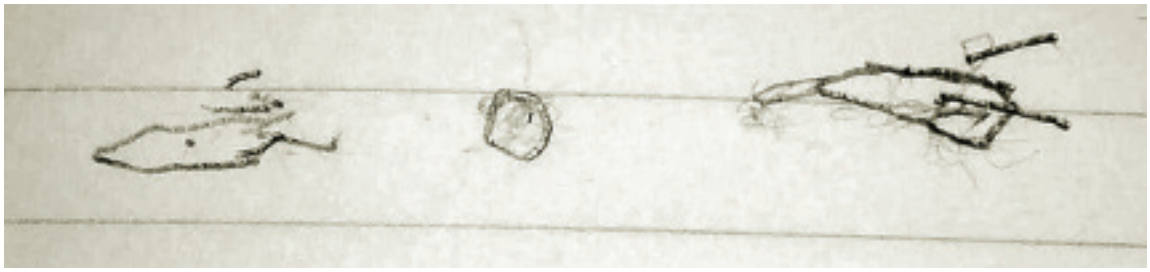
# Magic darts and messenger molecules

## Toward a phytoethnography of indigenous Amazonia

**LEWIS DALY & GLENN SHEPARD JR**

*Lewis Daly is a social anthropologist and ethnobotanist who lectures in environmental anthropology at University College London (UCL). Lewis is currently working on a series of articles on human-plant engagements in Makushi culture and cosmology. He is co-editor of the online magazine* TEA: The Ethnobotanical Assembly. *His email is: l.daly@ucl.ac.uk. Glenn H. Shepard Jr is an ethnobotanist, medical anthropologist and film-maker based at the Museu Paraense Emílio Goeldi (MPEG) in Belém, Brazil. He is engaged in fieldwork among the Matsigenka people of southern Peru, studying traditional medicine, health status, ethnobiology and community-based resource management. He is currently working on a monograph entitled 'Sorcery and the senses'. He blogs at* Notes from the Ethnoground *(ethnoground.blogspot.com). His email is: gshepardjr@gmail.com.*



LEWIS DALY

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

### Magic darts

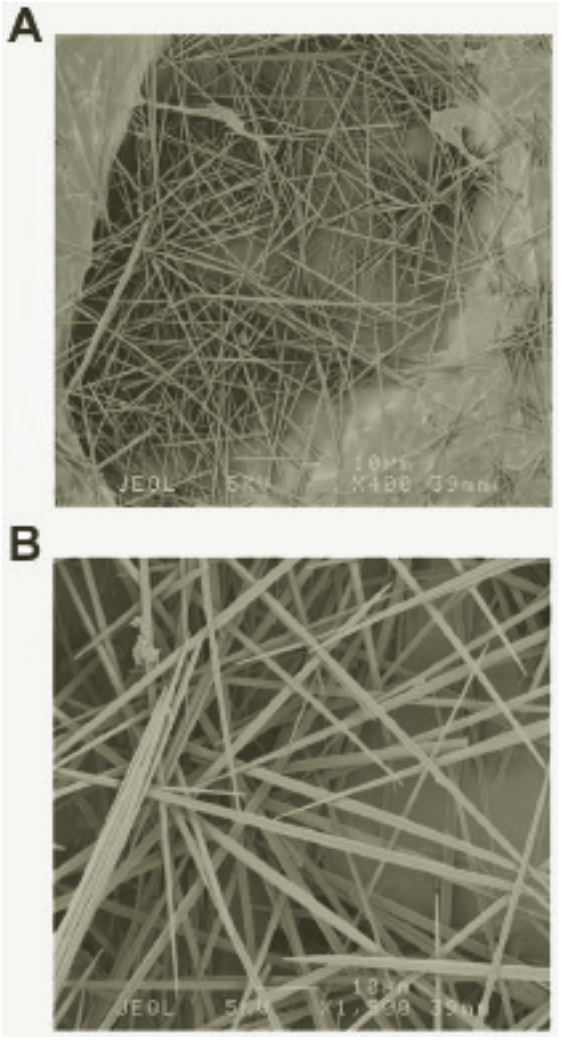
> *Waawî* is a tiny crystal, like a marble. It looks like an arrow, but with macaw feather wings. The *pia'san* [shaman] speaks to it; it shoots up in the air like a missile … it shoots into your chest and kills you straight away.

The Makushi elder, Grandpa John, was explaining shamanic spirit darts to Lewis Daly in July 2013 in 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* (Daly 2015; van Andel et al. 2015). To illustrate these 'magical' projectiles, Grandpa John laboured for a while over a sketch in Daly's field notepad (Fig. 1). The result – a tiny cluster of dark lines – disappointed Daly, who initially wrote off the seemingly incoherent scribbling to John's arthritis and failing eyesight.

In 2017, Daly came to the Museu Paraense Emílio Goeldi (MPEG) in Belém, Brazil to work with 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, or calla lily family, a botanical group known to contain a class of toxic phytochemicals called 'raphides'. These microscopic, needle-like crystals of calcium oxalate (Fig. 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 appreciate Grandpa John's sketch as an accurate representation of a pathogenic process taking place on 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 victims' tongues with snake fangs and scrape out their rectal sphincters 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 article, 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 aetiology 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.




K. KONNO

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

### Amazonian phytoworlds

Plants and people are entwined in deep historical partnerships. Indigenous agroecological systems are typically characterized by an extraordinary diversity of wild and cultivated plants (Daly 2016; Rival 2001). Biodiversity is associated with the transformative powers of shamans (Shepard 1999), while cosmic energy flows echo rainforest 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 & 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

We acknowledge support from Brazil's National Research Council (CNPq) through Programa de Capacitação Institucional (PCI) and thank the Grant Office and Human Sciences Division at the Museu Paraense Emílio Goeldi (MPEG) in Belém, Brazil. Shepard's field research was supported by the Wenner Gren Foundation and the National Science Foundation. His ongoing work is supported by CNPq productivity grants (Proc. 309064/2009-0, 308991/2015-0). Daly's research in Guyana from 2011-2016 was supported by the School of Anthropology at the University of Oxford. Fieldwork was made possible by a scholarship from the Economic and Social Research Council (Award Number: ES/I016694/1).

Abraão, M. et al. 2008. Ethnobotanical ground-truthing: Indigenous knowledge, floristic inventories and satellite imagery in the upper Rio Negro, Brazil. *Journal of Biogeography* 35(12): 2237-2248.

Brightman, M. & J. Lewis (eds) 2017. *The anthropology of sustainability: Beyond development and progress.* London: Palgrave Macmillan.

LEWIS DALY

**Fig. 3.** *A farmer among the fish poison plants (*a'ya*) in his garden.*

species furnish essential metaphors for ritual and sexual symbolism. Thus, indigenous engagements with tropical biodiversity are both pragmatic and ideological, multisensory and multiscalar, reflecting what Lévi-Strauss (1966) termed the 'science of the concrete'.

Despite their centrality to indigenous lifeways and cosmologies, plants remain on the margins of mainstream anthropological theory (Rival 2012: 69). Recently, however, a group of anthropologists have begun to explore the botanical world from an anthropological perspective (Daly et al. 2016; Hartigan 2017; Kawa 2016; 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 article, 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 12,000 people in Guyana, the Makushi have endured a long and tumultuous history of contact with various colonial and post-colonial 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, for the Makushi, social and ritual life is unthinkable without plants. To be Makushi is to farm in the rainforest (*yu*) and to perpetually engage with its diverse inhabitants – plant, animal and spirit (Fig. 3).

## The Matsigenka

The Matsigenka live in the Amazon headwaters in southern Peru. They currently number some 13,000 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 .

## What kind of people are plants?

For many Amazonian peoples, non-human 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 (Santos-Granero 2012; Vilaça 2002). In recent decades, anthropologists of lowland South America have made great strides in theorizing non-human subjectivity in such cosmologies (Descola 2013). Yet these formulations tend to generalize the diversity of non-human 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 de Oliveira 2016; Rival 2012; Shepard 2004; Wright & Taylor 2009). 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 the possession of a 'soul' (*ekaton*), the vital essence which 'brings life to things'. The soul, in turn, is composed of shimmering light energy (*a'ka*), which ultimately emanates from the sun (*wei*) – a photosynthetic cosmology if ever there 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 (Taylor 1996).

For the Matsigenka, some – but not all – plants can be people. Although plants 'grow' – which is 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 or soul, *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 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 played by 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 the sensory perceptions


Butt Colson, A. 2001. Itoto (kanaima) as death and anti-structure. In Rival & Whitehead (2001).

Chaumeil, J.P. 1993. Del proyectil al virus: El complejo de dardos-mágicos en el chamanismo del oeste Amazónico. In C.E. Pinzon (ed.) *Cultura y salud en la construcción de las Américas*, 261-277. Bogota: Instituto Colombiano de Antropología.

Conklin, B.A & L.R. Graham 1995. The shifting middle ground: Amazonian Indians and eco-politics. *American Anthropologist* (N.S.) 97(4): 695-710.

Daly, L. 2015. What kind of people are plants? The challenges of researching human-plant relations in Amazonia. *Engagement* (blog), December. https://aesengagement.wordpress.com/2015/12/08/what-kind-of-people-are-plants-the-challenges-of-researching-human-plant-relations-in-amazonian-guyana/.

— 2016. Cassava spirit and the seed of history. *Commodity histories blog,* February. http://www.commodityhistories.org/research/cassava-spirit-and-seed-history.

— et al. 2016. Integrating ontology into ethnobotanical research. *Journal of Ethnobiology* 36(1): 1-9. https://doi.org/10.2993/0278-0771-36.1.1.

de Oliveira, J.C. 2016. Mundos de roças e florestas. *Boletim Do Museo Paraense Emílio Goedi, Ciências Humanas* 11(1): 115-131.

Descola, P. 2013. *Beyond nature and culture* (trans.). J. Lloyd. Chicago, IL: University of Chicago Press.

Desphande, S.S. 2002. *Handbook of food toxicology.* New York: Marcel Dekker.

Gagliano, M. et al. 2018. Plants learn and remember: Lets get used to it. *Oecologia* 106(1): 29-31.

Gottlieb, O.R. & M.R. de M.B. Borin 2005. Insights into evolutionary systems via chemobiological data. In E. Elisabetsky & N. Etkin (eds) *Ethnopharmacology: Encyclopedia of life support systems,* 25-70. Oxford: UNESCO/Eolss Publishers.

Haraway, D. 2008. *When species meet*. Minneapolis, MN: University of Minnesota Press.

Hartigan Jr, J. 2017. *Care of the species: Races of corn and the science of plant biodiversity.* Minneapolis, MN: University of Minnesota Press.

Hayes, A.W. (ed.) 2008. *Principles and methods of toxicology.* (5th edition). New York: Informa Health Care.

**Fig. 4.** *The bitter, aromatic bulb of a* bina *plant charm (*Cyperus sp.*).*
**Fig. 5.** *Matsigenka hunters apply painful eye-drop medicines to improve their aim.*
**Fig. 6.** *A Matsigenka healer using a caustic Araceae to treat Shepard for a painful caterpillar sting.*

and phytochemical components of shamanic and medicinal plants – what might be termed the 'logic of substantivity'.

## The concept of medicines as poisons

The Amazon rainforest harbours a vast trove of medicinal, bioactive and toxic plants: of 150 known psychoactive plants from around the world, 130 (87 per cent) are from South America, mostly the Amazon basin (Schultes & 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 Association 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 a fundamental part of 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 to Daly, with great 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, having emerged 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. The category of *bina* plant charms includes a diversity of species used for myriad purposes. Most belong to the Araceae, Amaryllis, Iris or Cyperaceae (sedge) families, all members of the monocotyledonous ('Monocot') superorder of plants known for the frequent presence of the needle-like raphide toxins noted above (van Andel et al. 2015). These plant charms, which tend to have fleshy storage organs such as bulbs (Fig. 4 – *Cyperus* sp.), 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, 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 odour' (*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


LEWIS DALY


GLENN SHEPARD


GLENN SHEPARD


Herdt, G. 1981. *Guardians of the flutes,* vol.1; *Idioms of masculinity.* Chicago, IL: University of Chicago Press.

Hustak, C. & N. Myers 2012. Involutionary momentum: Affective ecologies and the sciences of plant/insect encounters. *Differences* 23(3): 74-118.

Hutukara Association 2015. *Manual of traditional Yanomami remedies.* Boa Vista, Brazil: Hutukara Associação Yanomami.

Ingold, T. 2013. Anthropology beyond humanity. *Suomen Antropologi: Journal of the Finnish Anthropological Society* 38(3): 5-23.

Kawa, N. 2016. How religion, race, and the weedy agency of plants shape Amazonian home gardens. *Culture, Agriculture, Food and Environment* 38(2): 84-93.

Kirksey, E. & S. Helmreich 2010. The emergence of multispecies ethnography. *Cultural Anthropology* 25(4): 545-576.

Kohn, E. 2013. *How forests think: Toward an anthropology beyond the human.* Berkeley, CA: University of California Press.

Konno, K. et al. 2014. Synergistic defensive function of raphides and protease through the needle effect. *PLOS One* 9(3): 1-7.

Kopenawa, D. & B. Albert 2013. *The falling sky: Words of a Yanomami shaman.* Cambridge, MA: Harvard University Press.

Lévi-Strauss, C. 1966. *The savage mind.* London: Weidenfeld and Nicolson.

Loomis, I. 2017. Trees in the Amazon make their own rain. *Science,* 4 August. doi:10.1126/science.aan7209.

Lovejoy, T.E. & C. Nobre 2018. Amazon tipping point. *Science Advances* 4(2): eaat2340.

Luna, L.E. 1984. The concept of plants as teachers among four mestizo shamans of Iquitos, northeastern Peru. *Journal of Ethnopharmacology* 11(11): 135-156.

Myers, N. 2015. Conversations on plant sensing: Notes from the field. *NatureCulture* 3: 35-66.

— 2017. From the Anthropocene to the Planthroposcene: Designing gardens for plant/people involution. *History and Anthropology* 28(3): 297-301.

Plowman, T.C. et al. 1990. Significance of the fungus *Balansia cyperi* infecting medicinal species of *Cyperus* (Cyperaceae) from Amazonia. *Economic Botany* 44(4): 452-462.
Pollan, M. 2013. The intelligent plant. *The New Yorker* 89: 92-105.
Reichel-Dolmatoff, G. 1976. Cosmology as ecological analysis: A view from the rain forest. *Man* 11(3): 307-318.
Rival, L. 2001. Seed and clone: The symbolic and social significance of bitter manioc cultivation. In Rival & Whitehead (2001).
— 2012. Animism and the meanings of life: Reflections from Amazonia. In M. Brightman et al. (eds) *Animism in rainforest and tundra: Personhood, animals, plants, and things in contemporary Amazonia and Siberia.* Oxford: Berghahn Books.
— & N. Whitehead (eds) 2001. *Beyond the visible and the material: The Amerindianization of society in the work of Peter Rivière.* Oxford: Oxford University Press.
Rivière, P. 1994. WYSINWYG in Amazonia. *Journal of the Anthropological Society of Oxford* 25(3): 255-262.
Santos-Granero, F. 2012. Being and people-making in native Amazonia: A constructional approach with a perspectival coda. *HAU: Journal of Ethnographic Theory* 2(1): 181-211.
Schultes, R.E. & R.F. Raffauf 1990. *The healing forest: Medicinal and toxic plants of the northwest Amazon*. Portland: Dioscorides Press.
Shapiro, N. & E. Kirksey 2017. Chemo-ethnography: An introduction. *Cultural Anthropology* 32(4): 481-493.
Shepard Jr, G.H. 1999. Shamanism and diversity: A Matsigenka perspective. In D.A Posey (ed.) *Cultural and spiritual values of biodiversity*, 93-95. London: United Nations Environmental Programme and Intermediate Technology Publication.
— 2002. Primates in Matsigenka subsistence and worldview. In A. Fuentes & L. Wolfe (eds) *Primates face to face: The conservation implications of human and non-human primate interconnections*, 101-136. Cambridge: Cambridge University Press.
— 2004. A sensory ecology of medicinal plant therapy in two societies. *American Anthropologist* 106: 252-266.
— 2015. Agony and ecstasy in the Amazon: Tobacco, pain and the hummingbird shamans of Peru. *Broad Street* 2(1): 5-20.

the spirit of the vulture (*tisoni*), frightening game animals and offending their spirit masters. Matsigenka hunters use purgative and emetic plants to cleanse themselves of these odours and imbue their bodies 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 (Fig. 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 (Fig. 6). A milder species treats cataracts and conjunctivitis. The raphide-containing *Dieffenbachia* is used as an abortifacient, a hunting purgative and to inflict sorcery illness. Perhaps the most important category of plants in the Matsigenka pharmacopeia, in terms of sheer diversity and frequency of uses, are cultivated sedges (*Cyperus* spp.) of the Cyperaceae (the botanical family of papyrus), also included in the Makushi category of *bina* charms.

Known as *ivenkiki* in Matsigenka, or *piri-piri* in Peruvian Spanish, cultivated sedges contain bitter, aromatic root-bulbs. The Matsigenka recognize dozens of sedge varieties with variable uses, which include fever, headache and snakebite, fertility control, treating or causing insanity and imbuing cultural skills such as hunting, weaving and singing. Such diverse uses might be dismissed as 'magic' or superstition. However, pharmacological studies of cultivated sedges have 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, which are known to constrict blood vessels, alter uterine contractions and at high doses, cause convulsions and hallucinations. The systemic fungus in cultivated sedges destroys their flowers, rendering them entirely dependent on human management, while infusing the whole sedge plant with fungal phytochemicals; indeed, the Matsigenka term *ivenkiki* refers to the grey-white fungal 'button' that grows where the flower should be. In this light, many Matsigenka uses of sedge varieties appear coherent with the physiological properties of ergot alkaloids (Shepard 2002).

## Becoming plant, becoming person

Among the Makushi, shamanic training involves the consumption of copious doses of tobacco (*kawai*) and other ritually significant 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 a 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, descend into the room to feed upon pungent cigar smoke (Fig. 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 (Fig. 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 the aforementioned *Dieffenbachia,* 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 responsible for the attack 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* or 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.

## 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. 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. Indeed, plants even control the 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.

Recent work suggests that plants exhibit complex and *sui generis* forms of intelligence (Pollan 2013; Trewavas 2003), learning and memory (Gagliano et al. 2018). This raises the difficult question of how we conceptualize the enigmatic agency of plants. Some scientists grappling with the molecular basis of plant communication find metaphors derived from human communication to be misleading. As Melissa, a graduate student studying plant circadian rhythms at the University of California, Davis, mused to anthropologist 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.

Indigenous understandings of plants as both material and spiritual agents also defy reductionist, Cartesian scientific concepts, while confounding the distinction between signifier and signification.

Gottlieb & de M.B. Borin (2005: 34) propose that alkaloids and other micromolecules, the most important compounds driving animal-plant interactions, first evolved to communicate information across cell membranes:

> The primordial function of micromolecules in organisms, and probably the reason for their original appearance, does not con-

cern attraction, defense or any other ecological function, but membrane construction … