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Magic Darts and Messenger Molecules: A sensory ecology of human-plant engagements in indigenous Amazonia

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Abstract:	Recent scientific findings about plant intelligence are forcing anthropologists to reconsider indigenous theories of plant vitality. In this paper, we compare original ethnographic and ethnobotanical research among two different peoples from opposite extremes of lowland South America - the Makushi of Guyana and the Matsigenka of southern Peru - and explore how somatic experiences and chemonsensory properties of plants permeate indigenous understandings of illness etiology and medical efficacy in both the cosmological and microbiological domains. We synthesize emerging theory in ecosemiotics, embodiment, plant personhood, and plant intelligence with the concept of "sensory ecology" (Shepard 2004) to recast multi-species ethnography as a phytochemical, as well as a philosophical, endeavour.
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MAGIC DARTS AND MESSENGER MOLECULES:

A sensory ecology of human-plant engagements in Amazonia

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❖ Key words: Amazonia, Makushi, Matsigenka, ethnobotany, shamanism, sensory anthropology

1. Introduction: Magic darts

> *Waawî* is a tiny crystal, like a marble. It looks like an arrow, but with macaw feather wings. The *pia'san* [shaman] speaks to it; it shoots up in the air like a missile… it shoots into your chest and kills you straight away.

The Makushi elder Grandpa John was explaining shamanic spirit-darts to author Lewis Daly in July 2013 at Rewa village on the Rupununi River in southern Guyana. *Waawî* darts are the primary tools of shamans (*pia'san*): they are fired during shamanic warfare, extracted in curing rituals, and obtained during training from a category of plant-charms known as *bina* (Andel *et al*. 2015; Daly 2015). To illustrate these magical projectiles, John laboured over a sketch in Daly's field notepad (Figure 1). The result – a tiny cluster of dark lines – disappointed Daly, who initially wrote the seemingly incoherent scribbling off to John's arthritis and failing eyesight.

In 2017, Daly came to the Goeldi Museum in Belém, Brazil to work with author Glenn Shepard. Together, we read up on the botany and chemistry of *bina* plants for clues to Makushi concepts. *Bina* charms come from many botanical families, but most belong to the Araceae, a family known to contain a class of toxic phytochemicals called "raphides." These microscopic, needle-like crystals of calcium oxalate (Figure 2) puncture tissues causing stinging, irritation and inflammation in what is called the "needle effect" (Konno *et al*. 2014: 1). In light of this, we came to

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appreciate Grandpa John's sketch as a sophisticated representation of a pathogenic process taking place at a microscopic scale.

This chemistry may also be significant in the phenomenon of *kanaimà* assault sorcery in the Guyana region (Butt Colson 2001; Wilbert 2004). According to the Makushi, *kanaimà* dark shamans use powerful *bina* plants to master special pathogenic darts in order to incapacitate their victims. Following this, they pierce the victim's tongue with snake fangs and scrape out the rectal sphincter with an iguana or armadillo tail. Anthropologists have interpreted the symptoms of *kanaimà* assault as a symbolic inversion of ingestion: mouth swollen shut like a sphincter, rectum open like a mouth (Whitehead 2002). Yet these also match the mucosal and gastrointestinal symptoms caused by exposure to large doses of calcium oxalate (Desphande 2002: 553; Hayes 2008: 990). This finding does not "explain away" *kanaimà* sorcery or the widespread concept of magic darts in Amazonian shamanism (see Chaumeil 1993). Rather, it reveals a chemosensory pathway connecting these more widespread ideologies to a particular Makushi logic of substance.

In this paper, we compare original ethnographic research among the Makushi people of Guyana and the Matsigenka people of Peru, exploring how chemosensory experiences permeate indigenous understandings of etiology and efficacy in the cosmological and microbiological domains. We synthesize emerging theory in ecosemiotics, embodiment, plant personhood, and plant intelligence with the concept of "sensory ecology" (Shepard 2004) to recast multispecies ethnography as a phytochemical, as well as a philosophical, endeavour.

