The Amazonian Travels of Richard Evans Schultes

Chapter II. World War II Rubber Mission

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April 8, 2019

The following text is from the interactive map available at the link:

banrepcultural.org/schultes

Following the Japanese attack on Pearl Harbor, Schultes left the Amazon and reported to the U.S. Embassy in Bogotá to enlist, only to be sent back to the Amazon on a special mission vital to the Allied war effort: the study of rubber-producing trees. Schultes' quest to procure disease-resistant varieties of natural rubber would shape his travels across the Amazon for the next decade and lead to myriad discoveries.

World War II and the Rubber Crisis

On December 7, 1942, Richard Evans Schultes was on the outskirts of Mocoa, Putumayo in southern Colombia when he learned that the Japanese had bombed Pearl Harbor. Schultes immediately reported to the American embassy in Bogotá, expecting to be sent back to the States to undergo basic training and then be shipped to the European battlefield (Schultes, Field notebook 1952, p. 43). Much to his surprise, he was instructed to stay in South America and await further orders.

[Caption] Japanese attack on Pearl Harbor

As Schultes made his way down the Putumayo River in 1942, Nazi Germany was consolidating control of continental Europe after conquering Poland in 1939 and France in 1940. German U-boats were devastating British shipping in the Atlantic while the German army turned its hungry gaze west towards the eastern European countries and the Soviet Union.

[Caption] Map of the European Theater of World War II, 1942

[Caption] Japanese bombers

Following the attack on Pearl Harbor, the Japanese launched a "centrifugal" attack, nearly simultaneously invading British and Dutch colonies in the Philippines, Borneo, Hong Kong, Java and Sumatra. By May 1942, Japan had conquered a wide arc of territory from Burma in the west to New Guinea to the south and Iwo Jima in the north.

[Caption] Map of the Southeast Asian Theater of World War II, 1942

In taking these territories, the Japanese forces had seized control of the global supply of a material vital to the war effort: rubber. Each Sherman tank required a half ton of rubber; a heavy bomber required a full ton (Davis, 1996, pp. 297-300). Some warships contained 20,000 rubber parts (Davis, 1996, 300). Rubber not only was a component on every single wheel of every single vehicle, it coated every wire. The fallen European colonies in Southeast Asia, primarily British

Malaya and the Dutch East Indies, produced 99% of the world's supply of natural rubber (Davis, 1996, 300).

Recognizing this vulnerability, Franklin D. Roosevelt formed the Rubber Reserve Company (RRC) in 1940, with the task to meet urgent wartime demand for rubber by conserving current rubber reserves, recycling scrap rubber, and reopening wild rubber tapping in South America. It would be up to plant explorers like Richard Schultes to find productive rubber stands across the Amazon rainforest.

> The American Government, looking towards the immense and abandoned stands of wild rubber in the Amazon jungle, organized ... an entity to assist local governments to start jungle production. I joined this organization and immediately plunged into the rubber forests of Colombia as an explorer, searching out the densest [stands] and best type of rubber, mapping rivers, and reporting on their navigability and other tasks preparatory to the rebirth of the wild rubber industry.
>
> I became intensely interested in the rubber plant, the more so since I saw, from studies in the field, that botanically there was so much to do before we lay claim to even a preliminary understanding of ... this group of plants which had become so vital to our civilisation that neither peace nor war could go on without it.
>
> Thus, quite without planning, I became absorbed in the study of rubber-a study which probably will be the principal theme of my life's botanical productivity" (Schultes, Field notebook 1952, p. 43).

Rubber: The Tree That Changed the World

Schultes would later call rubber the "the tree that changed the world in one century" and observed that "Few economic plants have more deeply affected civilization than the Pará rubber tree ... the product of which has made possible present-day transportation and much of modern industry and technology." (Schultes, 1970, p. 197)

[Caption] Natural Distribution of the genus *Hevea*

95% of all natural rubber is derived from the latex of trees in the genus *Hevea*, a group of plants native to South America and found throughout the Amazon and Orinoco watersheds and the Guianas (Schultes, 1956, pp. 124-125). When the trunk of a *Hevea* tree is cut, a white latex leaks from the bark, at which point it can be gathered, coagulated and stored in the form of what we know as natural rubber.

