GOD'S HEALING LEAVES: THE COLONIAL QUEST FOR MEDICINAL PLANTS IN THE TORRID ZONE*

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ABSTRACT. The colonial era witnessed a fevered quest for exotic medicinal plants by European physicians and scientists. This essay explores the geographical principles that oriented the search towards the lands and peoples of the humid tropics. Believing that God had planted botanical cures for diseases in their places of origin, medicinal plant collectors concentrated their efforts in the pestilential equatorial latitudes. Although many subscribed to the ancient Doctrine of Signatures, colonial bioprospectors discovered early that indigenous and diasporic peoples represented storehouses of plant knowledge. Assuming that native knowhow constituted more instinct than intelligence, Europeans employed coercion, bribes, torture, and promises of freedom to extract their ethnomedical secrets. In the case of especially lucrative healing plants, imperial and colonial entities conspired to pilfer and naturalize endemic species in their distant colonies. In response to this legacy of inappropriate exploitation of native peoples and tropical plants during the colonial era, most present day bioprospectors follow established codes of ethnobotanical ethics. *Keywords: Medicine, botany, tropical rainforest.*

In the late-twentieth century, the public's attention was drawn to the world's tropical rainforests, not just as exotic bestiaries and biodiversity hotspots, but as sources of miracle-cure drug plants. Popular magazines and books touted the pharmaceutical potential of rainforest vegetation, citing for example the case of quinine derived from South American cinchona trees, the historical remedy for malaria, and especially the 1970s discovery of vincristine from the Madagascar periwinkle (*Catharanthus roseus*), the highly-successful therapy for childhood leukemia. About the same time, the doyen of modern ethnobotany, Richard Evans Schultes, published a sumptuous volume on his years exploring the Amazon for medicinal and psychoactive plants: *The Healing Forest* (with R. Raffauf 1990). And popular books by Schultes's student Wade Davis *The Serpent and the Rainbow* (1985), and Mark Plotkin's *Tales of a Shaman's Apprentice* (1993), as well as the 1992 Hollywood production *The Medicine Man*, popularized the idea that tropical rainforests represented possible pharmaceutical factories of drug plants. Disseminated by the press and legitimized by Western science, the notion that the humid tropics represented a font of future pharmaceuticals shaped a generation's perception both of the instrumental value of tropical forested landscapes, and of the urgency to preserve them (Voeks 2004; Robinson 2010, 11).

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This compelling environmental narrative was disputed by those who claimed that ethnobotanical inquiry by Big Pharma and its scientist errand boys represented merely the latest chapter in a lengthy history of colonial and neocolonial exploitation of indigenous people. In this critique, bioprospecting for novel drug plants represented "merely a sophisticated form of biopiracy" (Shiva 2007, 308). Highly profitable tropical drug plants, according to this counternarrative, were being shamelessly exploited by distant multinational corporations, with little or no benefits directed at the country of origin of either the species' or the local people who originally learned their uses (Neimark 2017).

The biopiracy counternarrative was also constructed on the received wisdom that outsiders had inappropriately exploited the intellectual and genetic property of indigenous tropical peoples since the earliest days of exploration and colonization. Most of these ethnobotanical efforts ended in failure, but some were wildly successful and highly profitable. For example, a scant sixteen years after the Columbian landfall, guaiacum (*Guaiacum officinale*) was being imported in large quantities from the Caribbean to Europe to treat the French disease (syphilis). The new remedy, learned "from one of the [native] physicians of that country" (Monardes 1580, folio 11), exploded in popularity following the publication of German Ulrich von Hutten's influential *Of the Wood called Guaiacum* in 1519. Between 1568 and 1608, twenty-one tons had reached Seville alone (Gänger 2015). This and other tropical American exports of medicinal plants in the sixteenth century were only slightly less valuable than dyewoods and sugar (Estes 2000). But modern concepts of prior informed consent and respect for intellectual property rights were still centuries away, and these and many other medicinal plants as well as native knowledge were treated as open-access resources, attainable by whoever was sufficiently charming, clever, or if need be, cruel (Voeks in press).

For twentieth-century bioprospectors, the humid tropics represented the motherlode of botanical opportunities. Biodiversity reaches its global zenith near the equator, and plant species are brimming with bioactive secondary compounds. Moreover, whereas so much knowledge of nature among indigenous people in the temperate zone has succumbed over the centuries to cultural erosion, in the tropics many millions of people continue to heal what ails them and their loved ones with nature's medicinal affordance. But biodiversity and biochemistry were unknown concepts during the early modern period, and the effectiveness of plants in the healing process was measured by their humoral virtues—hot or cold, moist or dry—not their chemical properties. And the protean plant diversity that defines the tropical latitudes was ill appreciated in the sixteenth through eighteenth centuries. Sir Hans Sloane, for example, who was both well-traveled and possessed botanical collections from Asia, Africa, and Latin America, believed the flora of the tropics to be rather homogenous. "I find a great many plants common to Spain, Portugal and Jamaica and the East Indies," he reported, "and most of all Jamaica and Guinea [West Africa]" (Sloane 1707, Preface). Even Carl Linnaeus, whose formidable

familiarity with the world's tropical plants was second to none, thought the tropical flora of the world to be "rather uniform" (Stearn 1988, 781). If not biodiversity and biochemistry, then what drove colonial scientists and physicians to plumb the depths of the tropical forest primeval for its medicinal secrets?

