realities.

The presence of layers of colonialism in discourses and practices can be traced by asking questions such as: Who is claiming authority and prestige? Who acknowledges or fails to

acknowledge whom? What happens to the original knowledge-keepers when they place the knowledge in circulation during field trips, hand over information or make it known publicly? Where is knowledge located and produced around non-human actors such as plants and animals or their derivatives?

In a previous essay, I explored the layers of colonialism in the circulation of knowledge on *Cinchona* plants and their alkaloids, starting with the Jesuits' appropriation of indigenous wisdom in the sixteenth century, to the decline of bark extraction from forests and plantations after the rise of synthetic antimalarials in the second half of the twentieth century. The layers appeared in processes such as the smuggling of Andean seeds abroad, the establishment of colonial plantations in southeast Asia, and the Dutch trade monopoly on the bark from the nineteenth century to the present day. Layers of colonialism can also be seen in the appropriation of natural products and local knowledge, the delocalization and relocation of the locus of authority in relation to them, the burying of local knowledge and their bearers, the insertion of ideas on what should be done with nature, who should appropriate it and how, the non-transference of technology, the encouragement of projects that lack opportunities for success, and the destruction of nature, among other things (Cuvi, 2018); as well as the supplanting and assimilation of knowledge with no credit of their original bearers, the recognition of "proper" knowledge only when mediated, translated or validated in the "centers" of knowledge, according to their canons; also the belief that the original holders of the knowledge will have access to it when translated into new canons (Seth, 2009), or the construction of an idea of what is truth (Nieto, 2019). These layers are linked to the destruction of nature and the idea that it is intended to be dominated and domesticated, the re-situation of ways of obtaining things derived from nature, and biopiracy or the use of new technologies, such as the biomolecular sphere, for relocating things in new places.

These layers structure the colonial fact by inserting themselves into thoughts, subjectivities, bodies, territories and resources, and technoscience helps to achieve this by disciplining knowledge, bestowing it with objectivity and reason, reformulating questions, methods, and objectives, and bringing to the scene machinery, maps, films, articles, books, and lectures that contain and project ideas about what nature is, its purpose, and how to appropriate and transform it.

One of the effects of the layers of colonialism is that the natives or locals in colonial or postcolonial territories become convinced that they lack knowledge or believe that what they know is useless in the light of modernity. An idea is installed that the emissaries and representatives of Eurocentric modernity are the ones who should validate knowledge. Those emissaries, sometimes compared to missionaries, take it upon themselves to uphold these ideas by mobilizing knowledge through devices such as maps, measurements, diagrams, plant specimens etc. After this happens, historical narratives become fundamental to the consolidation of those imaginaries.

Various studies have analyzed the layers of colonialism (without using that term) in the relationship between Caldas and Humboldt, especially as regards the idea of the geography of plants, also known as phytogeography, levelling of plants or, nowadays, biogeography. These studies occasionally speak of theft or appropriation, derivation, mutual influence,

synchrony, or cooperation, among other words, almost always in reference to Humboldt's failure to acknowledge Caldas (Nieto, 2006; Cañizares-Esguerra, 2006; Zimmerer, 2006; Jackson, 2008; González-Orozco, Ebach, Varona, 2015; Gómez-Gutiérrez, 2016, 2019; Valencia-Restrepo, 2018, 2019; Vila, 2018; López-Ocón, 2010; among others). Ideas such as "comprehension" have been suggested by Nieto (2009) to interpret similar processes in the relationship between Europe and America. Researchers have also written about Humboldt's colonial attitude in either appropriating or failing to acknowledge his sources among the scientific communities in Lima (Cushman, 2011) or in general among communities in the Americas. Some decades ago, Brading (1991, p.532) mentioned that "Humboldt can be seen as an inspired editor and commentator, himself figuring as a contributor in the sections on geology and mining, but otherwise engaged essentially in compiling and presenting the collective research and inquiries of an entire generation of Spanish officials and Creole savants."

More recently it has been argued that, like any other traveler, Humboldt was not alone, and that "his work was enriched, nourished and to a certain extent defined by the context in which [he] related to nature and the cultures of the Americas, what his guides showed him, what other travelers had described, or information from local naturalists about Latin American nature" (Nieto, Cueto, 2019).

Studies on Humboldt's failure to acknowledge Caldas are not new. Various critics have presented the former as the silencer and the latter as the one silenced. As far back as 1887, an anonymous author wrote in the *Papel Periódico Ilustrado*, a Colombian publication, that Humboldt never mentioned various gentlemen, among them Caldas, although he used the information they had generously provided him, along with a large amount of data about the country, topography, mines, products, climates etc. (cited in Serje, 2005, p.83). Controversy ensued right from the time of the Prussian's voyages and Caldas's protests, even though the hagiographical view of Humboldt prevailed, one that plays up his virtues and portrays him as a neutral, affable emissary of European technoscience in America. Even today, there are those who believe that Caldas became a Humboldtian (Fernández, 2019, p.80).