2. Amazonian Phyto-Worlds

Plants and people are entwined in deep historical partnerships. Indigenous agroecological systems are typically characterised by an extraordinary diversity of wild and cultivated plants (Rival 2001; Daly 2016). Biodiversity is associated with the transformative powers of shamans (Shepard 1999), while cosmic energy-flows echo rain forest ecology (Reichel-Dolmatoff 1976). In this frame, the Yanomami shaman Davi Kopenawa describes shamanic visions through an encyclopaedic concatenation of plant and animal species (Kopenawa and Albert 2013). Likewise, among the Sambia forest people of New Guinea, Herdt (1981) shows how the morphology, reproductive biology and sensory properties of keystone tree species furnish essential metaphors for ritual and sexual symbolism. Thus indigenous engagements with

tropical biodiversity are both pragmatic and ideological, multisensory and multi-scalar, reflecting what Lévi-Strauss (1969) termed the "science of the concrete."

Despite their centrality to indigenous lifeways and cosmologies, plants remain at the margins of mainstream anthropological theory (Rival 2012: 69). Recently, however, a group of anthropologists has begun to explore the botanical world from an anthropological perspective (Daly *et al*. 2016; Kawa 2016; Hartigan 2017; Myers 2017), a project which has been dubbed 'anthrobotany' (Daniel Moerman, pers. comm. 2005) or 'planthropology' (Myers 2017), and whose chief method we term *phytoethnography*. In this paper we explore the role of sensory experience in mediating people-plant engagements through a cross-cultural comparison of our original research among the Makushi (Daly 2015) and Matsigenka (Shepard 2004).

- The Makushi

The Carib-speaking Makushi people live in the North Rupununi region of southwestern Guyana. Numbering around twelve thousand people in Guyana, the Makushi have endured a long and tumultuous history of contact with various colonial and postcolonial forces. Makushi gardeners cultivate hundreds of species and varieties of crops (Daly 2016), and as such have an intimate and sophisticated understanding of the living logics of plants (Daly 2015). Put simply, Makushi social and ritual life is unthinkable without plants. To be Makushi is to farm in the rain forest (*yu*), and to perpetually engage with its diverse inhabitants – plant, animal, and spirit (Figure 3).

- The Matsigenka

The Matsigenka live in the Amazon headwaters in southern Peru. They currently number some thirteen thousand people living throughout the Urubamba, upper Madre de Dios, and Manu River basins. Matsigenka is an Arawakan language, and the term *matsigenka* means 'person' or 'people', including the human essence of animals, certain plants and other beings. The Matsigenka hunt, farm, fish and gather, depending on a tremendous diversity of wild and cultivated resources for their sustenance. Since the 1980s, gas exploration has increasingly affected communities in the lower Urubamba region.

3. What kind of People are Plants?

For many Amazonian peoples, nonhuman agents can be "persons" or "subjects" (cf. Viveiros de Castro 1998). In such cosmologies, personhood and corporeality are typically thought of as being fabricated via the sharing of substances and essences between bodies of different kinds (Vilaça 2002; Santos-Granero 2012). In recent decades, anthropologists of lowland South America have made great strides in theorising nonhuman subjectivity in such cosmologies (Descola 2013). Yet these formulations tend to generalise the diversity of nonhuman agency while reducing biological organisms to symbolic referents (Kohn 2013). While animals and the metaphor of predation play a central role, plants have been mostly overlooked (but see Shepard 2004; Wright and Taylor 2009; Rival 2012; Oliveira 2016). Here, we underscore the centrality of botanical beings and plant-based substances in Amazonian cosmologies.

For the Makushi, plants can be "persons" (*pemon*), and are routinely spoken of, and spoken to, in subjective terms. As one gardener told Daly, "Plants? They are people!" Personhood is ultimately determined by possession of a "soul" (*ekaton*), the vital essence which "brings life to things." The soul, in turn, is constituted of shimmering light energy (*a'ka*), which ultimately emanates from the sun (*wei*): a photosynthetic cosmology if there ever was one. The possession of *ekaton* unites plants, animals, and humans in an integrated web of cosmic sociality. However, what the Makushi mean by "soul" should not be conflated with Western concepts. The soul infuses the substance or "body" (*esak*) of the plant in complex and uncertain ways. Its curative or toxic properties may be seen as a direct expression of this holistic spirit, as revealed through specific sensory properties. As with many Amazonian cosmologies, such unified body/soul concepts defy Cartesian dualism (e.g. Taylor 1996).

For the Matsigenka, some, but not all plants, can be people. Although plants "grow," a manifestation of their "life force" (*ani*), they don't "walk" or express other signs of volition; thus the Matsigenka treat most plants as inanimate beings (Shepard 2018). There are exceptions: the rubber tree (*Hevea brasilensis*), and other latex-containing plants are treated as animate due to their elastic resin. Psychoactive plants are considered to be animate beings with spirit "masters" (*itinkami*) who appear in human form. The Matsigenka word for spirit, *suretsi*, also refers to the heartwood or pith of a plant. Analogous to the Makushi case, *suretsi* can refer to the pharmacological principles of medicinal and toxic plants. When a plant is heated in water, its soul "contaminates" or "infuses" (*okitsitinkake*) the brew. When a person

drinks the decoction, the soul of the plant, manifest in its taste, odour and colouration, "infuses" the body with this the holistic substance/soul.

Although substance sharing is well documented in Amazonia (Santos-Granero 2012), we highlight the centrality of plants for substance-based transfers, and the key role of chemosensation in mediating them. Qualities, capacities and knowledge can be acquired by humans via the bodily incorporation of plants and other subjectivities. In order to fully appreciate plant personhood, then, it is imperative to investigate sensory perceptions and phytochemical components of shamanic and medicinal plants: what might be referred to as the 'logic of substantivity.'

4. The Concept of Medicines as Poisons

The Amazon rain forest harbours a vast trove of medicinal, bioactive and toxic plants: of 150 known psychoactive plants from around the world, 130 (87%) are from South America, mostly the Amazon Basin (Schultes and Raffauf 1990). Most bioactive plants contain alkaloids, nitrogen-containing compounds of low molecular weight that traverse cell membranes, causing physiological effects. Thousands of toxic plants have been discovered by indigenous peoples of the Amazon as medicines, poisons and shamanic substances (for example, see Hutukara 2015). Many plants used in indigenous medicine and ritual have strong chemosensory properties, and are commonly described as being "bitter", "poisonous", "pungent" or "strong" by local healers. Chemosensory potency is often instrumental to understanding efficacy: the strongest medicines are also the strongest poisons (Shepard 2004, 2015).

- Makushi: Bitter manioc, bitter bulbs

Poisonous plants are fundamental in Makushi society and ritual. Daily life depends upon the harvest and detoxification of cyanide-containing bitter manioc (*Maniot esculenta*, *kîse* in Makushi). The transformation of this deadly poison into a life-giving foodstuff is a source of immense pride for Makushi people; as a village leader exclaimed with passion, "We are scientists! We turn poison into food!" Poison (*kawi*) is also integral to the structural dynamics of Makushi cosmology. Poisonous plants and snakes (*kîi*) are mythically entwined, emerging from one another's bodies in the highly transformational "beginning times" (*pia'ton*) (cf. Rivière 1994).

Makushi plant medicines often involve plant-to-human substance transfers. Many medicinal plants are toxic, poisonous, irritating, astringent, or bitter (*mai*), with

their efficacy or "strength" (*meruntî*) residing in this chemosensory potency (see Figure 4). The category of *bina* plant-charms includes a diversity of species used for myriad purposes. Most belong to the Araceae, Amaryllis, and Iris families, some of which are known to contain the needle-like raphide toxins noted above (Andel *et al*. 2015). Plant-charms are typically rubbed into lacerations on the recipient's body, or dripped into the eyes or ears. The potent substances contained in these plants, and the extreme sensory reactions they induce, are instrumental in their power as charms or cures.