[Caption] Latex extraction from a *Hevea* tree

[Caption] Latex coagulation

Amazonian rubber was first observed by western scientist in the early 1700s in French Guiana, when French ethnobotanist Jean Baptiste Christian Fusée-Aublet watched local Indians dip their feet in *Hevea* rubber tree sap and hold them over the fire, thus creating the first custom-made trainers. Aublet also observed local indigenous groups consuming *Hevea* seeds (Schultes, 1977, p. 134).

[Caption] *Hevea* seeds

Schultes' personal hero Richard Spruce also observed use of rubber seeds in his travels in the mid-19th century:

> Seeds are an excellent bait for fish. Macaws eat them greedily, but to man and quadrupeds they are poisonous in a fresh state. The Indians on the Uaupés render them eatable in this way: after being boiled twenty-four hours, the liquor is strained off, and the mass that remains has something the colour and consistence of rice long boiled. Eaten along with fish it is exceedingly savoury (Schultes, 1956, p. 135).

While the indigenous peoples of the Amazon, especially the northwest Amazon, enjoyed consuming the seeds, most indigenous people had little use for the latex produced by the tree.

Hevea latex was first brought to Europe in the 18th century, but it was too brittle in the cold and too soft in the heat to be useful for manufacturing. A series of innovations in the 1800s enabled the production of rubber raincoats and rubber tires from *Hevea*, leading to increased demand in Europe and the United States (Schultes, 1977, p. 133). With the increasing popularity of bicycles in Europe, as well as the invention of the pneumatic tire and the first mass production of automobiles in 1901, the stage was set for demand to soar, and the Amazon remained the sole source of high-grade rubber.

[Caption] Macintosh patent

The Atrocities of the Rubber Boom

With demand for rubber escalating rapidly, ambitious and sometimes unscrupulous businessmen swooped into Amazonia in search of enormous profits. They soon learned that the low density and wide distribution of the trees made harvesting wild rubber latex a difficult and labor-intensive task. To meet demand, ruthless traders enslaved local indigenous groups through insurmountable debt and extreme cruelty, in the process establishing vast and enormously profitable business empires.

[Caption] Witotos at Casa Arana, 1912

Schultes had met Witotos on the Putumayo River who bore witness to this era. Some were missing fingers and ears that had been cut off by rubber traders. The Witoto territory—between the Putumayo and Caquetá Rivers—was the dominion of one of the most brutal rubber barons in all of the Amazon: Julio Arana.

[Caption] Julio César Arana

Julio César Arana was born in 1864 in Rioja, a small town in the Peruvian rainforest (Hemming, 2008, p. 204). At 24, he opened a trading post in Tarapoto that sold supplies to rubber collectors, typically on credit. As the price of rubber soared, Arana was soon earning fourfold profits (Hemming, 2008, p. 204). He purchased several new rubber circuits, and spent time in the Javari River area and Manaus learning the rubber business and planning to make a killing (Hemming, 2008, p. 204).

Arana made his first trip up the Putumayo in 1896 (Hemming, 2008, p. 204). At the turn of the 20th century, the Putumayo was a disputed border area between Colombia, Peru and Ecuador. In 1906, Pope Pius X ruled that all armed forces must be removed from this disputed region, creating a political no man's land that Arana would exploit to his own commercial advantage (Hemming, 2008, p. 204).

Arana began making deals with Peruvian and Colombian rubber traders operating on the Putumayo. He used his oversight of local transportation to leverage debt and seize control of several smaller enterprises, amassing a rubber territory covering more than 12,000 square miles (30,000 square kilometers) (Hemming, 2008, p. 209).

[Caption] Robuchon's map of the territory occupied by Julio César Arana and his brothers

[Caption] View map of the territory occupied by Julio César Arana and his brothers

Arana consolidated his empire, bringing in his brother-in-law to help administer the business and recruiting Afro-Caribbeans from the British colony of Barbados (Hemming, 2008, pp. 205 - 206). Each of the rubber stations were protected by 15 to 20 heavily armed guards, and access to the area was controlled by the fleet of boats owned by the concern J.C. Arana y Hermanos.

[Caption] Casa Arana, 1912

In the early days of the rubber trade, the Witoto and Bora exchanged rubber for trade goods. Arana turned this into a system of slave labor enforced by institutionalized violence (Hemming, 2008, p. 20). Indians were required to bring 165 pounds (75 kilos) of rubber each quarter (Hemming, 2008, pp. 205-206). If they failed to do this, they were put in the stocks and whipped to the bone, or had limbs hacked off by machetes (Hemming, 2008, p. 212). The resulting wounds and scars became known as *la marca Arana,* the mark of Arana.