This essay explores the geographical principles that encouraged colonial physicians and men of science to set their botanical gaze on distant tropical latitudes. Some of this enterprise represented a practical extension of the medieval trade in medicinal spices, most of which were imagined to inhabit exotic equatorial locales (Brockway 1979; Schiebinger 2004; Freedman 2008). It was a sensible assumption that other hugely profitable plants awaited discovery in the Torrid Zone. And the mysterious provenance of healing plants, inhabiting exotic and barely known lands, added to their intrinsic allure. But we will argue that the notion that equatorial landscapes in particular represented sources of botanical cures found inspiration from ancient Christian-inspired axioms regarding the relationship between people and nature. We suggest that the principle elements in this evolving narrative included the following concepts: that God had placed a medicinal plant remedy for each disease in the same geographical location from which the disease originated; that botanical cures were endowed by the Creator with identifiable signatures; that technologically primitive peoples possessed special instincts regarding the identity and properties of healing plants; and that indigenous people lacked the intelligence and managerial skills to sustainably manage globally significant medicinal species. Appreciating the assumptions under which Europeans pursued the great colonial quest for nature's healing plants informs both our current perception of bioprospecting opportunities in the tropical realm, as well as the suspicion held by some regarding the legitimacy of these efforts.

The Geography of Healing Leaves

The late fifteenth-century Iberian landfall in the Americas spawned an unprecedented exchange between the Old and New Worlds of plants, animals, and microbes. The latter in particular breached intercontinental germ barriers that had existed for millions of years. A flotilla of crowd viruses rushed into the Americas and Oceania, causing nothing short of a demographic collapse among indigenous populations (Lovell 1992). Figures continue to be debated, but what is clear is that the geographical quarantine of the Americas translated to almost zero immunity on the part of New World inhabitants to Old World microbes. For the century and a half after the Columbian encounter, the impact of foreign germs and worms represented "the greatest human catastrophe in history" (Cook 1998, 13), reason enough for European men of science to scour tropical forests and fields for their healing secrets.

But the tragic impact of disease among the native populations was not the primary catalyst for colonial bioprospecting efforts. For outside of their role as laborers, the physical well-being of native peoples, and later enslaved Africans,

was seldom of much concern. Rather, it was the expansion of Europeans into the enervating tropics and its devastating influence on their own health that encouraged this medicinal quest. Whether in Africa, Asia, or the Americas, the constitution of arriving Europeans simply did not seem up to the climatic challenge. For visitors and colonists steeped in Hippocratic humoral traditions, the causes of ill health in tropical climes were obvious—the blistering hot winds, the stagnant rivers and putrid marshes, the accelerated decomposition of vegetation, even the peculiar alignments of the stars. Poor health and premature death for "unseasoned" outsiders was seen as a consequence of environmental excess, a feature equatorial landscapes possessed in abundance (Adams 1849, 190-222; Glacken 1967, 7–12).

For Europeans who risked the journey, the mortality rates were often astronomical. In Portuguese Goa, a sixteenth-century proverb noted that "Of the hundred who go to India [from Portugal], not even one returns" (Boxer 1963, 7). In West Africa, there was little missionizing in the early centuries of exploration compared to the Americas because of the heavy death toll among whites. Some 25 percent to 50 percent of Portuguese traders working in Africa in the fifteenth century died before they could return to their homeland. And the situation did not improve much over the coming centuries. According to Willem Bosman, who spent many years on Africa's Gold Coast, the worst disease was the pox, which killed thousands (Bosman 1721, 95). Racialized nineteenth-century metaphors such as "The Land of Death" and "The White Man's Graveyard" reinforced the vision of sub-Saharan Africa as hostile, brutish, and disease ridden (Jarosz 1992). In the West Indies, where most of the indigenous population had already perished, the situation for Europeans was similarly dire. "Newly arrived people," according to Nicolas Bourgeois, "are less adapted to live here." The malignancy of the air in these "hot countries," he reported, "pu [t]s the victim in his tomb as soon as the first bout of fever attacks" (Bourgeois 1788, 136 and 415).

Europeans were no strangers to ill health and premature death. But the tropics possessed a distressing array of unfamiliar ailments, quite unknown to the ancients, and for which even Dioscorides's *The Materia Medica,* the thousand-year-plus, gold-standard pharmacopoeia, offered little relief (Stannard 1999). Iconic among these new diseases was an innocuous genital chancre carried away from the West Indies by one of Columbus's crew. The origin of syphilis is still contested, but it was likely introduced to Europe in 1493 when the Admiral returned from his first voyage. Ulrich von Hutten, himself suffering and ultimately succumbing to the infection, noted in his influential text that "the French Poxe arrived in 1493, or thereabouts." He said that the doctors agreed that it was caused by environmental conditions, "Unholsome blasts of the aire," and "venemus vapours to come downe from the ayre" (Hutten 1536, folio 1 and 3; Estes 2000). The epicenter of the first outbreak was Italy, but when the French and their multinational mercenaries marched on Naples in

1495, their reward for rape and pillage was the unseen spirochete bacterium. Carried to their respective homes by the victors, syphilis burned quickly across central and northern Europe. Asia would shortly come to know the disease as well, as Vasco da Gama likely transported syphilis to South Asia in his 1498 voyage to India. In short order, sailors and soldiers had spread the dreaded disease around the world. An equal opportunity ailment, syphilis infected the low and high born, including kings and popes, covering their bodies in great seeping tumors before driving them to dementia and eventual death (Desowitz 1997).

