Rubber: The Invisible Movement of Traditional Knowledge

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ABSTRACT
This work discusses the rubber's trajectory from the history of science's perspective and traditional knowledge that have been interconnected since the 18th century. Rubber, originating from traditional knowledge, became a technologically sophisticated industrial product, but it never lost its origins. Produced from the sap of a plant, unlike most natural resources explored in the forest and exported *in natura*, it left the Amazon already processed. Scientists, between the field and the laboratory, faced two challenges: To know the best "gum" producing plant, hence the botanical and agricultural studies; To understand the chemical transformation process of latex into rubber. Only today, with nanotechnology, scientists begin to unravel the "mystery" of "carbon black": Traditional knowledge remained invisible in the weaving of sciences, transforming natural rubber into a symbol of colonisation resistance.

KEYWORDS
Rubber, Traditional knowledge, Amazonia, History of Sciences, Scientific relation

RÉSUMÉ
Ce travail analyse la trajectoire du caoutchouc du point de vue de l'histoire des sciences et des savoirs traditionnels, qui sont entremêlés et interconnectés depuis le XVIIIe siècle. Le caoutchouc, issu des savoirs traditionnels, est devenu un produit industriel technologiquement sophistiqué, mais n'a jamais perdu ses origines. Produit à partir de la sève d'une plante, contrairement à la plupart des ressources naturelles explorées en forêt et exportées *in natura*, il quittait l'Amazonie déjà transformé. Les scientifiques, entre le terrain et le laboratoire, ont été confrontés à deux défis : connaître la meilleure plante productrice de « gomme », d'où les études botaniques et agricoles ; et comprendre le processus de transformation chimique du latex en caoutchouc. Au XXIe siècle seulement, grâce à la nanotechnologie, les scientifiques commencent à percevoir le « mystère » du « noir de carbone ». Le savoir traditionnel est resté invisible dans le tissage des sciences, faisant du caoutchouc naturel un symbole de résistance à la colonisation.

MOTS CLÉS
caoutchouc, connaissances traditionnelles, Amazonie, histoire des sciences, relations scientifiques

This work deals with the traditional knowledge on rubber and its global applications as an ancient process in relation to modern sciences. Its hypothesis is that, until today, traditional knowledge, which never gained recognition, has invisibly permeated the entire scientific process that provides rubber with diverse social uses: From clothing, medicines, food to highly sophisticated industrial uses, reaching all peoples worldwide.

1. THE INTERNATIONAL TRAJECTORY OF TRADITIONAL KNOWLEDGE ABOUT RUBBER

The contact between traditional knowledge and the scientific community occurred when caoutchouc samples were sent to the Académie des sciences in Paris, in 1736, by Charles Marie de La Condamine[1], who carried out a scientific expedition (during 1735-1745), through the Peruvian, Brazilian, and Guyanese Amazon[2]. During the trip, the extreme diversity of trees and plants existing on the banks of the Amazon River called his attention. He wondered what would happen if the "virtues" they attributed to the natives of the country were examined.

1 Minguet, 1981: 15. Previously, chronicler reports on that material had reached Europe through Cortez, who had observed that the Aztecs in Mexico played with a hard elastic ball. Pedro Martirand and the Spanish chronicler Juan de Torquemada had also spoken of elastic material.

2 With the expedition, La Condamine aimed at clarifying the debate started by Newton about the exact configuration of the Earth. His intention was to measure the equatorial arc, which, for Newton, was greater than the polar radius; something not accepted in Paris.

When interacting with the Omáguas tribe near the city of Manaus, in the Brazilian Amazon, La Condamine perceived that they had real mastery of local plants. They identified and used hallucinogenic plants, and other plants from which oils and various poisons could be extracted for hunting, fishing and war. He was particularly interested in the vast number of species whose saps obtained by cutting their trunks produced resins, gums and balsams. He singled out the oil of the copaíba tree, used especially for illumination, and a resin called "*cahuchu*" widely used in the Amazon, where it was abundant.

Rubber samples, stored in rolls, were sent to the Academy of Sciences in Paris, together with information about the uses of the plants from which the dark, resinous, material was extracted. La Condamine explained that the material was known by the name given by the Brazilian Indians: "*caoutchouc*" –*cahuchuc* in Spanish (Minguet, 1981: 15). Indigenous people used it to make very resistant bottles and containers, boots and even hollow balls, which collapsed when kneaded, then returned to their original shape. He observed that a sort of syringe was widely used among the Omáguas. In the trip report, he explained that when cahuchuc was recently collected, with the resin still fresh, it could be moulded anyway one wanted. Its plasticity and impermeability were extraordinary. La Condamine piqued the curiosity of European scientists and even traders.