- Matsigenka: Invisible worms, eagle eyes and ergot

Toxicity is fundamental to Matsigenka medicine, as encapsulated in the concept of *kepigari*. The word comes from the root *-piga-*, "to return, spin," and by extension "to feel dizzy; to be intoxicated; to go insane." *Kepigari* refers to all toxic, narcotic and psychoactive substances as well as lethal poisons. Plants and other substances that are *kepigari* are often "bitter" (*kepishiri*), "painful/pungent" (*katsi*), or have an "intoxicating odor" (*kepigarienka*). The Matsigenka seek out bitter, pungent and other toxic plants as medicines because their toxic properties are said to hurt, kill, gather together and expel intrusive pathogenic agents, conceptualized as microscopic worms, or *tsomiri* (Shepard 2004). Toxic plants are also important as hunting medicines. A man can "lose his aim" by eating improperly cooked meat, by having sex prior to a hunt, or from menstrual blood. These transgressions make his body reek of carrion or raw blood (*janigarienka*) and infuse him with the spirit of the vulture (*tisoni*), frightening game animals and offending their spirit-masters. Matsigenka hunters use purgative and emetic plants to clean themselves of these odors and imbue their body with the spirit of the harpy eagle (*pakitsa*), the epitome of hunting prowess. They also apply caustic plant juices to their eyes to give eagle-eye vision (Figure 5). The psychoactive nightshade *Brunfelsia* produces dizziness, nausea and a needle-like prickling sensation in the hands and feet described as *tseki-tseki-tseki-tsek!*, a physiological manifestation of the plant's harpy eagle soul infusing the body (Shepard 2002).

Like the Makushi, the Matsigenka use toxic Araceae species. One caustic *Philodendron* is extremely effective for caterpillar stings (Figure 6). A milder species treats cataracts and conjunctivitis. The highly toxic *Dieffenbachia* sp. is used as an abortifacient, a hunting purgative, and to inflict sorcery illness. However, the

botanical group most similar to the *bina* of the Makushi in terms of uses and function is a diverse set of cultivated sedges (*Cyperus* spp.) with bitter, aromatic bulbs known as *ivenkiki* (Shepard 2002). The Matsigenka recognize dozens of sedge varieties with variable uses ranging from fever, headache and snakebite to fertility control to treating or causing insanity to imbuing cultural skills such as hunting, weaving and singing. Such diverse uses might be dismissed as "magic" or superstition. However pharmacological studies revealed a mutualistic infection of the fungus *Balansia cyperi* (Plowman *et al*. 1990), related to rye ergot (*Claviceps purpurea*), the botanical source of LSD. Like rye ergot, *Balansia* fungus produces ergot alkaloids, known to constrict blood vessels, alter uterine contractions, and at high doses cause convulsions and hallucinations. Many Matsigenka uses are coherent with the physiological properties of ergot alkaloids.

5. Becoming Plant, Becoming Person

Among the Makushi, shamanic training involves the consumption of copious doses of tobacco (*kawai*) and other toxic plants. During apprenticeship, the shaman (*pia'san*) becomes an *esak* of plants, a word meaning both "master" and "body." Thus shamanic learning is a corporeal as well as spiritual enterprise, as the body becomes infused with the substance and subjectivity of master plants. During healing rituals known as "beating leaf", shamanic spirits – including *waawî* spirit-darts – feed upon pungent cigar smoke (Figure 7). Among the Matsigenka, too, tobacco and shamanism are synonymous: the shaman is *seripigari*, "the one intoxicated by tobacco." Tobacco is judged by how painful (*katsi*) and intoxicating it is, which is also a measure of the shamanic strength of the person who prepared it (Figure 8). Tobacco and other toxic and psychoactive plants are like food for shamans and their spirit allies: as their powers grow, shamans come to relish the pungent nourishment of tobacco over ordinary food (Shepard 2015). In both cases, the shaman might be thought of as part-plant.

The Matsigenka and other peoples of the Western Amazon consume the hallucinogenic plant brew known as ayahuasca during shamanic rituals. Ayahuasca and other shamanic plants are referred to as "plant teachers" who impart knowledge directly to the apprentice shaman (Luna 1984; Shepard 2018). Likewise, the Makushi refer to shamanic master plants as "*piai*-plants," a term that means both "plants used by shamans" and "plants that *are* shamans". Thus these powerful plants are shamans

themselves, capable of teaching, transforming, and physically inhabiting their human apprentices.