Although the historiography around Humboldt, often hagiographic, has constructed narratives that reinforce and, in some cases, inevitably solidify the idea of a wise man who lavished his knowledge on barbarian lands, the current article, like some others cited earlier, resists the reemergence of layers of colonialism in the history of scientific expeditions in the Andes.

The layers of colonialism deployed by Humboldt in his work on cinchonas did not just affect Caldas. The Prussian sided with those who claimed that indigenous peoples of the Andes were unaware of the medicinal properties of cinchonas, claiming that it was mission physicians who discovered them:

> This tradition is less improbable than the assertion of European authors, and among them the late writers Ruiz and Pavon, who ascribe the discovery to the Indians. The medicinal powers of the Cinchona were likewise entirely unknown to the inhabitants of the kingdom of New Granada (Humboldt, 1821, p.22-23).

Although this controversy has lasted centuries, and Caldas's own position was, as I will show, close to the above denial, the authors of various contemporary studies tend to recognize the original knowledge-bearers. Medicinal plants clearly resembling *Cinchona* were documented in the sixteenth century by Nicolás Monardes and Juan Fragoso, protobotanists who compiled information on the natural products that arrived at Europe (Ortiz, 1994). Also, Estrella (1995) provides seventeenth-century evidence in the form of reports by Fernando de la Vega and Miguel de Santistevan on the *Cinchona* forests in Loja. Along the same lines, Crawford (2016) has compiled a series of proofs that the knowledge circulated from local healers to the Spanish.

In what follows, I explain some general issues on cinchonas, the object of hundreds of historical, botanical, chemical, forestry, agricultural and commercial studies. I then analyze some primary and secondary sources that show the layers of colonialism in the relationship between Caldas and Humboldt over these plants. Those sources were obtained in physical archives in Quito, as well as online archives and libraries.

First, however, I want to look more closely at the quote by Humboldt that prefaces this article; it was written in response to a debate about who first discovered *Cinchona* plants in the New Kingdom of Granada. Among other things, it illustrates the facility with which one's words can be used against one. The first phrase is eloquent and unassailable, given what we know about the history of science, while the rest of the text helps us glimpse aspects of scientific controversies, the role of networking, interpersonal tensions, and commercial and personal interests, among other key issues in the history of the cinchonas. The paragraph cited shows Humboldt's support for Mutis as the discoverer of *Cinchona* in that territory. Both Europeans were implacably opposed to the claims of the Creole Sebastián López Ruiz, who had his own supporters in Madrid. Humboldt felt that despite his claims, López Ruiz had been recognized for something he did not deserve. Thus, Humboldt (1821, p.28) wrote, "[i]n the history of sciences, it often happens that the person who knows how to diffuse, with a certain degree of boldness, the discovery of another, passes for the discoverer himself, instead of him who made that discovery."

Cinchona in the history of science

"Quina" is the most common name for the trees and shrubs in the *Cinchona* genus, and some of the *Remijia* and *Ladenbergia* genus whose bark has medicinal properties and are noted for their antipyretic and antimalarial qualities. Another very common local name is "cascarilla" (husk). *Cinchona* bark has four main medicinal alkaloids: cinchonine, cinchonidine, quinidine and quinine, the latter being the most important. Each species has different concentrations of alkaloids, which can vary even within the same species depending on location, altitude, soil type, age of the tree and time of year the bark is harvested. There is also much hybridization between species. Traditionally, species with a higher percentage of quinine have been preferred, although the mixture of all four alkaloids, known as totaquine, obtained from species like *C. pubescens*, was used with good results, especially by the British Empire.

Cinchona has been extensively studied in the history of science and medicine. This research sheds light on the influence of nature, or of non-human actors (plants and alkaloids) in history, or the commercial, economic and political motivations that led to scientific controversies. There were botanical, medical and biochemical debates about taxonomy, the quantity and quality of the alkaloids, who first discovered them, forms of extraction, preservation etc. There were also debates less associated with those issues, although not free of personal conflicts, such as those that arose during the Cinchona Mission in the mid-twentieth century (Camp, 1949; Cuvi, 2011). Various disputes involved religious values, especially during the early years of quinine therapy, when its use was related to the struggles between Protestants and Catholics, or against the Jesuits (Jarcho, 1993). *Cinchona* plants have fueled various historiographic debates, from the centuries-long myth of the Countess of Cinchón, debunked by Haggis (1941), or the debate mentioned earlier over whether indigenous peoples knew about the bark's medicinal properties.

These and other complexities are interwoven in the long history of cinchonas. In part, this helps us understand why Humboldt wanted to leave his mark in this history.

When Caldas and Humboldt started researching cinchonas, there was already a deep indigenous, Creole and European knowledge about them. People knew how to find them in the countryside and there were botanical and commercial descriptions as well as information on how to fell or preserve them. For example, in his *Memoria sobre el corte de las quinas* in the late eighteenth century, Eugenio Espejo (1993) gave an in-depth overview on trade, monopolies, deforestation and other topics.