João Barbosa Rodrigues, a Brazilian botanist who ran the Botanical Garden of Rio de Janeiro in the late 19th and early 20th centuries, noted that, until Europeans became aware of the use of elastic gum, only the indigenous people knew of its many uses (Barbosa Rodrigues, [1992]1900: 11). He also observed that, in addition to the Portuguese colonisers, catholic missionaries began to coat their shoes with that liquid, waterproofing them, to walk in wetlands. Then the shoes themselves were made with elastic gum, initiating the product's trade by Brazilian Indians (*ibid.*; Dean, 1989: 30).

According to Barbosa Rodrigues, until the 1840s, it constituted a purely indigenous industry, as was also that of *guaraná* (a drink). After 1850, as exports increased, the indigenous industry began to disappear. Since the end of the 19th century, rubber was already used in the production of tubes and soon started in the preparation of wires for telegraph cables, which blasted their export.

They started to form rubber plantations, that attracted many descendants of Brazilian Indians who had abandoned their agricultural and breeding sites, and were seduced by the rubber profit. This process forced the smaller producers into miserable working conditions, practically enslaved. With the intensification of production and trade, the indigenous population began to decline, decimated by fevers or forced to change, preventing settlement (Barbosa Rodrigues, [1992]1900: 13,14). According to Barbosa Rodrigues, although Brazil was still a slave-based economy, the rubber industry was always based on the labour of free men, even though those who were dedicated to this industry faced near-slavery conditions. In the 1930s and 1940s, that reality of misery was experienced by immigrants from the Brazilian Northeast who were attracted to the Amazon for the same reason of exploiting rubber and reduced to the worst working conditions that a human being could support. Brazilian Indians, however, had already abandoned that work and took refuge elsewhere.

Resulting from the economic process that invaded the exploitation of rubber in the Amazon, the indigenous culture that had, with its knowledge, instituted the use of rubber, disappeared (or was it hidden?), together with the knowledge that basically named plants for their properties and uses: According to Barbosa Rodrigues, their etymology always express a property of the plant. Thus, Brazilian Indians discovered the *Kaaocho*, hence the name *Cáucho*, which is pronounced caoutchouc. *Kaaocho*, is derived from *kaa or ochu*, which means "cry of the plant", or "plant discharge". Barbosa Rodrigues concluded that Brazilian Indians did not have an artificial method, like the botanists: they more or less preserved the affinities of the ressource, thus reaching what nature teaches (Barbosa Rodrigues, [1992]1905: 82). He also concluded that a notable fact of the indigenous nomenclature was the large geographical area it occupied, always applied to the same plant, with only variation in the pronunciation of some terms, according to the latitude and the crossing races (*ibid.*: 83).

Traditional knowledge has enabled the best exploration of *Hevea Brasiliensis*, among the many species and families of "weeping woods". It found the method to make the incisions in the trunk, and taught that, the closer they are to the soil, the higher the tree's productivity and the better the quality of the latex. Thus, indigenous people demonstrated a profound knowledge of the condition of production of the plants, and also of the best climatic conditions for their exploitation. They knew that, at the time of fruiting, or fall of the leaves, from May to June, in the Amazon, the quality of latex is richer and more abundant, as it is the time of the sap's descent. They also knew that older plants, when they reached their full development (aged 20 to 25 years), should be exploited. A new tree would exhaust its production quickly and the quality of the rubber would not be good.

Brazilian Indians knew a huge variety of plant species, which samples were later collected and classified by botanists into families that supply rubber. In comparison, by 1900, European botanists had only classified ten species (Barbosa Rodrigues, [1992]1900: 17).

2. THE BEST "GUM" PRODUCING PLANT

Since La Condamine published his findings in Paris, the traditional knowledge of Brazilian Indians was thrown into invisibility. Knowledge and culture of origin were separated. The botany race started to classify the plants and define the best rubber producer.