The process of corporeal transfer can also work in reverse: human bodily fluids can be placed into plant tissue in order to alter the plant for shamanic ends. For the Makushi, certain plants are "omens" (*paanî*), possessing clairvoyant powers. These plants tend to have caustic tissues, notably *Dieffenbachia* sp., an Araceae with particularly high concentrations of raphide crystals. If an ill (*paran, i.e.* cursed) individual places a few drops of their blood into a notch cut in the plant's stem, the enemy who cursed them will be revealed in a dream (*we'ne*): this is embodiment in reverse, flowing from person to plant. Among the Matsigenka, a similar procedure involves applying the toxic sap of *Dieffenbachia* and other caustic plants to the hair, clothing or footprint of a victim in order to inflict a lethal inflammatory illness. Thus the flow of substances and the concomitant transfer of power and knowledge is bidirectional, mediated by and encoded within specific chemical sensations.

6. Plant Intelligence, Messenger Molecules and the Anthropocene

Plants transmit information within themselves, to one another, and to fungi, animals and the biosphere. Plant-animal interactions have been especially important drivers of evolution, involving visual and tactile as well as biochemical signals. Indeed, plants even control weather: Amazonian trees create aromatic compounds that serve as condensation nuclei, seeding the clouds for rain (Loomis 2017). Underground, plants and fungi live in intimate symbiotic associations, forming vast subterranean communication networks (Tsing 2015: 138). Inherently communicative, these multispecies assemblages traverse the biosphere. Much plant-human communication takes the form of what Donna Haraway has called "non-linguistic embodied communication" (2008: 27), working via somatic and semiotic transfers. Indigenous understandings of plant substances as both material and spiritual agents defy Cartesian dualism, while confounding the distinction between signifier and signification.

Recent work suggests that plants exhibit complex and *sui generis* forms of intelligence (Trewavas 2003; Pollan 2012), learning and memory (Gagliano *et al*. 2018). Gottlieb and Borin (2005: 34) suggest that alkaloids and polyphenols, the most important compounds driving animal-plant interactions, did not emerge for their apparent ecological function in attracting or deterring predators. Instead, these

compounds likely evolved to communicate information across cell membranes. Trewavas points out that "the suite of molecules used in signal transduction are entirely similar between [animal] nerve cells… and plant cells" (2003: 2). In other words, phytochemicals represent a kind of biospheric nervous system. Such findings give new levels of insight into indigenous understandings of "plants as teachers" (Shepard 2018).

However, it is important to consider these findings critically. Myers (2015) and Hustak and Myers (2012) marshal a feminist reading of recent as well as classic research on plant communication into a critique of the reductionist, "disenchanting" neo-Darwinian epistemologies and Western cultural bias infusing much published scientific work on plant chemistry and ecology. However, some scientists grappling with the molecular basis of plant communication find metaphors derived from human communication to be misleading. As Melissa, a graduate student at a U.C. Davis lab studying plant circadian rhythms, mused to Natasha Myers (2015: 47),

> To assume that a plant is maybe passively, or responding in a way that is caused by a chain of biochemical reactions is to say it is less important than whatever a human is doing. And I think that is not true… It is as if you are suggesting that to characterize it that way [at the molecular level] is to be completely insufficient. [It's as if there] has to be more there. And I think it is important, and it's arguably sufficient the way it is.

Our purpose here is to show how, if treated with epistemological nuance and care, indigenous knowledge and laboratory science can illuminate one another, without privileging one way of knowing over the other. Such synergies are all the more striking when we consider the tremendous philosophical and cultural differences between indigenous and Western ways of knowing and being, and should give pause to anthropologists who would dismiss science for its colonial and patriarchal legacies.

There is a deeply political dimension to human-plant engagements. Plants are silent political agents, acting as semiotic, ecological, and chemical mediators between indigenous societies and outside forces. Plant-politics play out in the peripheral and contested spaces that emerge between indigenous and state society, between the world of the forest and the market economy (Tsing 2015). Deforestation, for instance, violently disrupts the complex ecosemiotic network of plant-animal communication, leading to continent-wide – even global – shifts in rainfall, biodiversity loss and ecosystem collapse (Lovejoy and Nobre 2018). These escalating ecological impacts

bring about cascading consequences for the lives and cultures of indigenous peoples. Indigenous activists across Amazonia are campaigning against the appropriation of their lands and traditional environmental knowledge by corporate and state interests (Conklin and Graham 1995; Kopenawa and Albert 2013).

Indigenous phyto-philosophies can teach us a great deal about sustainability and multispecies relationality in the Anthropocene era (Brightman and Lewis 2017). Indeed, as awareness of anthropogenic impacts on the environment increases, anthropologists are beginning to pay greater attention to chemical ecologies (Shapiro and Kirksey 2017; Tsing *et al*. 2017). In this vein, our research emphasises the central role of plant compounds in mediating human-plant relationships and undergirding socio-ecological systems. If forests think, they most certainly do so with phytochemicals; not with the kinds of signs and symbols that anthropologists are accustomed to analysing (Kohn 2013).

7. Conclusion

> The more deeply we commit ourselves to studying a people, the more impossible it becomes to ignore what they say and think (Herdt 1981: 128)

The biggest challenge facing multispecies ethnography (Kirksey and Helmreich 2010), as we see it, is a methodological one. The conventional methods of social anthropology are not sufficient for investigating the complex and elusive relationships that transpire across species boundaries (Tsing 2015). As Eduardo Kohn (2013) has argued, interspecies relations are inherently semiotic, involving sign flows across species boundaries. And yet sensory experience and phytochemistry have been overlooked in much multispecies discourse. Human-plant relations are intrinsically sensory, and are often mediated through chemosensation. Our ethnographic findings suggest new avenues of analysis into the semiotics, pragmatics, and metaphysics of human-plant engagements – in line with what Shepard (2004) has dubbed "sensory ecology." We are interested in the complex ways people think about, and think with, plant-life. Anthropological methods are of course fundamental to this enterprise, and yet as we have shown, phytochemical, ecological and even atmospheric studies sometimes provide unexpected avenues of insight into the deeper cultural meanings of plants for indigenous people. If we are to take their insights seriously, we must take

all of their insights seriously, not just the ones that appear to appeal most directly to our particular discipline. Such two-way dialogue will be especially important in collaborative research arrangements between indigenous peoples, scientists and anthropologists in different parts of Amazonia (Abraão *et al*. 2008; Hutukara 2015).

After Grandpa John made that tiny sketch drawing, it took over four years, combining the observations of two ethnobotanists and a thorough survey of published literature, to reveal the profound wisdom contained there. This is not to say that every element of indigenous ideology must be backed up by scientific facts to be considered valid; nor will all scientific findings resonate with indigenous philosophies. But rather than being reductionist, seeking to simplify socio-cultural phenomena to mechanistic underpinnings, this approach could be called "additionalist," seeking out synergies between indigenous and bioscientific insights that reveal a more complete view of the vast, mysterious universe we all inhabit together. This perpetually unfolding discovery of deeper meanings is the very essence of both scientific inquiry and shamanism.

Figures:

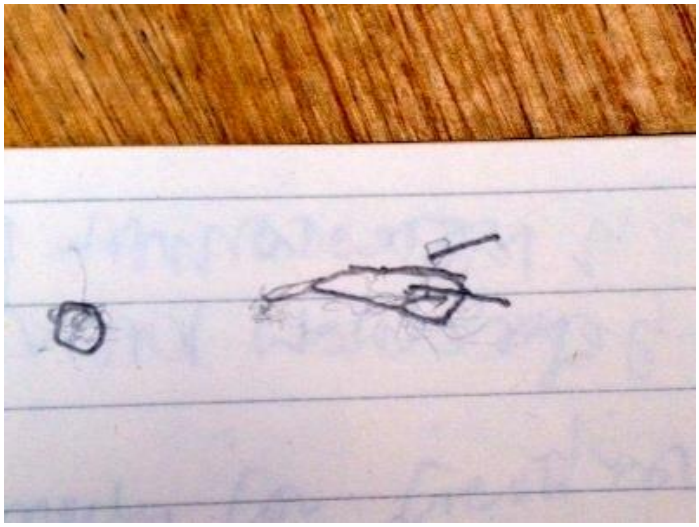

Figure 1. Grandpa John's tiny drawing of a *waawî* spirit-dart.