Fortunately, as physician Garcia d'Orta informed his sixteenth-century readership from his post in Goa, "each day brings new diseases... [but] God is so merciful that in each land He gives us medicines to cure us. He who causes the illness provides the medicine for it" (Orta 1913 [1563], 105). Indeed, it was widely believed that God, in his great beneficence, had placed the cures for humankind's myriad maladies in the lands from whence illnesses originated. And because so many of these new diseases were believed to have originated in the equatorial latitudes, the pursuit of drug plants was focused sensibly on the humid tropics. These ideas were discussed early by Spanish physician Nicolás Monardes. Referring to the general knowledge that syphilis "came from these parts of the [West] Indies," he reported that the discovery of the botanical remedy was made by a Spaniard "that suffered great pain of the pox, which he had taken by the company of an Indian woman, but his servant ....gave unto him the water of guaiacan, wherein not only his grievous pains were taken away that he did suffer, but he was healed very well." Consequently, "Our Lord God would from whence the evil of the pox came, from thence should come the remedy for them" (Monardes 1580, Folio 11; also Earle 2012, 112). German botanist Georg Rumphius repeated this idea from Indonesia, "the Creator... provided each... country with its own medicaments... all countries have their own and singular illnesses which are to be cured by its native remedies" (Rumphius 1741–1750, in Beekman 1981, 12). Likewise Dutch physician Jacobus Bontius, in his 1631 treatise on tropical medicine, reported that "where the diseases above spoken of are endemical, there, the bountiful hand of nature has planted herbs whose virtues are adapted to counteract them" (Bontius 1769, 24). Englishmen Thomas Trapham, who practiced medicine in Jamaica, noted similarly that "the overflowing bounty of the great healer of us all, who hath given a balm for every Sore, and that not to be far sought and dear bought, but neer at hand" (Trapham 1679, 93–94). And English intellectual Samuel Hartlib connected this geographical association to specific healing plants, stating that "where any Endemical or National disease reigneth, there God hath also planted a specifique for it." It followed that, "in the West Indies, (from whence the great Pox first came...) there grow the specifiques for this disease, as Gujacum, Salsaperilla, Sassafras, and the Savages, do easily cure these distempers" (Hartlib 1655, 81). The tropical latitudes were clearly endowed with God's healing flora, but how were newcomers to discover their identities?

Most scientists believed that God had blessed each botanical remedy with a mark of its presence (Prest 1981, 82). This principle, known as the Doctrine of the Signatures (or like cures like), holds that medicinal plants retain an identifying sign, or similitude. The healing properties of plants could thus in principle be gleaned from their various sensorial attributes—shape, size, aroma, and color. The red exudate from bloodroot (*Sanguinaria canadensis*), for instance, indicates that it should be applied towards ailments of the blood. The fleshy leaves of stonecrop (*Sedum acre*) suggest its use to cure kidney problems (Bennett 2007). Botanist William Coles was a great proponent of the concept, noting that "Wallnuts have the perfect signature of the Head. . .The Kernel hath the very figure of the Brain, and therefore it is very profitable for the Brain" (Coles 1657, 3). This concept dates at least two millennia to ancient India and China. But by the time the idea of botanical signatures had reached Christian Europe, it had been attributed to the hand of God and to man's expulsion from the Garden of Eden. Eden was once teeming with healing herbs, it was understood, and residence in the Garden is what kept Adam and Eve free of illness. But following their expulsion, the first couple confronted diseases of the flesh that could only be cured with leaves and roots appointed by the Almighty (Prest 1981). Botanical signatures were intended to assist mortals in their search for God's healing gifts.

The Doctrine of the Signatures was not accepted by all, particularly as Enlightenment skepticism and empiricism challenged religious dogma. Even in the time of the ancients it was not universally accepted; Dioscorides was a fan of the signature concept, but Galen was not (Court 1985). Indeed, many colonial-era naturalists and doctors found it impossible to identify which part of the plant was the actual signature—was it the heart-shaped leaves, or the latex-rich stem? Naturalist John Ray saw little value in the antiquated theory or "the foolishness of the chymists who chatter and boast so loudly of the signatures of plants" (Ray 1660, 148 cited in Raven 1950, 98). English feverologist Robert Talbor was of a similar mind. "Why Eye-bright was specifical to heal the distempers of the Eyes, because its flowers they say resembles a Birds eye." "What rational man," he argued, "would be satisfied with such reasons?" (Talbor 1672, 8–10) Indeed, in the far-flung colonies, where physicians struggled daily with disease and premature death, the theory of botanical signatures yielded to the more practical approach of plumbing the healing secrets maintained by indigenous and diasporic forest dwellers.