Still in the 18th century, the botanist Jean-Baptiste Fusée Aublet published an accurate description of a tree producing rubber, native to Guyana, and named it *Hevea guianensis,* without realising its relationship to the sample sent earlier by La Condamine (Dean, 1989: 32). In 1875, Jean-Baptiste Lamarck analysed a dry species he suspected to be different from that classified by Aublet (*ibid.*). Earlier, in 1807, the Austrian botanist Franz Sieber, passing through Belém, in the state of Pará, obtained a specimen with flowers which he sent to the Director of the Berlin Botanic Garden, Carl Ludwig Willdenow, who gave the scientific name (*Hevea brasiliensis*) to the species already known as the rubber tree, in 1811 (*ibid.*). In 1865, Jean Mueller von Argau published a taxonomic analysis of the specimen sent by Sieber in the journal *Linnaea* and confirmed the name *Hevea brasiliensis*, establishing it as the best-producing species of rubber latex. He was then recorded as the classifier of this species. The rubber tree finally won a prominent place in the herbarium of the Botanic Gardens in Rio de Janeiro and Pará, in Brazil, in Kew Gardens, in England, and in the Berlin Botanic Garden in Germany (Dean, 1989: 33).

In the path between the countryside and botanical gardens, rubber-producing species were scientifically defined, concomitantly traditional knowledge lost its visibility for the "colonising" scientific community.

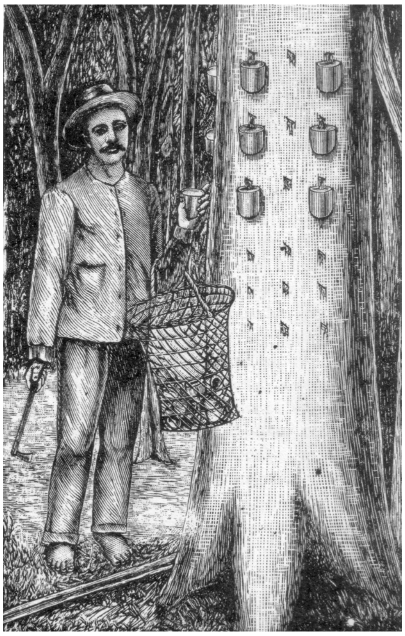
Studies about the different species of rubber continued throughout the 19th century. Then England entered the struggle for its production, having obtained great success in Asian plantations, planting seeds of "*Hevea*" smuggled from Pará by a British botanist (Minguet, 1981: 15; Dean, 1989: 41).

Attempts to cultivate *Hevea* to replace extractivism have unsuccessfully occurred in Amazon. One example was the creation, in Óbidos (Amazonas) in 1907, of a large *Hevea* plantation by the *Companhia Agrícola do Baixo Amazonas*, a French company owned by Paul Le Cointe that lasted until 1913 (Stoll, 2020). Most important was the installation of the American Ford Company concessionaire of the Government of Pará of a million hectares of land in the Tapajós valley to cultivate native rubber trees in the 1920s. This concession was operated by the *Companhia Ford Industrial do Brasil* which, to set up its operations, founded the city of Fordlândia. In 1934, the Company created another city named Belterra, near Santarém. Both were abandoned by the Americans shortly after the second war.

In the Amazon, the latex extraction method remained extractive, while the English achieved record production in Asia by planting pirated seeds from Brazil.

3. FROM LATEX INTO RUBBER

Figure 1. Rubber tapper making incisions in the trunk (drawing by Barbosa Rodrigues, [1992]1905: 37A)



It is known that rubber was essential for the revolutionary steam machinery and the isolation of belts and bumpers between railway wagons. When it first began to be used in telegraph wires, in around 1874, England imported thousands of pounds of rubber from the Amazon (Dean, 1989: 32). A huge urban and economic expansion occurred in the Amazon because rubber had become one of the country's most important export. The region also was structured scientifically, with Museu Paraense Emilio Goeldi becoming a research centre in natural sciences, and consequently studies about rubber. At the beginning of the 20th century, various European scientists worked there, including Jacques Huber and Adolpho Ducke who spent time studying *Hevea* amongst other Amazonian products used by indigenous people (Sanjad, 2010: 208).

The tree extractive method and the latex processing principle used by Brazilian Indians were maintained. Natural rubber has never lost the majesty bestowed by indigenous knowledge.

The extraction of latex consisted of making precise incisions in the trunk of the trees, from which milk flowed into bowls placed just below them, hence the name *"choro da madeira"* (fig. 1). After a few hours each day, the bowls were collected, and the preparation of the rubber started in the smoking process (fig. 2). These two interconnected actions defined the quality and also the resistance (degree of elasticity) of the rubber. It was necessary to know how to distinguish the state of

Figure 2. Smoking the rubber
(drawing by Barbosa Rodrigues, [1992]1905: 39A)

the milk that was collected and the property of the burnt material in the smoke, whose gas changed the quality of the rubber (Barbosa Rodrigues, [1992]1905: 39, 40).

They not only bequeathed the knowledge of the plants and the forms of their exploitation, but also made known the extraction instruments, and the latex coagulation process that provided the best quality rubber, which implied botanical, chemical, and ecological knowledge. They gathered all this knowledge just by working with nature –their living laboratory. If not by fire, the method is still used today and has guaranteed the improvement of rubber, increasingly sophisticated, for industrial purposes.

Another question for scientists concerned the elasticity obtained in the smoking processing of the latex. The botanist Adolpho Ducke, then at the Rio de Janeiro Botanic Garden, working on the American project, studied the geography of the different and best rubber species and sought to find the plant that would solve issues related to latex processing, investigating methods to delay the coagulation, and also a solution for the problem of latex concentration (it contained only 30% rubber, while the rest was water that they wanted to avoid exporting[3]).

For the latex concentration problem, the creaming methods patented in 1923 and 1924 in Germany and England, which involved adding colloidal materials, predominated. Fordlândia technicians undertook a broad search of Amazon plants to find a creaming agent that was abundant in the region. Ducke noted that the local people used the seed of the *jutaí* tree. The result of this research was latex creaming on an industrial scale (Domingues, 2012). Traditional knowledge was still valuable.

More recently, in 2007, in a meeting of the Brazilian Society for the Progress of Science (SBPC) held in Belém (state of Pará), the chemist Fernando Galembeck stated that only now, in the 21st century, with nanotechnology, have chemists been able to perfect the qualities of natural rubber.

Marcia Rippel and Fábio Bragança, reiterated the importance of incorporating nanoparticles into natural rubber, but stated: "Natural rubber is a strategic material, as it is not replaced by synthetic rubbers in many applications. This is due to two factors: a) its special properties (resilience, elasticity, flexibility, resistance to abrasion, impact and corrosion, easy adhesion to fabrics and steel and impermeability, insulating properties of electricity, impermeability to liquids and gases, capacity to disperse heat and malleability at low temperatures); b) the similar cost-benefit ratio of natural and synthetic rubbers." Then, natural rubber, into industrial field, "is a strategic material which cannot be replaced by synthetic rubber in many technological applications" (2009).

CONCLUSION

Most of the special properties of natural rubber pointed out by Rippel and do Carmo Bragança were based, at the origin, on indigenous knowledge (2009). This work sought to discuss the traditional knowledge when it was an Indigenous people tradition, considering their relationship with the knowledge of nature, environment and its natural resources. Their knowledge, today, can be seen as ecological practices, that have been lost along with their culture, that have suffered successive genocidal processes.

As João Barbosa Rodrigues observed: "In his botany, the Indian observer spirit is still poetically manifested, always giving us an idea of the property by the use or the usefulness of the plant that serves as a theme for tales" ([1992]1905: 84). Thus, by making traditional knowledge invisible, also the tacit pact with nature established by the Indians was lost.

Traditional knowledge circulated internationally into rubber, as ideas into books or letters (Seccord, 2004), but it was not considered. It is known that, in the international economic process, rubber became an important and innovative instrument in the development of industrialisation. For the natural sciences, rubber represented an eternal challenge that has been overcome step by step over time, but until today not achieved. Thus, traditional knowledge was reconfigured in the dependence that rubber imposed on institutionalised sciences.

3 In a letter to Auguste Chevalier (dated 16/11/1938), Ducke's approximation to the Americans can be understood in the international context of the 1930s, since he was radically opposed to the Nazi-Fascism which dominated Europe before the Second World War (Domingues, 2012:118).

Rubber exploration methods inherited from traditional knowledge have remained a "natural" process; as "natural" –without politics or social organisation– the inhabitants of the New World were understood. This mark of cultural inequality has coined binomials of the "Ocidental" imaginary, including savages/civilised ones, who founded national identities even in colonised countries such as Brazil. What Gruzinski stated about historians can describe scientists who, guided by this Eurocentric worldview and colonial-imperialist discourse, never managed to recognise traditional knowledge (2017).
However, rubber was born from a typically tropical plant and, for centuries, circulated around the world as a product chemically processed by indigenous practices, whether from the Amazon or Asia. So, paradoxically, if natural rubber is an image of symbolic violence of colonisation, it can be seen as a great symbol of resistance to the same colonisation.

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