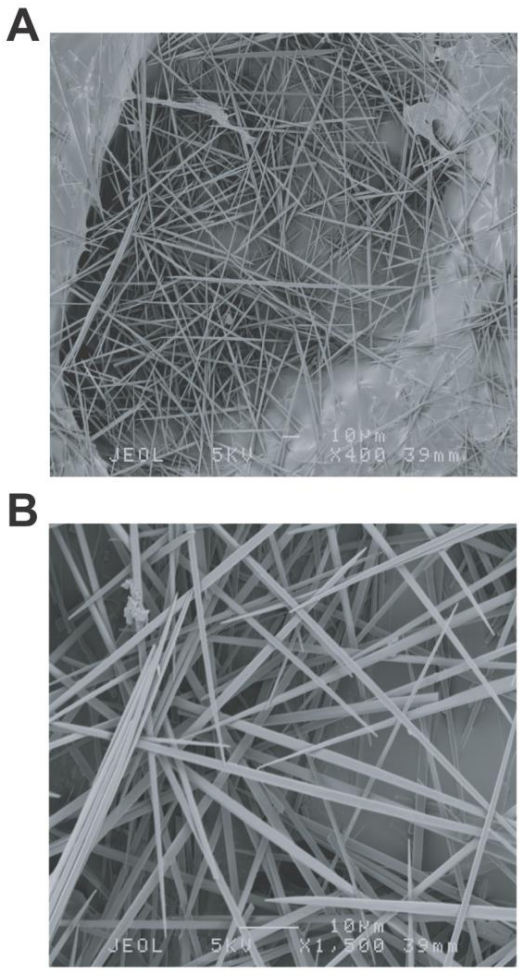

Figure 2. Raphides in plant tissue (Konno *et al*. 2014: 2).

Figure 3. A Makushi farmer with the fish-poison plants in his garden (*mîî*).

Figure 4. A highly toxic fish poison plant (*aya*) – also used as a medicine.

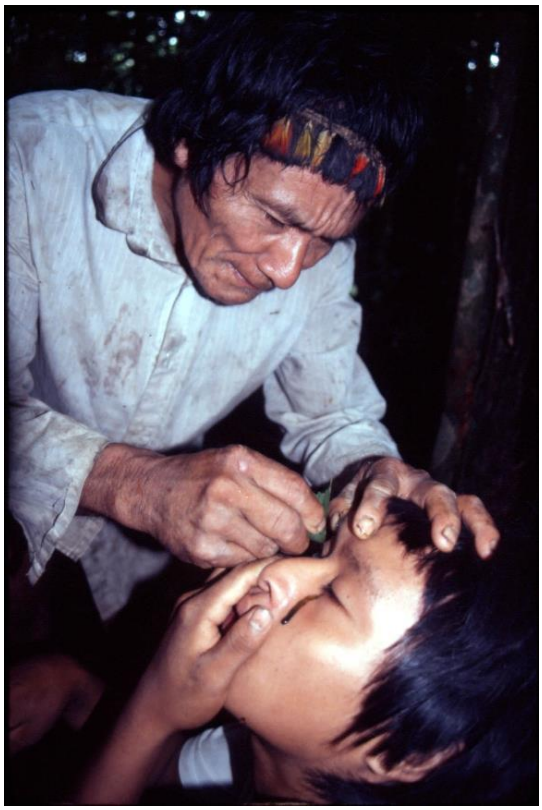

Figure 5. Matsigenka hunters apply painful eye-drop medicines to improve their aim.

Figure 6. A Matsigenka healer using a caustic Araceae to treat Shepard for a painful caterpillar sting.

Figure 7. A Makushi shaman (*pia'san*) conducting a healing ritual.

Figure 8. For the Matsigenka, the more painful the tobacco snuff, the more powerful the shaman.

Figure 9. A Makushi farmer and her grandson in a cassava farm.

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