A Forest of Secrets

The healing virtues of tropical medicinal plants, as European visitors quickly discerned, were held in the collective or specialized knowledge of native populations. To uncover the medicinal potential of these mysterious floras, they needed the help of locals. As French missionary Raymond Breton reported in 1647 from Guadeloupe, "One must have a great leisure to learn from the savages the names and virtues of the plants, the trees, and other things of these

lands" (Breton 1978, 50). British physician John Woodward prepared a toolkit for collecting and transporting plants from the tropics, including descriptions of the "pagan" people's customs, and that travelers should take note of "their Physick, Surgery, and the Simples they use; [and] their Poysons" (Woodward 1696, 10). It was acknowledged that India, China, and other Asian civilizations were richly endowed with competent physicians and healing species. But the backwater societies of the Torrid Zone, it was argued, also held secrets that could revolutionize medical practice. According to Robert Boyle, "Nor should we onely expect some improvements to the Therapeutical part of Physick, from the writings of so ingenious a People as the Chineses' but rather should also 'take notice of the Observations and Experiments' even of the 'Indians and other barbarous Nations'" (1663, cited in Gascoigne 2009, 554). In colonial Brazil, according to Friar Vicente do Salvador, the indigenous shamans were "privy to herbs and other medicines" that were sorely needed in the colony (Vicente do Salvador 1931 [1627], 62). Similarly in West Africa, Bosman reported that "The green Herbs, the principal Remedy in use amongst the Negroes, are of such wonderful Efficacy, that 'tis much to be deplored that no European Physician has yet applied himself to the Discovery of their Nature and Virtue" (Bosman 1721, 216-217). "The woods are their apothecaries," reported Englishmen Robert Knox from Ceylon (Knox 1681, 19). But would they share their secrets?

Indigenous people were in some cases quite willing to impart their botanical knowledge to visitors. Alexander von Humboldt, who was plagued by "aradores" (chiggers) on his Orinoco expedition, notes that he was cured with the leaf of "uzao," shown to him by "an Indian" (Humboldt and Bonpland 1827, 245). From Java, Thomas Horsfield described the properties of the mysterious Antshar, a powerful tree poison that was revealed freely by "an old Javanese" (Horsfield 1823, 83). And from Malabar, Van Reede reported that "the natives" were happy to disclose the names and the curative virtues of plants (1678–1693, cited in Váczy 1980, 44).

But these examples may have been the exception, similar to currently investigating the collective plant knowledge of a rural community. Local shamans, whose knowledge was specialized and idiosyncratic, were a different story. Then as now, specialized healers zealously guarded their botanical remedies as personal intellectual property. Reporting from Barbados, for instance, William Hillary reviewed the local treatments for yaws, noting that the "Negro doctors" discovered a treatment using the caustic juices of certain plants which "they keep as a secret from the white people, but preserve among themselves by tradition" (Hillary 1759, 341). Jacques Bouton similarly related from Martinique his amazement at the stellar health of the indigenous people and on the "beautiful" botanical secrets they possessed, "but it is impossible to get them out of them" (Bouton 1640, 45). Charles Rochefort noted that the Caribbean people "are extremely jealous of their secrets in medicine, especially their women... they have yet to want to communicate... their sovereign remedies" (Rochefort

FIG. 1—Charles de Rochefort on St Kitts Island (1681) collecting medicinal species. In : Histoire Naturelle et Morale des Iles Antilles de l'Amerique. Pg. 53. RB 330382. The Huntington Library, San Marino, California.

1681, 562). (Fig. 1) Some employed gentle persuasion and bribes for this information. Nicolas Bourgeois offered money for medicinal plant remedies in Guadeloupe, but "the cleverest" among them carefully guarded the secret "of medicinal herbs that we do not know nearly as well as they do" (Bourgeois 1730, 482). In Hispaniola, it was necessary to "gain their confidence, as I was able to do with some of them," in order to "pull from them the secret" (Cited in Weaver 2002, 440). Among the Indians in Dutch Suriname, Swedish botanist Daniel Rolander reported that they were "too jealous of their [medicinal plant] secrets to reveal them to anyone unless he has inspired their trust, and can provide them valuable information in return" (Rolander 2008 [1755], 1487). Michel Descourtilz, working in Haiti in the midst of the revolution, bartered for several medicinal recipes from an anonymous mulatta healer. She was reluctant to disclose any of her secrets in the beginning, but he "softened" her temperament over time by giving her some of his paintings of plants, "which she coveted" (1799, cited in Schiebinger 2004, 81).

There are documented cases of financial compensation and even manumission granted in exchange for specialized medicinal plant formulas (Fett 2002, 64). The most instructive of these involved an enslaved man in Dutch

FIG. 2—John Stedman. 1796. 'The Celebrated Graman Quacy.' Narrative, of a Five Years' Expedition, Against the Revolted Negroes of Surinam, in Guiana, on the Wild Coast of South America, from the Year 1772 to 1777. Image painted by William Blake. RB 23614. The Huntington Library, San Marino, California.

Suriname, Graman Quassi. Born in West Africa in 1690 and later transported to Suriname, Quassi was freed from enslavement for his service hunting down African maroons for the military and planters, and for his skills as an herbalist (Price 1979). Quassi was a famed healer who employed medicinal plants and magical amulets to cure what ailed the black and white population. For his many contributions to the colony, he was sent to The Hague to meet with Willem V, the Prince of Orange, who presented him with a fine gold-laced jacket, a golden medallion, a gold-tipped cane, and a gold breastplate inscribed with the words "Quassie, faithful to the whites." (Fig. 2) Dutch soldier John Stedman considered him "one of the most Extraordinary Black men in Surinam, or Perhaps in the World" (Stedman 1790, 581). Quassi's principal contribution, however, came from his discovery of the fever-fighting properties of a native treelet, later named by Linneaus *Quassia amara* in his honor (Carney and Rosomoff 2009, 90). The bitter wood of this species compared favorably with Jesuit's bark (*Cinchona* sp.) for its ability to lower body temperature, and over time according to Stedman made Quassi a rich man. He may have sold the recipe for a "considerable sum" to the Swedish botanist Donald Rolander, a student of Linneaus, who forwarded it to Europe (Lewis 1791, 529; Schiebinger 2004, 213), although there is suspiciously no mention of this in Rolander's diary. Quassi lived into his 80s, addressed in personal correspondence as Master Phillipus of Quassi, Professor of Herbology.

In addition to infectious disease, plant-derived poisons were a source of great anxiety for Europeans in the tropics. And when antidotes could not be wrested peacefully from the local population, violence was employed. Sir Hans Sloane related the story of the discovery of contra yerva (likely *Dorstenia contrajerva*) in Guatemala, used to counteract the effects of arrow poisons. A Spanish doctor, having been wounded by a poisoned arrow, "took one of their Indian Prisoners, and tying him to a Post threatned to wound him with one of their own venomous Arrows, if immediately he did not declare their Cure for that Disease, upon which the Indian immediately chaw'd some of this Contra Yerva, and put it into the wound, and it healed" (Sloane 1707, lv). Similarly in Indonesia, the Dutch were in tremendous fear of the infamous Makassar poison tree. As they consolidated their seventeenth-century foothold on the islands, the poison-tipped projectiles of indigenous warriors proved a formidable defense. They knew the natives possessed an antidote, but according to German soldier Johann Saar, the only cure they knew for a wounded man was for him to immediately consume "his own excrement, as fresh as it goes from him" (Cited in Carey 2003, 528). German physician Engelbert Kaempfer spent many years investigating the question, and although he never recorded the plant's name, he indicated that the identity of the botanical cure had finally been extracted "by torture" (Kaempfer 1996 [1712], 99).

Ethnobotanical Instinct

The actions wrought on indigenous and diasporic people in pursuit of their botanical knowledge were consistent with the pervasive European view of the tropical American races as "slow-witted phlegmatics" (Cañizares-Esguerra 2006, 68). Spanish physician Francisco Hernández, who spent seven years in early sixteenth-century Mexico compiling a detailed census of the healing flora, argued that the native people were docile and idle due to the weak star arrangement and the humid air (Chabran 2000, 21). Others believed their melancholic behavior and womanlike features, especially lack of beards in men, was the result of the crude American cuisine, especially the lack of meat, wheat bread, and wine (Earle 2012, 25). Combined with the exuberant fecundity of tropical nature, these negative cultural perceptions enabled observers to embrace ancient environmental determinist ideas regarding resource abundance and Amerindian indolence (Safier 2014). Thus, Alexander von Humboldt concluded that the harsher climate of the northern latitudes encouraged human labor and industriousness. Not so the humid tropical climates, however, where "in the midst of abundance, beneath the shade of the plantain and breadfruit tree, the intellectual faculties unfold themselves less rapidly than under a rigorous sky. . .where our race is engaged in a perpetual struggle with the elements" (Humboldt and Bonpland 1818, 15).

European perceptions of the temperament of sub-Saharan Africans and their diaspora were often worse. Combined with the enervating climate, Africans were saddled with ancient biblical interpretations of their sinful origin, as well as archaic notions of evil and monstrosity associated with their skin color (Friedman 1981, 9–21; Cosgrove 2001, 65; Voeks in press). According to Jean Barbot, a commercial agent in West Africa in the late 1600s, they were "sensual, knavish, fond of lying, gluttons, abusive. . .foul eaters, drunkards" (Hair and others 1992, 84). From his 1720 visit to Senegal, John Atkins reported that African men were idle, planted scarcely enough to feed themselves, and spent most of their waking hours "smoaking all day in long Reed-Pipes together, unplagued with To-morrow, or the Politicks of Europe" (Atkins 1737, 50).

This demeaning perception underpinned a crucial aspect of nature-culture relations in the tropical realm; in spite of their masterful understanding of nature's healing properties, native people were no more owners of this knowledge than self-medicating beasts. This followed from the view, widely held in the eighteenth century, that within the Christian Chain of Being—God, Angels, Man, Animals, Plants, and Minerals—each link had an equal claim to existence, but each was also "unequal in dignity" (Lovejoy 1964, 186). Understanding of the virtues of nature, in turn, was seen to diminish in quality and quantity along a hierarchical gradient from the wild beasts that browse on the vegetation, to the primitive folk who toil in close

> association with the forest and its bestiary, and finally to "civilized" people. According to Robert Talbor, this decline in knowledge of nature, from beasts to men, was a consequence of the Great Fall from Eden. "Adam had a perfect knowledge of the virtues of all plants. . .But since the Fall, Soul and Body have deviated from their first Perfection." Having lost their "primitive purity," people were now consigned to following the observations of "the irrational creatures, as Birds, Beasts, and Fishes" (Talbor 1672, 1–4). Thus, in his epic *The Divine Weeks,* penned in the late-sixteenth century, French poet Du Bartas (Snyder 2012, 374) suggests that just as each disease co-occurred with its botanical remedy, likewise each of the creatures in Eden was paired with its own natural medicine:

"Yet each of them can naturally find

What simples cure the sicknesse of their kind;

Feeling no sooner their disease begin,

But they as soone have readie medicine.

The ram for phisike takes strong-senting rue;

The tortoise, slow, cold hemloke doth renew."

Similar to the ecclesiastical foundation of the Doctrine of Signatures, the medicinal nature of healing plants was seen to be provided by God through the observable actions of birds and mammals. Talbor offered an example of how the "readie medicine" celandine (likely *Chelidonium majus*) became an ophthalmic treatment for people. The plant's virtue "was learnt from the swallow, who hath been often observed to squeeze the juice of the herb with her bill upon the blind eyes of her young, by which means they gain their sight" (Talbor 1672, 1-4). God blessed the swallow with the healing power of celandine, and people learned by observing the swallow. The German botanists Johann von Spix and Carl von Martius made similar notations in their early nineteenth-century journey through Brazil. Of "the Indians and Negroes" who harvest ipecacuanha (*Carapichea ipecacuanha)*, the source of the powerful emetic ipecac, "We are assured that the savages had learnt the use of the ipecacuanha from the irara, a kind of martin, which is accustomed, they say, when it has drunk too much of the impure or brackish water of several streams and pools, to chew the leaves and the root, and thereby excite vomiting" (Spix and Martius 1928 [1824], 221). Similarly, Engelbert Kaempfer reported from Malaysia that locals believed that the mongoose, if bitten by a poisonous snake, would bolt into the forest, seek out mungo root (unknown species), and chew it as an antidote. The native people, Kaempfer recorded, discovered the value of the plant by observing the mongoose, and Kaempfer in turn learned it from the local people (Kaempfer 1996 [1712], 96–97).

This perceived linkage between people and plants carried considerable philosophical baggage. Europeans were convinced of their own cultural and racial superiority, and this connection between plants and "savages" was taken as a clear sign of their brutish instinct rather than inherent intelligence (Scheibinger 2004, 82). They were, in the words of Thomas Trapham, "animal people," with no more entitlement to intellectual property rights than beasts in the forest (Trapham 1694, 117). French merchant Jean-Baptiste Tavernier commented widely on the native peoples he encountered in his travels. The most "hideous" of these, he reported, were the Cafres (Khoi) of the Cape Province, South Africa, who "live almost like beasts." But "brutal as they are" he continued, "these Cafres... have nevertheless a special knowledge of simples, and know how to apply them." Ships captains and others frequented the Cafre doctors, and in each case "were totally healed" (Tavernier 1889 [1676], 395). Likewise Edward Long, in his *History of Jamaica*, succinctly summed up the assumed link between ethnobotanical knowledge and native peoples, stating that "brutes are botanists by instinct" (Long 1774, 381). Clearly, few doubted that indigenous people had a profound understanding of botanical nature's medicinal properties, and many believed that this knowledge had the potential to be medically useful and perhaps enormously profitable. But central to this narrative was the notion that indigenous rural people discover drug plants by blunder, instinct, and intimate association with the other beasts in the forest, rather than by wits and intelligence. Such an argument served to systematically de-humanize native people and, at the same time, to negate any need for compensating those who were willing to share their medicinal knowledge—voluntarily or through force. "Botanist brutes" had no claim to intellectual property rights because their medicinal discovery process was instinctive rather than the product of intellectual inquiry. Furthermore, because of the immense global significance of some of these newfound drug plants, native peoples could not be trusted to sustainably harvest and manage them, a point brought home powerfully by the theft of Jesuit's bark (*Cinchona* spp.), the source of life-saving quinine.

The Fever Tree

The genus *Cinchona* includes over two-dozen trees and shrubs endemic to the highlands of Central and South America. Its primary medicinal value comes from the presence of the bitter-tasting alkaloid quinine in the bark of several species. Widely known as Jesuit's bark, quinine acts to dramatically inhibit the presence of the protozoan parasite, *Plasmodium falciparum*, the cause of malaria (Brockway 1979, 103–139). Unlike so many other exciting new ethnobotanical discoveries of the time that ultimately proved ineffective, Jesuit's bark truly was a miracle drug.

French surgeon Nicolas de Blégny was the first to reveal that the drug was derived from "the Bark of an Indian Tree, of the bigness of a Cherry-Tree."

But knowledge of global biogeography was still muddled, and he was uncertain whether "Indian" referred to India or Peru (Talbor 1672; Blégny 1682, 2). Scientists eventually understood that the source of the cure grew in the South American Andes, and they were eager to learn the details of its ecology and inherent medicinal properties. William Arrot, a Scottish physician working in Peru, provided the earliest accurate description of the plant from the field. In 1737, he reported that there were four types of cinchona, each with different qualities, and that the bark should be used when it was fresh, as it became "insipid and useless" with age. Arrot's most important notations, however, involved the harvest of the precious bark. He reported that "large quantities of it are cut yearly" by the indigenous laborers, with "a great many of the fine large bark trees having been entirely cut down." Unsustainable harvest practice appeared to threaten the fever tree. Arrot also commented, however, that the bark grew back nicely in ten to twenty years, meaning that if properly managed, the cinchona supply could be assured (Gray 1809, 81–83).

Although the original discovery of the fever tree is lost to history, the story most often repeated was popularized by French geographer Charles Marie de la Condamine. Having returned from Ecuador via the Amazon River, he recorded an ancient tradition "of which he could not vouch for the truth" that the virtues of "quinquina" had been instinctively learned by South American mountain lions, which chewed the bark of the tree to relieve what ailed them. The lion's unusual actions were observed by local Indians, who then tried it successfully on their own fevers. Later, the Spanish Jesuits learned the treatment from the natives (Condamine 1738 [1737], 233). Although giving priority to indigenous people for the discovery, Condamine's notations also fit neatly into Christian notions of cultural hierarchy within the Chain of Being as well as the instinctive rather than intellectual nature of indigenous knowledge.

The issue of who originally uncovered the healing properties of cinchona over time became crucial to British designs on the precious botanical resource. Did priority go to the Andean natives, or did the Spanish themselves learn the secret? For good reason, the British opted to believe the latter. For by disallowing indigenous discovery, the native people could not be considered the rightful custodians of the plant's intellectual property. But not everyone agreed. William Arrot stated that "its qualities and use were known by the Indians before any Spanish came among them." Likewise, according to Spanish botanist José Celestino Mutis, who spent decades studying the flora of the Andes, the peoples of the region had long prepared a healthful fermented beverage out of cinchona bark (Gray 1809, 81–83; Mutis cited in Zimmerer 2006, 350). Others disputed these claims. Humboldt was of the opinion that the native peoples were not the discoverers of the drug plant, and that they "would rather die than have recourse to cinchona bark." He also considered it extremely improbable that "the discovery of the medicinal power of the cinchona belongs to the primitive nations of America" (Humboldt 1821, 22–23). English botanist Richard

Spruce, who would be pivotal in the cinchona story, also wrote that the Indians did not use it for fevers because they considered it a heating drug (in the humoral system), which one would never employ to treat a fever (Brockway 1979, 111). And Sir Clements Markham argued that the local Indians "attached little importance" to cinchona (Markham 1880, 6). But whatever the true explanation, it is clear that Britain had every reason to discredit indigenous knowledge and use of cinchona, which they ultimately did (Brockway 1979, 103–139).

But pretext for foreign appropriation of cinchona required more than simply priority of discovery and vague reference to the Great Chain of Being. And this the British marshaled through an environmental narrative. The Andean Indians, they argued, could not be trusted to protect a botanical resource of such critical importance to all of humanity. Arrot's early report of destructive harvest of cinchona bark was backed up by other eyewitnesses, who noted that South American *cascarilleros* (bark collectors) took no conservation precautions during harvest, simply felling the trees and stripping away their bark. Humboldt similarly commented that the harvest practices he witnessed were unsustainable. "The tree is felled in its first flowering season," he observed, and as a result "The older and thicker stems are becoming more and more scarce" (Humboldt 1850, 591). (Fig. 3) Humboldt was a keen observer of details, and his observations cannot be discounted out of hand. But it is difficult to gauge today whether Spanish colonial harvest practices in fact threatened the species

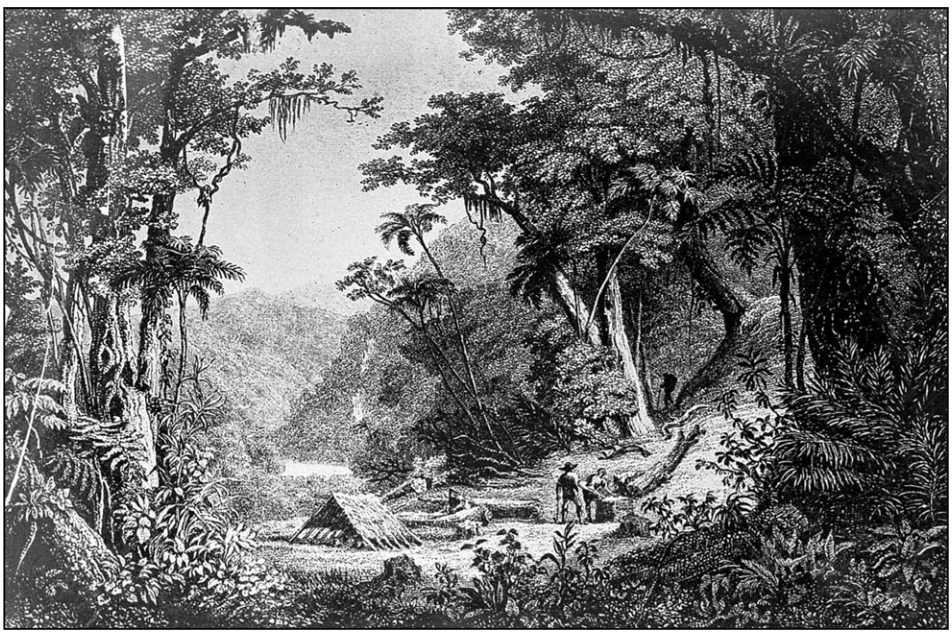

FIG. 3—Charles Laplante. 'The Gathering and Drying of Cinchona Bark in a Peruvian Forest.' 1867. Wellcome Library, London, Creative Commons, 20956i.

at the landscape level. Indeed, there was evidence that harvest techniques were less harmful in the long run than Humboldt and others envisioned. For instance, the seemingly destructive exploitation of cinchona trees that had taken place in earlier generations was apparently being corrected by the Jesuit clergy, who ordered that five new individual seedlings should be planted in the form of a cross for each tree felled to strip its bark (Gramiccia 1988, 10–11). More important, however, was the dissertation on cinchona written in 1839 by William Dawson Hooker. His conclusions contrasted with everything that had been written by outsiders. He argued that bark removal was more destructive than felling the trees because insects actively attacked the debarked individuals. When the tree was cut down, as was done by indigenous harvesters, it actively coppiced, and after six short years "the Cinchonas [were] again fit for cutting" (Hooker 1839, 14–15). The problem of overharvest, it would seem, was solved. Unfortunately, young Hooker died of yellow fever only a year later at the age of twenty-six, and his controversial findings were likely never noticed by those who should have seen them. Ironically, this also included his father, Sir William Jackson Hooker, who was poised to orchestrate an international plot to secret the cinchona seeds out of the Americas and transplant them in Asia.

Whether the harvest of cinchona was or was not sustainable, in the minds of Europeans, the inhabitants of the equatorial world were culturally backward, governed by instinct rather than intelligence, and intellectually incapable of managing their own botanical resources. And so, in order to protect this globally significant resource, the elder Hooker hatched a bold plan to pirate the precious cinchona seeds out of South America to Britain's colonies in Ceylon and India. "Given the profoundly destructive method of exploitation by the natives," he confided to a colleague, "the smuggling of precious cinchona seeds out of Bolivia represented a humanitarian act" (Cited in Jackson 2008, 38). Humanitarian, perhaps; but the real impetus for naturalizing cinchona in India was Britain's ongoing imperial ambitions. They had serious designs on West Africa, yet every expedition—save those with adequate supplies of quinine—had succumbed to the effects of tropical fevers (Brockway 1979, 127–133). Moreover, British India was witnessing massive malarial mortality, perhaps one million lives lost per year. If they could cultivate their own cheap source of quinine, British army officers and their families could operate without threat of bouts of malaria. In so many ways, the future of Britain's colonial enterprise depended on a cheap and readily available supply of life-giving Jesuit's bark (Honigsbaum 2002, 87–90).

The cinchona project, as coordinated by Kew Gardens in London, provided funds and logistics to facilitate the theft of cinchona seeds. The project was carried out by Clements Markham and Richard Spruce. Their letters made it clear that "jealousy" on the part of the local governments would be avoided by working undercover. Bribes and threats would be necessary, as the Bolivian government had granted a monopoly on their cinchona resource, and had

banned any export of the seeds. Spruce used USD $400 to secure land in the Andes, moved into a secluded hut, and began collecting ripe seed pods and seedlings of *Cinchona pubescens*, one of the quinine-bearing species. It was hugely difficult work, but he managed to smuggle almost 100,000 dried seeds and 637 seedlings over the Andes to the port of Guayaquil, where he put them on a ship bound for England. Spruce's huge cache was later shipped to India's Nilgiri Hills, where it became the nucleus for British cinchona production. The Jesuit bark monopoly was broken. As for Markham, he directed his efforts at Bolivia and Peru, where he collected seeds of *Cinchona calisaya*. He met considerable resistance from Peruvians, who were incensed that he was absconding with their national treasure. He slipped out of the country with a load of seeds, but by the time they finally reached India, the seeds were dead. Markham's major accomplishment was to whip up nationalist resentment and hostility among locals towards European biopirates, a sentiment that continues to this day.

The names Hooker, Markham, and Spruce are forever linked to either a great humanitarian feat or a monumental act of genetic theft and imperial conquest, depending on your perspective. As quinine became readily accessible, literally millions of lives were saved, and continue to be so. The real losers were Bolivia and Peru, which were deprived of their once endemic resource, the indigenous people of the Andes, whose knowledge of the healing properties of a local rainforest tree is now the world's knowledge, and the countries of West Africa and India, for which malaria could no longer act as "an ally" to autonomy (Brockway 1979, 132).

Conclusions

The European colonial era was marked by a quest to identify and exploit the healing properties of tropical nature. This search intensified as colonists battled hitherto unknown diseases in their distant possessions. Because most of the medicaments and therapies that they brought with them proved ineffective against this onslaught of novel germs and worms, they sought out local remedies for what ailed them. They came armed with Christian-inspired concepts regarding people-plant relations that helped guide their bioprospecting efforts. Among these was the geographically inspired notion that God had created a botanical cure for each and every disease in the same location from whence the disease originated. Identification of the correct herbal treatment, in turn, was facilitated by the Doctrine of Signatures. It was quickly appreciated, however, that indigenous and diasporic forest-dwellers represented better sources of plant knowledge than simply guessing what did or did not constitute a botanical signature. And so the medicinal plant identification efforts of outsiders were directed at shamans and community healers. If Europeans harbored any ethical issues regarding the acquisition of this knowledge, it was superseded by deeply held beliefs regarding indigenous people and their ethnobotanical knowhow.

Native peoples were seen as the custodians of this precious information, but they had not acquired it by means that would bring into question European ideas of real property.

In the case of Jesuit's bark, the English crafted an environmental destruction narrative to justify the theft of the most beneficial medicinal plant that has ever been discovered. Whether this plot and its outcome were morally justified at the time remains to be seen. The long term result failed to generate fabulous wealth for it protagonists, although it did democratize a drug that has saved countless lives. What is most clear, however, is that the British pirated away cinchona seeds because it served their long-term geopolitical objectives, regardless of the consequences for the indigenous people who discovered it, or the Andean countries from which it was appropriated.

The tropics are still seen as a potential cornucopia of valuable drug plants. But this vision is now grounded in ecological and biochemical insights rather than ancient theological musings. Nearly all current research is carried out following the codes of ethics developed by relevant professional societies, each inspired by language forthcoming from the 1992 Rio Convention on Biological Diversity and the 2010 Nagoya Protocol on Access and Benefit Sharing. And in spite of the claims of some issue entrepreneurs that we are the midst of a biopiracy epoch second only to the colonial era, there is no evidence that inappropriately exploited medicinal plants have enriched the coffers of a foreign corporation or a more developed country in the past century.

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