Much of the knowledge was local. In Loja, where the best bark was found, there were complex social and commercial networks (Moya, 1994). Mutis heard about Loja from several actors, among them Miguel de Santistevan. Various people researched and wrote drafts and books, for example, José Ignacio Pombo (Puig-Samper, 1991). The Creole Carlos Montúfar and his family also knew about cinchonas, in connection with trade. His commercial interests caused him to make a stop in Loja on a trip to Europe, via Lima, with Humboldt. According to Hampe, the "true motivation" for Montúfar's visit to Madrid "was to obtain a special permit for his father, Don Juan Pío Montúfar, to be allowed the privilege of exclusive trade in cinchona from the equatorial Andes ... What his family wanted, then, was to break the Crown monopoly on the benefits of cinchona (which had existed since around 1790) and give the Montúfars the chance to obtain 'very great benefits'" (Hampe, 2002, p.717; emphasis in the original).

Much information, including Espejo's report, cited earlier, was obtained during the creation of a royal monopoly on cinchonas (Puig-Samper, 1991), which was suggested in part to put an end to the problem of adulteration. Thus, both Caldas and Humboldt had access to printed information and actors with empirical knowledge, and both constructed silences about those sources.

Caldas, Humboldt and *Cinchona* research

Like Caldas and many others, Humboldt was interested in the taxonomy, distribution, medical and historiographical controversies and, tangentially, the exploitation and

conservation of *Cinchona* forests. He wrote on the plants in his leading works, even in *Aspects of Nature,* but the two most important sources for the present analysis are (1) the different editions (in Spanish) of his *Essay on the geography of plants,* in which he explained the distribution of various species according to altitude and latitude and (2) a book chapter published in 1821, titled "An account of the Cinchona Forests of South America; drawn up during five years residence and travels on the South American continent."

Even though Caldas spent relatively little time with Humboldt and his French travel companion, Aimé Bonpland, the story of that brief acquaintance has been told many times. Caldas, who was by then a new protegé of Mutis, traveled to the province of Quito to solve a legal problem, and took advantage to get in contact with Humboldt and Bonpland. For several months, they shared lodgings, information and went on field trips together. But apparently their temperaments and interests were incompatible, because when Caldas offered to continue traveling with the Europeans, Humboldt opted instead for a Quito resident, Carlos Montúfar, the son of the marquess of Selva Alegre, a slight which Caldas resented. In 1802, after discovering that he would not be traveling on with Humboldt and Bonpland, Caldas poured out his resentment in various letters (for example, Caldas, 2016i). But he tempered his anger in various spaces and it did not prevent him from staying in touch with Humboldt by letter subsequently. For example, he wrote the Prussian in November 1802, in response to a letter in which Humboldt described his voyage. In it, he called the baron "my beloved and respectable friend" (Caldas, 2016k).

Once separated from the Europeans, Caldas went on various botanical and geographical field trips in the province of Quito and sent his results regularly to Mutis. One of his priorities were the cinchonas, since he was interested in resolving the debate about the distribution range of the different species, in particular the famous "fine" or "true", *Cinchona officinalis*, endemic to the Loja region, where other species also exist. The disagreements between the Royal Botanical Expedition of the New Kingdom of Granada, led by Mutis, and the Botanical Expedition to the Viceroyalty of Peru, led by Hipólito Ruiz and Josef Pavón, are well-known (Fernández, 2019; Fernández, Jiménez, Fonfría, 2004). Both expeditions were commissioned by the Spanish Crown, but they were competing to prove that the territory assigned to each of them contained the best species, especially *Cinchona officinalis*, which was directly tied to commercial interests.

Caldas sent his results to Mutis via letters, plant specimens and notes from what would be his most important work on the topic: the *Memoria sobre el estado de las quinas en general y en particular sobre las de Loja* (Caldas, 1966a). He also produced various manuscripts/drafts and maps, some of which have recently been reproduced by López-Ocón (2010) and Gómez-Gutiérrez (2019). In July 1804, he visited Loja, anxious to get there before Juan Tafalla and Juan Manzanilla, who were part of the Peru expedition. There are some summaries of his explorations in letters to the secretary of the viceroyalty in 1808, and to the viceroy in 1809. In them, he laid out his position on the disputed taxonomy of cinchonas, as I will explain later (Caldas, 2016n, 2016ñ).

In March 1805, at the request of the baron of Carondelet, the president of Quito, Caldas published his *Memoria*, in words favorable to the Crown. The baron of Carondelet was eager

to know if the Loja forests "could yield enough cinchona to supply the royal pharmacy forever" (Caldas, 2016m).

As early as 1804, Caldas expressed explicit disagreement with the altitude ranges identified by Humboldt. He wrote to Mutis that the higher range was actually larger and that "there is nothing more capricious than the ranges that baron von Humboldt established for the vegetation of the precious *Cinchona* genus, in his geography of plants" (Caldas 2016l). He had seen Humboldt's range categorizations from reading his manuscripts, since until at least 1807 he had no access to the Prussian's printed works (Gómez-Gutiérrez, 2019). In Caldas' *Memoria*, a year after this letter, he went into more detail. He wrote that Humboldt and Bonpland "spent so little time there, that they would only have been able to see a few" (Caldas, 1966a, p.255). He was right: Humboldt's most significant field trip on cinchonas was a very short visit to Loja, where he received knowledge in particular from the botanist Vicente Olmedo. That field trip, made en route to Lima, was driven by Mutis (Montúfar, 2008), the interests of the Montúfar family (Hampe, 2002, p.717), and Humboldt's own desire to leave his mark on the history of the antimalarial drug.

Despite having been in Loja for under five days, Humboldt did not hesitate to intervene in the debate, playing up his own authority by stating that none of those involved in the controversy about cinchonas (Mutis, Ruiz, Pavón, Zea), had ever been in Loja (Humboldt, 1821). This also invisibilized Caldas, who had visited the region in 1804, and published a *Memoria* that was "particularly" devoted to the cinchonas of Loja.

Caldas' most trenchant criticism of Humboldt came in his translation of Humboldt's *Essay on the geography of plants*, in 1809. He included two lengthy notes on cinchonas. In the first, he mentioned that he had "irrevocably" fixed the distribution of the *Cinchona* genus and its species (Caldas, 1985, p.13-14). In the second, he reiterated some points and was more explicit:

> *Quina* trees have been the main object of our botanical expeditions … Perhaps more fortunate in this regard than Humboldt, we indicated the area which each species occupies, and we dared to fix the latitude up to which each grows, in other words we established its tropics. If I were to go into details on this, if I demonstrated my ideas on the geography of the *quinas*, I would have to use many numbers, and this note would turn into an entire volume. Reserving all that material for our *Cinchografía*, we will merely say at this point that the upper limit of the cinchona genus, established by many observations and verified measurements from 1802-1805, is 1,679.97 *toesas* (3,919.83 yards) above sea level, in other words 180 *toesas* higher than Humboldt's. The lower limit we have established with equal care at 183 71 [*sic*] *toesas* (458.67 yards) lower than Humboldt. The breadth of the large zone which contains the vegetation of all species, is 1,496.26 *toesas* (that is 3,491.16 yards). We add our determinations compared to Humboldt's so that people can judge at first hand the differences between them (Caldas, 1985, p.121-122).

These were not minor details, and it is hard to imagine that the well-informed Prussian did not have access to them, at least via some reference. But he said nothing, at least in public, on these corrections, although he did correct himself. In the *Essay on the geography of plants* he states that "we have not encountered any true fever tree at less than 700 meters

(359 *toesas*) above sea level and not one higher than 2,900 meters (1487 *toesas*)" (Humboldt, 1985, p.51-52), but in the *Account*... of 1821, he corrected the lower range, mentioning the presence of species as low as 200 *toesas*, although he maintained the maximum altitude as 1,500 for one species (Humboldt, 1821). In these texts he could have given credit to Caldas, who had died five years earlier, but he did not. He did, however, acknowledge Mutis, who, as explained earlier, obtained much of his information from Caldas's reports.

Did Caldas's corrections, made as early as 1804, resented Humboldt? How likely is it that he would have known of them through Mutis, or directly, through Caldas's letters? Perhaps his lack of acknowledgment was the result of the deterioration in their relationship? Did he ignore Caldas because he did not see him as a peer to be debated, or did he think Caldas might inconveniently overshadow him? It is hard to know, and rivers of ink have been devoted to the matter. Whatever the reasons for this obvious silence and silencing, the results are clear: as with the idea of biogeography, Humboldt avoided mentioning Caldas in relation to cinchonas. In his *Essay on the geography of plants*, he barely portrayed him as a "young man from Popayán, who devotes himself with tireless zeal to astronomy and some aspects of the description of nature" (Humboldt, 1985, p.104).

However, the question of the range of the *Cinchona* species was merely the tip of the iceberg. In fact, the most significant critiques concerned their taxonomy. Caldas disagreed with Humboldt's classification and other proposals circulating at the time, a highly problematic posture, since it affected various trade interests. Caldas, rightly, claimed that Humboldt and Bonpland were adding more confusion to the existing taxonomy. As late as his 1821 volume, Humboldt maintained that he had found a new species in Loja, which he called *C. condaminea,* which is barely recognized today as a variety of *C. officinalis*. The confusion arose from the fact that Mutis had shown them *C. pubescens*, telling them it was the "true" Loja variety. So, when they saw *C. officinalis* in Loja, they thought it was a different species to the one described by La Condamine (Fernández, 2019, p.73-75).