[Caption] Weighing rubber at Casa Arana, 1912

Some of the more striking reports of the company's brutality include that of a rubber baron opening fire into a group of men, women and children for target practice, and the burning of a communal longhouse with forty families inside (Hemming, 2008, pp. 212-215). It was reported that if the Indians tried to flee the oppressive violence, their children would be held over a fire and tortured (Hemming, 2008, p. 212).

[Caption] Photos of the hardships endured by the Witotos during the rubber boom, taken by the American Walter Hardenburg

This reign of terror was good business for Arana: in 1903, the Putumayo region produced 500,000 pounds (230,000 kilos) of rubber, an amount that doubled by 1905 even though the trees were becoming harder to find (Hemming, 2008, p. 206). Over twelve years, Arana exported more than 4,000 tons of rubber from the Putumayo, earning more than $7.5 million (Davis, 1996, p. 239). In the interim, the once proud Witotos had been reduced in number to less than 20% of their original population, from 50,000 to 8,000 (Davis, 1996, p. 239).

The tales of slavery and butchery—brought to light by heroic journalists and diplomats—horrified the world. Eventually Arana's company was shut down, but many of the worst offenders of the atrocities escaped punishment. Arana himself had hidden away enough money to live comfortably until he died in Lima in 1952, at the age of 88 (Hemming, 2008, p. 230).

The Odyssey of the Cultivated Rubber Tree

With the value of rubber at record highs in the beginning of the 20th century, there were many attempts to establish cultivated rubber plantations in South America that all collapsed due to South American leaf blight, a fungus native to Amazonia that attacks, weakens and usually kills the trees.

[Caption] Map of the Distribution of the Genus *Hevea*

The leaf blight fungus—*Microcyclus ulei* (formerly known as *Dothidella ulei*)—lives only in the soils of the Amazon rainforest, having coevolved with *Hevea*. The spores can travel only short distances, which is why individual rubber trees are widely dispersed in the forest. Thus, planting trees in close proximity to one another in the presence of the fungus was a recipe for economic failure.

There was hope that cultivating the rubber plants far from the Amazon would solve the leaf blight problem. However, attempts to transport rubber seeds out of South America also failed when the oily seeds quickly spoiled and perished.

[Caption] Henry Wickham next to a *Hevea* tree in Santarém, Brazil

Enter Henry Wickham, a British subject, who had spent many years living in the Amazon and Orinoco in the mid-19th century, and had a keen interest in plants of potential commercial value.

In 1876, Wickham was in Santarém when a steamship of recent vintage—the S.S. Amazonas—forged up the Amazon River on an inaugural voyage from Liverpool to Manaus. While the ship was making its way downriver, Wickham learned that a corrupt businessman had left the vessel without cargo for the return trip (Schultes, 1977, p. 136; Hemming, 2008, p. 192). Seizing this opportunity, Wickham instructed his indigenous associates to collect all available rubber seeds that were ripening at that moment (Hemming, 2008, p. 192).

Previous seed shipments had been sent by sailing ships, and the few days saved by the faster steamboat helped ensure that at least some seeds survived the voyage to England. More than 70,000 seeds were collected and transported to the Kew Gardens outside London, of which 2,800 survived (Schultes, 1977, p. 136). The resulting seedlings were packaged in glass-domed cases and shipped through the Suez Canal to Ceylon, Singapore and other tropical colonies (Schultes, 1977, p. 136).

View map of odyssey of the cultivated rubber tree

[Caption] Glass-domed cases used to transport *Hevea* seedlings

After initial difficulties cultivating and efficiently harvesting the latex in Asia, rubber plantations expanded as methods improved and profitability grew. In 1907, there were over 10 million rubber trees in Ceylon and Malaya. Just two years later, Malaya had planted more than 40 million (Davis, 1996, p. 306).

[Caption] Rubber tree in Singapore botanical garden

New techniques for tapping trees were developed: if harvesters made only a light incision in the bark, the rubber trees could be harvested at a younger age and more often without impeding growth or killing the tree (Schultes, 1984, p. 11). Cloning the most productive genetic lines soon led to doubling of production within a generation (Davis, 1996, p. 306). As the Asian plantations expanded and grew more productive, the Amazon rubber industry collapsed and Southeast Asia became the dominant provider.

[Caption] Singapore rubber plantation

Rubber Development in Latin America

On the eve of World War II, the United States faced dire rubber shortages as Japanese forces threatened Southeast Asian rubber plantations and domestic stockpiles ran low. Realizing it would be utterly impossible to meet wartime rubber needs through wild rubber harvesting alone, the United States government decided it was necessary to establish blight-resistant rubber plantations in the Americas.

> The United States Department of Agriculture, looking towards the future, resolved to assist Latin American governments technically in the establishment of rubber plantations. It fostered a scientifically sound research programme directed primarily towards scouring the Amazon jungles, which were going into production, for outstanding or promising trees from the point of view of yield and disease resistance for the breeding of superior trees for the New World plantations. The Department had several jungle explorers busy, but none was at work in Colombia, where the rubber tree was perhaps least known. On December, 1943, I left the Rubber Development Corporation, joining the rubber programme of the Bureau of Plant Industry of the Department of Agriculture as plant explorer (Schultes, Field notebook 1952, p. 45).

[Caption] Map of USDA rubber cooperative

The USDA rubber cooperative established tropical rubber research stations in Costa Rica, Guatemala and Haiti, at sites chosen for their favorable microclimate and assurances of support from local governments. These centers were supported by cooperative projects in nine Latin American nations: Brazil, Bolivia, Colombia, Dominican Republic, Ecuador, Mexico, Nicaragua, Panamá and Peru (Rands, 1955, p. 7).

Researchers at these stations investigated various techniques to combat South American leaf blight. They found that spraying fungicides on small plants proved effective, but was impractical to treat larger, mature trees (Rands, 1955, p. 7). One of the most promising (though labor-intensive) solutions was to graft together various strains of *Hevea*, combining disease-resistant stems and roots with high-yielding but disease-susceptible crowns, a product referred to as the “3-component tree” by USDA scientists (Rands, 1955, p. 7-8).

[Caption] 3-component tree grafting

Continued experimentation with plant grafting, along with selective breeding of highly productive and disease resistant varieties, offered tantalizing promise for the long-term potential of New World rubber plantations. However, this research depended on the ability of plant explorers like Richard Evans Schultes to find unique varieties of rubber in the remote corners of the Amazon rainforest.

[Caption] 3-component tree

Upon his transfer to the USDA-run rubber cooperative, Schultes’ focus changed from an inventory of *Hevea* to coordinating the collection of *Hevea* seeds that might enable the creation of disease-resistant plantations in the Americas. His research area would be the less-explored northwest Amazon, where very little was known about *Hevea* besides early botanical accounts—including those by Richard Spruce in the mid-1800s—indicating that potential blight-resistant species might exist there, possibly including the oldest forms of the genus.

[Caption] Schultes meeting with fellow researchers

Schultes took a position with the government with some hesitancy and would often bristle at the restrictions of working for a bureaucratic institution, illustrated by an incident described in Green Medicine:

> When, in his second year, he contracted to work for a government agency, he was asked to fill out reams of forms. He completed these with his usual signature, Richard Evans Schultes. They were sent back with the terse notation that no one in government service was permitted to use three names; he was to call himself "Richard Schultes" and that was that.
>
> He responded: "How does Franklin Delano Roosevelt get away with it?" (Kreig, 1966, pp. 73-74)

Rubber Research in the Colombian Amazon

Schultes' rubber research would frame his travels for the next decade. With funding and logistical support from the United States government, Schultes had an unprecedented opportunity to traverse the Amazon rainforest seeking new varieties of rubber while living amidst indigenous groups and collecting other plants of interest.

The Apaporis River

In late 1943, Schultes' first major mission with the RRC was to estimate potential rubber yields on Colombia's remote Apaporis River. Schultes began his expedition in the inaccessible headwaters of the Apaporis between the confluence of the Macaya and Ajajú Rivers, where he encountered an undescribed species of *Hevea* on the spectacular tabletop mountains of Chiribiquete.

[Caption] Cerro Chiribiquete

The unusual variety—later described as ***Hevea nitida* var *toxicodendroides***—was small and shrub-like, and thrived on the rocky soils of the savannah-like ecosystems on the exposed mountaintops (Schultes, 1945, p. 12). The species showed exceptional resistance to leaf blight and produced a high-quality latex, but had limited commercial tapping potential due to its small size (Schultes, 1945, p. 12).

[Caption] *Hevea nitida var toxicodendroides* tree

[Caption] *Hevea nitida* var *toxicodendroides* drawing

Schultes believed this variety could provide valuable blight-resistance properties when crossed with larger and more productive species of *Hevea* (Schultes, 1945, p. 12). He later found this same species near Araracuara on the Caquetá River, in the highlands of the Vaupés region, including the sandstone mesas at Yapoboda near the Cuduyari, and on Cerro Circasia on the Vaupés River, thereby helping researchers determine its approximate geographical range.

View map of the Range of *Hevea nitida* var *toxicodendroides*

After leaving the Chiribiquete highlands, Schultes descended the full length of the Apaporis, observing and recording a high quantity of rubber trees on its banks. He later returned in the early 1950s to establish rubber stations at Soratama, near the mouth of the Pacoa River, and Jinogoje, near the mouth of the Pira Paraná River. During this time, Schultes meticulously charted the course of the Apaporis and made detailed counts of *Hevea* on its banks.

[Caption] A Tucano rubber tapper bringing in a days production at Soratama

[Caption] Wash day at Soratama

Schultes found that the middle and lower sections of the Apaporis had a variety of at least three species of *Hevea*. One of the most common was ***Hevea benthamiana*** (Schultes, 1945, p. 18), a medium-sized tree that is recognizable by the golden-brown hue on the undersurface of its leaves (Schultes, 1956, p. 125). It produces a high quality, pure white latex, only slightly inferior to the top commercial varieties (Schultes, 1945, p. 7). Schultes found *H. benthamiana* was frequently tapped but had never been grown in plantations (Schultes, 1956, p. 125).

[Caption] *Hevea benthamiana* drawing

H. benthamiana grows close to banks of rivers and creeks and in swampy regions that have yearly flooding during rainy season, areas with abundant *miriti* palms (*Mauritia flexuosa*) (Schultes, 1945, p. 6). *H. benthamiana* is found in the northwestern Amazon and the upper Orinoco and is especially abundant in the Rio Negro watershed (Schultes, 1956, p. 125).

View map of *Hevea benthamiana*

The Vaupés River

In January 1944, Schultes arrived in Miraflores in search of rubber trees along the Vaupés River. In the upper courses above the Yurupari falls, he found abundant ***Hevea guianensis*** and a related variety, ***Hevea guianensis* var *lutea*** (Schultes, 1945, p. 12). Both were gigantic trees, growing to more than one hundred feet tall, often towering over the jungle canopy. The *lutea* variety could be distinguished by the erect position of its leaves (Schultes, 1956, p. 126).

[Caption] *Hevea guianensis var lutea*

[Caption] Map of *Hevea guianensis*

Both varieties of *Hevea guianensis* produced a yellowish latex of inferior quality, but were still commonly tapped for rubber in eastern Colombia (Schultes, 1956, p. 126). *H. guianensis* is the most widespread species of *Hevea*, found throughout the range of the genus, typically on well-drained soils and riverbanks that experience periodic inundation (Schultes, 1956, pp. 125-126).

[Caption] Rapids on the Vaupés

In the lower regions of the Vaupés, Schultes noted a change in the *Hevea* species present as the river became increasingly disrupted by rapids and flanked by imposing sandstone mountains (Schultes, 1945, p. 12). Schultes observed abundant ***Hevea nitida*** (formerly *Hevea viridis*) growing on the rocky slopes near the rapids (Schultes, 1945, p. 12). This variety was typically a medium-sized tree with a sparse crown of shiny-textured leaves (Schultes, 1956, p. 126).

[Caption] *Hevea nitida*

H. nitida has a yellowish, sticky latex that is devoid of elasticity, making it useless to rubber tappers. The variety was also avoided due to its anti-coagulant properties: its sap can spoil an entire batch of latex when mixed with higher quality *Hevea* (Schultes, 1956, pp. 125-126).

[Caption] Map of *Hevea nitida*

The Leticia Region & Loretoyacu

[Caption] The Amazon River

In September 1945, Schultes arrived in Leticia, a small town located on the Amazon River at the southernmost point in Colombia where Colombia, Peru and Brazil meet. Leticia would become one of Schultes' favorite towns in the Amazon. Schultes often remarked that—arriving in Leticia after months in the rainforest—he felt as if he was entering Boston or Manhattan (Plotkin, personal communication).

[Caption] Rubber tapping camps on the banks of the Amazon River

From Leticia, Schultes traveled west up the Amazon River to the mouth of the Loretoyacu River, where he stayed at the farm of Rafael Wandurruga, a Colombian from Huila who worked as a rubber tapper (Davis, 1996, p. 348). Wandurruga's farm became an important base of operations for Schultes, offering a comfortable location to work with many local rubber tappers, examining latex yields and collecting seeds of productive varieties.

[Caption] A rubber tapping camp on the Loretoyacu River

[Caption] Schultes examining rubber yields

In Loretoyacu, Schultes observed an abundance of ***Hevea brasiliensis***, a highly productive species that has been essential for commercial rubber production, serving as the sole genetic source of the Southeast Asia rubber plantations (Schultes, 1956, p. 124). The variety of *H. brasiliensis* found around Leticia had a high level of resistance to leaf blight and impressive latex yields, making the seeds ideal candidates for selective breeding programs (Schultes, 1970, p 268).

[Caption] *Hevea brasiliensis* photo

[Caption] Latex coagulation in a Loretoyacu rubber camp

The variety of *H. brasiliensis* Schultes encountered near Leticia was a rare ecotype that had adapted to live outside of the typical range of the species. *H. brasiliensis* typically grows in the southern half of the Amazon basin, and is found north of the Amazon River in just two isolated locations: near Leticia and a small area west of Manaus (Schultes, 1956, p. 125). The seeds of this unique and promising variety of *H. brasiliensis* provided valuable genetic traits for the rubber development program.

[Caption] Map of the Distribution of *Hevea brasiliensis*

[Caption] *Hevea brasiliensis* drawing

In October 1945, Schultes traveled north from Wandurruga's farm, ascending the Loretoyacu River before crossing overland to the Cotuhe River, where he built a log raft and paddled downstream to Tarapacá on the Putumayo (Davis, 1996, p. 357). He repeated this overland journey to the Cotuhe a year later in 1946, this time continuing by canoe all the way down the Putumayo River to its junction with the Amazon River, from there hitching a ride upriver to Leticia on passing riverboats (Davis, 1996, p. 359). During these journeys, Schultes determined that *Hevea brasiliensis* did not extend north beyond the Amacayacu basin.

[Caption] Schultes examining *Hevea* seeds in Leticia

While in Leticia, Schultes mobilized a massive effort to collect *Hevea* seeds to be shipped to research stations outside of the Amazon. To accomplish this task, Schultes paid locals to collect seeds, which he inspected and then packed in moist sawdust for preservation (Davis, 1996, p. 351). By the end of 1944, three tons of seeds had been gathered, and Schultes had personally examined some 600,000 seeds (Davis, 1996, p. 352). Schultes repeated this same program the following two years, returning to Leticia and Loretoyacu again at the end of 1945 and 1946 to collect seeds, exceeding the 1944 yields in both years (Davis, 1996, p. 358).

Rubber Research in Peru and Southern Brazil

After sending off the collection of *Hevea* seeds from Leticia, Schultes flew to Lima, Peru in April 1945 and then travelled overland to Tingo Maria, a newly constructed USDA rubber research station at the food of the Andes in central Peru (Davis, 1996, p. 352).

[Photo] Tingo Maria rubber extraction

Back in Lima in May 1945, Schultes met Russell Seibert, another American botanist researching *Hevea*, and they flew east together to investigate a particularly promising variety of *Hevea brasiliensis* that Seibert had discovered near Iñapari on the border with Brazil (Davis, 1996, pp. 353-354). Known locally as *acre fino,* the variety displayed high latex yields and potential disease resistance (Davis, 1996, p. 353).

Schultes spent five weeks studying these trees with Seibert, and agreed these were some of the highest quality *Hevea* he had seen (Davis, 1996, p. 354). Schultes took note of a bluish tint to the leaves, a detail that had eluded Seibert (Davis, 1996, p. 354). Unlike the *H. brasiliensis* variety Schultes had observed near Leticia, in this southern part of South America the species grew on higher, well drained soils, where it became a tall tree (Schultes, 1956, p. 125).

Returning to Lima, Schultes then undertook a tremendous journey across South America, described by Wade Davis in One River:

> From Lima he traveled overland to Cuzco and then by railroad to the shores of Lake Titicaca and across the Bolivian altiplano to La Paz...before flying five hundred miles east across the mountains to Guayeramerín, a small lowland outpost on the Mamoré River, just across from the Brazilian frontier. Finding the customs agents hopelessly drunk, he left Bolivia illegally, slipping across the caiman-infested river in a dugout paddled by Indian boys. Once in Brazil he took passage on the old Madeira-Mamoré railway, a steam locomotive that ran two hundred miles through the forest to Porto Velho...Arriving to Porto Velho on July 26 (Davis, 1996, pp. 354-355).

From Porto Velho, Schultes descended the Madeira River with the objective of exploring the Marmellos River, a southern tributary that empties into the Madeira about halfway up its course. Schultes' Brazilian colleague, the botanist Adolpho Ducke, had told him about a novel dwarf variety of *Hevea* that had been found in savannahs between the headwaters of the Marmellos and Manicoré rivers (Schultes, 1970, p. 246).

View map of *Hevea camporum* range

Ducke had described the plant as a new species, ***Hevea camporum***, but lacked sufficient plant materials to fully describe the species (Schultes, 1970, p. 246). Schultes hoped to find it, but was forced to turn back in 1945 due to low water levels (Davis, 1996, p. 355). Schultes attempted to reach these remote savannahs again in 1948, setting off up the Madeira River just days after being treated for beriberi, failing again to reach the remote savannahs (Davis, 1996, p. 356).

[Caption] *Hevea camporum* drawing

Rubber Research on the Rio Negro, Brazil

In 1946, Schultes was ready to begin his ascent of the Rio Negro and eager to follow in the footsteps of his hero, Richard Spruce, who had reported several intriguing varieties of *Hevea*. Schultes arrived in Belém in July and went by ferry up the Amazon River to Manaus, an Amazonian city located at the mouth of the Rio Negro.

[Caption] Richard Spruce drawing

On the banks of this mighty river, just outside of Manaus, Schultes encountered ***Hevea spruceana*,** a species of rubber named for Richard Spruce, who first described it. This variety of *Hevea* has an unusually swollen base and Schultes noted the strong, "sometimes objectionable" smell of the purplish-brown flowers (Schultes, 1970, p. 128).

H. spruceana occurs along the banks of the Amazon River from its mouth all the way up to its confluence with the Ica (Putumayo), a distance of 1,200 miles (~2,000 km), and is also found along the lower courses of several tributaries of the lower Amazon, preferring deeply flooded riverbanks (Schultes, 1970, p. 128). While not of commercial interest due to its watery latex, Schultes appreciated the opportunity to study the plant first discovered for science by his hero.

In the upper Rio Negro, Schultes was also seeking another variety of *Hevea* first described by Spruce: ***Hevea rigidifolia***, first found in *caatinga* (white sand) forests at Panuré on the Uaupés (Vaupés) River in Brazil, and until then only known only from this type of material. Panuré, also known as Ipanoré, was the site of an indigenous settlement in 1852 when Spruce visited, but had had been abandoned when Schultes arrived almost 100 years later.

[Caption] Schultes inspecting a seedling of *Hevea rigidifolia*

Schultes searched extensively for this rare variety, finally finding what he concluded were the same trees Spruce studied at Panuré (Schultes, 1953, p. 35). Schultes also encountered other specimens on both the Uaupés and the Issana rivers, helping to illuminate its natural distribution as a strict endemic of the upper Rio Negro in Colombia, Brazil and Venezuela (Schultes, 1970, p. 127).

[Caption] *Hevea rigidifolia* map

[Caption] Map of Hevea rigidifolia

H. rigidifolia is a medium-sized tree around sixty feet in height with a sparse crown of leathery leaves (Schultes, 1956, p. 126). It produces a resinous yellowish latex, poor for rubber manufacture and unsuitable for commercial purposes (Schultes, 1956, p. 126). It prefers the well-drained, sandy soils typical of the *caatinga* forests of the blackwater Rio Negro and its affluents (Schultes, 1956, p. 126).

[Caption] *Hevea rigidifolia* drawing

While on the Rio Negro, Schultes studied one of the most distinct species of *Hevea* he encountered: *Hevea microphylla* (Schultes, 1956, p. 126). Growing in boggy swamps, the tree features a swollen base that quickly tapers to a slender, flexuous trunk with smooth, reddish bark and unusual pointed fruits that appear triangular in cross section (Schultes, 19776, p. 255). This variety produced a watery latex that was unsuitable for commercial use (Schultes, 1956, p. 126).

[Caption] *Hevea microphylla* tree

Schultes visited the type locality of *Hevea microphylla* at the Ilha de Xibaru, and encountered many hundreds of specimens of *Hevea microphylla* at Piloto, near Barcelos and along the Rio Negro from the confluence of the Rio Negro and the Uaupés to the mouth of the Içana (Schultes, 1952, pp. 114-115). He found extraordinary concentrations of the tree near the town of Sao Felipe, slightly below the mouth of the Icana, as well as surprisingly high densities along the lower course of the Rio Icana and the Rio Xie (Schultes, 1952, p. 115).

[Caption] Map of the Distribution of *Hevea microphylla*

Schultes' research on *H. microphylla* helped to determine its geographic range as an endemic to the Rio Negro basin, from slightly below Barcelos up the Rio Negro to the confluence of the famed Casiquiare Canal—first explored scientifically by the German biologist Alexander von Humboldt and then by Spruce—and the Rio Guainía (Schultes, 1952, p. 116).

[Caption] *Hevea microphylla* drawing

A Lost Treasure

After more than a decade of research, Schultes and his indigenous colleagues had scoured some of the globe's least-known and most inaccessible rainforests to bring back a trove of rubber seeds and specimens of great variety, some high-yielding, others pest-resistant. If properly intermixed, this vast supply of genetic material would provide an ample foundation for thriving rubber plantations in the Americas.

[Caption] Turrialba research station

However, due to the end of the war and advances in synthetic rubber manufacture, the need to create a sustainable supply of natural rubber became less urgent. In an act of great shortsightedness, the U.S. government eliminated the rubber program on October 12, 1953. Within a year, the unique and priceless repository of genetic diversity of *Hevea* at Turrialba—the potential foundation of a flourishing natural rubber industry in the Americas—was felled and lost (Davis, 1996, p. 369).

[Caption] USDA rubber cooperative rubber plantation

Schultes wanted to compile all of his rubber notes and knowledge into a comprehensive report, but his request for support was denied. Needing a source of income upon his return to the United States, Schultes took the best suitable position available: curator at the Harvard Orchid Herbarium. This job had formal legal stipulations that demanded a complete focus on orchids, making it impossible for Schultes to continue his rubber work for several years (Davis, 1996, p. 369). He would never finish his comprehensive rubber report, an enormous loss to science.

Schultes often lamented how little we understood wild rubber, a compound that still today plays a vital role in many industries. Many products that require high tensile and tear strength as well as exceptional fatigue resistance are still produced from natural rubber, including airplane and automobile tires, surgical gloves, and contraceptives. The abandonment of the rubber program in the Americas was a missed opportunity for economic development and left the world's natural rubber supply at risk. Notably, if the South American leaf blight is one day transmitted to Asia, the results could be catastrophic.

While we may lament the aborted scholarship, Schultes' search for rubber between 1941 and 1954 was abundantly fruitful: it provided an unexcelled opportunity to investigate general flora of the Amazon and its use by local indigenous groups, a rich archive of local knowledge. In an enduring quote, Schultes wrote:

"Now is the time to record this information … entombed with the cultures who give it birth."

The Amazonian Travels of Richard Evans Schultes

Chapter II. World War II Rubber Mission

By Brian Hettler & Mark Plotkin

April 8th, 2019

The preceding text is from the interactive map available at the following link:

banrepcultural.org/schultes

This work is based on the writings, photographs and ethnobotanical records of Richard Evans Schultes. All photographs are property of the Schultes family unless otherwise indicated.

The Amazon Conservation Team would like to give a special thanks to Dr. Wade Davis, whose book One River was essential in reconstructing details of Schultes' travels for this map. For more information on Dr. Schultes, we highly recommend *One River* and *Lost Amazon: The Photographic Journey of Richard Evans Schultes* by Dr. Davis.

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