In his *Memoria* of 1805, Caldas came very close to resolving these taxonomic dilemmas, arguing that the Loja species did not grow in New Granada or Peru. This is not a trivial matter, since this statement did botany a favor, but it was problematic for the trade aspirations of both expeditions. "The truth was glaringly obvious, but no one was willing to admit it," according to Fernández, Jiménez and Fonfría (2004, p.579). Mutis was one of those affected by these conclusions, but he did not publicize these findings promptly. The merchant José Ignacio de Pombo, who was also connected to Caldas as his mentor and financier, even suggested that Mutis ignore Caldas's observations. Fernández (2019) writes that it makes no sense that a botanist of Mutis's caliber would have made such a mistake. He speculates that perhaps it was in Mutis's interests to maintain a "deliberate confusion to protect his trading activity and maintain his prestige untarnished" (p.68) and that this was a "suspicious systematic silence." He concludes that "the secrecy in which Caldas's discovery was kept is incomprehensible and also unacceptable" (p.89). He also explains that Caldas's subordination to Mutis was a reason why his observations were not made public.

Even twenty years after the death of José Celestino Mutis, when Sinforoso Mutis published his uncle's texts, he made no mention of Caldas's *Memoria*. According to Fernández (2019, p.94-95), this may have been due to some friction between Sinforoso

and Caldas, or perhaps because Mutis's nephew did not want to reveal that his uncle had concealed transcendent information.

By the time Caldas's report was evaluated in Spain and he was deemed in the right, the Creole had died. Thus, his observations on taxonomy were also buried, at least when he firstly made them public.

In addition to the questions formulated earlier, we have to wonder whether Caldas's statements, which ran contrary to various people's interests, condemned him to ostracism and increased the distance between him and Humboldt, who felt closer to Mutis. How much influenced his decision to abandon the circuit of lies and fraudulent claims about cinchonas? Whatever the answer, he did not change his mind. In a letter written in 1808 to the colonial authorities, he explained that Mutis had stayed silent about the taxonomic evidence and that Humboldt had increased the uncertainty "with his contrary opinions." His assessment of the Prussian was blunt: "We behold here doubts perpetuated by a learned man who ought to dispel them; we behold a doubt in which the interests of trade, the reputation of this medicament and public health are at stake" (Caldas, 2016n, p.290).

Taxonomy and distribution were matters on which Caldas and Humboldt disagreed, but on distribution in particular, the former did not mention the latter's data. Furthermore, they also disagreed on the work done in Loja by Olmedo, whom Caldas criticized harshly whilst Humboldt defended him. To Caldas, Olmedo's work was that of an official, more political and commercial than scientific, even though he was in charge of investigations of that type. He believed Olmedo had frustrated the aspirations which had sent him to Loja, and wrote that he should submit to Mutis, to climb out of the "lethargy in which he has been buried these three years" (Caldas, 1966a, p.259).

They also disagreed about how to transplant and grow cinchonas. Caldas suggested that this should be done in the Andes, as proposed by Espejo, for whom cinchonas were more precious than gold and silver. He declared that "transplants should be promoted in the equinoctial Andes, and not in Europe," (Caldas, 1966a, p.250). He tried taking plants there himself, although he blamed his porter when this enterprise failed.

Lastly, like Espejo, Santistevan and others, both protagonists of this story criticized the methods for extracting bark and the destruction of the *Cinchona* forests, so that at times Humboldt has been seen as the forerunner of conservationism of these trees.

In conclusion: Humboldt stayed silent about Caldas's work on cinchonas and the divergences between them, just as he did with the data he obtained from so many other informants in America. Although one could try to maintain that he did not have access to Caldas' texts, it would be hardly credible. Only in the 1826 edition of the *Essay on the geography of plants* did he mention Caldas as one of the forerunners in the geography of plants. Until that point, he had described him publicly as merely an "enthusiast." It was an important acknowledgment, although it came too late.

However, these silences were not constructed by the European alone, since Caldas was not explicit about his sources either. While he benefited from existing knowledge about cinchonas, he does not mention it in his *Memoria* (Caldas, 1966a). For example, he did not refer to Espejo's report of 1792 (Espejo, 1993). We know that Caldas talked to bark gatherers, because when discussing a *Cinchona* stand destroyed by fire, he said that

"according to an experienced bark gatherer, it could have yielded many hundredweight of the finest seasoned *Cinchona* bark" (Caldas, 1966a, p.252). He recognized "experience" and thus the existence of knowledge-bearers, but gave no names.

He referred to the inhabitants of Catamayo as honest, but also lazy, idolatrous and ignorant. On the use of *Cinchona* bark to treat malaria, he mentioned that many people in those parts died and that there was "no recourse [for] whoever was unfortunate enough to be attacked by it [malaria], mainly the Indians, amongst whom it wreaks the most havoc," and that in Loja it was "well known" that in order to treat them it was necessary "to take them prisoner, and often to use the harshest punishments, to get them to take the best and most powerful remedy that can be administered" (Caldas, 1966a, p.242). He wondered why cinchonas had fallen out of use, "if it is true, as La Condamine, Sabary, Ruiz etc. say, that the Spaniards found this remedy well established among them and took it from them at the time or after the discovery of the Province of Loja" (p.242). Although he offers no answer to this, he seems to be aligned with those who argued, along with Humboldt, that knowledge about cinchonas was constructed by missionaries. He often alluded to the "ignorance" of the people from Lojan about how to harvest cinchonas or promote and conserve plantations, the abuse of/by the bark gatherers and the damage to the monarchy's profits, Olmedo's poor performance and the ignorance of senior colonial officials (*corregidores*). Caldas was not given to appreciating and highlighting the virtues of those at his own social or scientific level or below, but lavished praise on those he considered more learned than himself or people to whom he was close, like José Mejía Lequerica.

Layers of colonialism between Caldas, Humboldt and cinchonas

The layers of colonialism refer to identifiable processes in the relationship between Humboldt and Caldas, such as the appropriation of knowledge, burying and supplanting knowledge-bearers, and non-acknowledgment.

Humboldt omitted Caldas and other Creoles, but this does not seem to have been an involuntary error. He clearly acknowledged certain sources in connection with cinchonas, for example, Tafalla and Olmedo (Humboldt, 1821). When he chose to give someone credit, he did not hesitate to promote them. He wrote to Bonpland, for example, "draw up a list of the people who have to be praised perpetually, and also praise Neé, Zea, Mutis, Cavanillas, Sessée, Pavón and Ruiz and Tafalla and Olmedo" (Humboldt, 1989b).

With those statements in mind, I agree with Zimmerer (2006, p.351), that Humboldt's acquisition of knowledge on the economic and taxonomic importance and range of cinchonas came about thanks to an extraordinary network of anticolonial Creole scientists. Besides Caldas, there were figures such as Francisco Antonio Zea, Jorge Tadeo Lozano and Joaquín Acosta, among others. One of the many proofs of Humboldt's use of that network can be found in a letter written in 1803, in which he explained that he had access to knowledge about cinchonas before the information was circulated, thanks to a manuscript by M. López (the brother of Sebastián López) who had shared the text with him privately (Humboldt, 1989a). The influence of various figures, however, is laden with silences in Humboldt's work.

Recognition of Caldas, on the other hand, have gradually increased (see, among others, Appel, 1994; Nieto, 2006; Gómez-Gutiérrez, 2018; Álvarez et al., 2019). His image as an "amateur" Creole scientist has been changing; the label was perhaps constructed because he was self-taught, perhaps for his geographic origin in the subaltern side of the colonial fact, or perhaps a mixture of the two, in addition to other issues and his bad relationship with Humboldt.

Caldas distrusted the two Europeans from the outset. He figured they might appropriate his ideas. An intelligent man, he was wary of them. In May 1801, describing his work on calibrating the thermometric scale, he wrote his friend Santiago Arroyo: "We are on the verge of a discovery that will honor my country. This chapter is highly confidential, especially since Humboldt and Bonpland are on their way here, and are capable of penetrating my ideas, if we are not careful" (Caldas, 2016a, p.86). He was intelligent, but apparently not that bold or astute. After meeting the travelers, he let down his guard. By January 1802 he was sharing all his information, a cooperative dynamic that he reiterated in several letters. He wrote that Bonpland let him "see and copy whatever I wanted" (Caldas, 2016e, p.147), that Humboldt praised his work and showed him how he had quoted it in his diary, which was no minor detail, since it described Caldas as a "genius." He was given access to Humboldt's diaries, or to parts of them containing praise (Caldas, 2016d). He explained that the Prussian had "taken whatever he wanted of my materials, and I did not hide anything from him" (Caldas, 2016g, p.160). His initial fear was replaced by excitement and pride at being "immortalized by the pen" of the European explorer (Caldas, 2016h, p.163). He was clearly hungry for recognition, and Humboldt was the right person to give it to him.

At the end of the day, however, Humboldt barely even referred to Caldas, either in relation to their synchronic thought/appropriation/cooperation on biogeography, and even less in terms of cinchonas. Did Humboldt really intend to acknowledge him, as he said when showing Caldas his diaries? Did he change his mind after getting to know him and after their impasses? Was he afraid the Creole might overshadow his own work, or did he simply rule him out because of his origin and lack of credentials? Whatever the reason, the result was that he buried him under a thick, heavy layer of colonialism.

Clearly, Caldas may have shared responsibility for his ostracism by underselling himself and presenting himself as a disciple of the European naturalists. That might have been false modesty, a way of expressing himself with the humility of a disciple or subaltern, but it could also have been part of a strategy in his desperate need for recognition. For example, he wrote from Popayán in 1801: "I am waiting impatiently for baron von Humboldt to arrive, not to contribute anything to this learned man, but to benefit from his brilliance" (Caldas, 2016b, p.92). He was also determined to follow Humboldt everywhere, "trying to learn and imbibe what I can from this wise traveler, to enlighten myself somewhat and escape from barbarism. Do keep hinting as much to him and recommending me so he will treat me with distinction and teach me" (Caldas, 2016d, p.120).

From the outset, Caldas situated himself as the subordinate: "I shall be honored to be the conduit to communicate to my friends whatever I can absorb from this unique man" (Caldas, 2016f, p.151). He behaved the same way with Mutis:

> What a contrast there is between the two of us! You, wise, known throughout all Europe, praised in the North as the worthy son of Linnaeus, appreciated in the Nation, the head of a brilliant expedition whose precious fruits the learned world awaits impatiently; I, ignorant, unknown even by my own countrymen, spending an obscure and sometimes poverty-stricken life in a remote corner of America, without books, instruments, ways to learn and without being able to serve my Homeland in any way (Caldas, 2016c, p.113).

He always called Mutis and Humboldt "wise" men, giving them maximum credit to his own detriment, at least in the early years. Maybe he really felt that way, or maybe he hoped their touch would induce them to elevate him. His submissiveness was such that at the end of his *Memoria* of 1805 he wrote that he had much yet to learn about cinchonas, and that the person could bestow that knowledge was the "enlightened Ruler [Mutis] who currently commands this Colony" (Caldas, 1966a, p.259). He admired and needed the Europeans, but both excluded him from their works, or failed to acknowledge him sufficiently. Caldas knew he was learned, but behaved humbly, perhaps too much so, contributing to his own burial. He recognized himself as subaltern and accepted the situation, although with certain limits. And although he flattered them, he also criticized their personal and scientific qualities behind their backs. For example, after having been excluded from the expedition, in a letter to his friend Santiago Arroyo, he called Humboldt an "ingrate" (Caldas, 2016j, p.215). And in 1802, reflecting on the future of his own works, he concluded that they would serve to "vindicate us from Humboldt's snub," although he added that "even in this extreme case I do not wish to diverge from the baron's opinion: we continue to be just as friendly, I make use of his knowledge and his instruments" (Caldas, 2010, p.113-114). Years later, he said of Mutis: "I can affirm that I have seen all the cinchonas in the Viceroyalty, alive and in their native locations, I have studied all of them carefully and on this topic I know more than Mutis himself … I am quite certain that without my works, Mutis's *Quinología* would contain a thousand doubts and would be less than half as long" (Caldas, 2016n, p.290).

He criticized them, but he never became entirely estranged. After Mutis died, he wrote a warm obituary, with phrases such as the following: "We can affirm that no mortal has ever known more about the *Cinchona* genus and its species" (Caldas, 1966b, p.22). Was he still somewhat afraid of rejection if he said anything negative in public about his mentor?

Based on some of the examples mentioned above and others, it is clear, as Nieto (2010) has shown, that there was a form of subordination in that relationship. That obedience, a layer that structures colonialism, conditioned the recognition of Caldas's knowledge as a scientist on his validation by the emissaries of the "centers" of knowledge who were traveling or resident in New Granada. They did not exalt him but translated his knowledge for themselves and received the credit.

For the burials to be unappealable, it was necessary to establish, among other things, a center of authority far from the Creoles. Along those lines, Nieto and Cueto (2019) have shown that the power of Eurocentrism "does not lie in the negation or scorn of others, but rather in their ability to translate, include and dominate the foreign within their own frames of reference." Clearly, the colonial fact would be impossible without that capacity

for translation, but it also requires sustaining processes of denial and scorn, invisibilization and silences.

Caldas recognized that he was more of an expert than Mutis, but he feared not being recognized or named. Yet that was precisely what happened, and he knew it would be very difficult to vindicate himself. He complained, stating that "after many years of toil, would Europe believe that I was the author of so many works? [not only on cinchonas] The name of Mutis would carry off all the glory and the travails that should properly have belonged to me" (Caldas, 2016n, p.293).

His ideas did not favor him: Caldas disagreed not only on the taxonomy and distribution of cinchonas, but also on what ought to be done with them. He was opposed to relocating the plants overseas, something the European powers sought to do and finally achieved six decades later, after Richard Spruce and Robert Cross successfully smuggled seeds from Ecuador to England and India.

Some elements of this history can be viewed from a Hegelian perspective within the framework of the master/slave relationship. In both sides' desire for recognition occurs Caldas's submissiveness to avoid a condemnation to symbolic death in the world of science. However, the metaphor does not apply completely, since Humboldt is not emptied by the submission, and Caldas does not achieve any recognition because he understands that he does have a certain power, since he possesses knowledge. On the contrary, that makes him despair. When he tries to go beyond affirming the master and negating himself as the slave, it is too late. He realizes that in the networks of circulation of technoscience there are other masters, among them Mutis, with little interest in granting him a space of resistance and authority. The layers of colonialism consist of that, too.

Final considerations

The quote with which this article begins shows some of the rules of the scientific game and the role of audacity in it. Between Caldas and Humboldt, the Prussian was the bolder of the two. In his writings on cinchonas, he shows audacity by presenting knowledge that was not necessarily his own and portraying himself as an expert, even though he had done little field work. At the same time, he had the audacity to stay silent about his less-confortable peers, among them Caldas. He deliberately buried and invisibilized them.

Along with his appropriations and translations of various topics in natural history and geography, these facts were crucial to structuring layers of colonialism in the relationship between the two men. These layers were added to others we can trace in the long history of cinchonas (Cuvi, 2018).

The responsibility for these processes that structured the colonial fact was far from being Humboldt's alone. Caldas assumed and accepted a position of subalternity, admiration and little or no criticism, above all at the beginning of their relationship. He performed a sort of "self-silencing," in addition to the silencing done by Humboldt. It was only a few years later that he started expressing his growing discontent, also with Mutis, perhaps too late to transform the narrative in his own time. Caldas's limited ability to publicize his knowledge can be understood in more ways than one, as a layer of colonialism, related to the type of

image constructed about himself. Humboldt was better able to mobilize, synthesize and promote an idea of expertise about cinchonas, acquiring recognition for himself, while blurring the possible recognition for others. In the end, the decisive factor may have been the silence on the part of Mutis, who was perhaps irritated by Caldas's conclusions.

However: this is not an attempt, as Nieto (2010) argues, to switch from Eurocentrism to extreme Americanism, denying any credit to the Europeans by labeling Humboldt as an unscrupulous appropriator. This history is intended less as a defense (there are several, which have been cited, among them Álvarez et al., 2019), and more at understanding how fundamental some processes have been in constructing layers of colonialism and determining the trajectories of technoscience. It will also help orient the reading of historical narratives that have been constructed about these processes.

Finally, we need to see the complexity in the layers of colonialism in this and other stories, and to understand that they exist not only in the Europe-America relationship, but also within America. So far, I have alluded above all to the relationship between Caldas and Humboldt, somewhat to Caldas's relations with Mutis, marginally to other Spaniards, Creoles and their bodies of knowledge, and very little to local lore and knowledge-bearers. Missing from this history (also) are shamans, guides and other actors who provided a large amount of knowledge to Caldas, Humboldt and Mutis, to Jussieu and La Condamine, to Tafalla, Ruiz and Pavón, to the Jesuits, to Espejo, Santistevan, Pombo and Olmedo, and the merchants of Loja, among others. They (both men and women) have been, historically, buried, even by Caldas, although they did have their defenders. As far as I have been able to tell, Caldas said nothing specific about this topic, but it is clear he used a matrix based European system of knowledge to appropriate, mobilize and transform local bodies of knowledge, a system that acted in relation to those knowledge-bearers in similar ways to what happened between him and Humboldt. Thus, there are cascading layers of colonialism. In the end, Caldas was a useful intermediary for colonialism, much to his disappointment and disadvantage. There is also a certain Hegelian master-slave dialectic in this history since the slave in the system becomes the master in another. This reflection can be applied to knowledge about cinchonas, but it can be extended to the ranges of plant levelling and biogeography. It is well known that indigenous peoples understood and consciously managed the altitudinal distribution of useful plants, an issue that has been called "vertical archipelago" and "ecological complementarity" by Murra (2002a), who recognized, among other things, that this pattern had been detected a long time ago, for example in 1967 by Ramiro Condarco Morales in the idea of "large symbiotic zones," or by other authors as far back as the sixteenth century (Murra, 2002b). There needs to be a much deeper study of Caldas's vision of local lore, which was far from being univocal: in several texts he makes scornful allusions to the natives and local people, but in others he stressed their contributions, for example, when he wrote that "they have managed to substitute simple instruments that match their genius" for handling fibers, and that "wiser than their masters, they managed to simplify many machines and many operations" (Caldas, 2016j, p.211). The "masters" here refers to the Spanish, without acknowledging that indigenous peoples had their own techniques for spinning and weaving.

Humboldt was one of those who denied that indigenous people could have known about the properties of cinchonas, which is not surprising, and Caldas insinuated as much in a way that leaves little room for interpretation. This layer of colonialism has lasted a long time, from the Jesuits in Loja to the Cinchona Mission in the 1940s, when US scientists renewed it by scorning and denying any local knowledge. Only Wendell Camp (1952) said explicitly that local knowledge was essential to reactivating intensive harvesting of Andean *Cinchona* forests and plantations throughout the Americas in the 1940s.

Decolonizing the hegemonic narrative on the merits of enlightenment European technoscience, such as that seen in a recent widely publicized text by Wulf (2017) on Humboldt, requires new narratives on the relations between Creoles and Europeans, and also complex narratives on the relations between Creoles, Europeans and indigenous peoples, narratives capable of acknowledging local, semiotic and material hallmarks and traces. That historical knowledge is also crucial for the present, for detecting the processes whereby layers of colonialism are constructed on various scales and in various sites, in the form of bioprospecting projects by pharmaceutical companies, sometimes supported by unscrupulous ethnobotanists who ignore ethical codes in knowledge-circulation spheres.

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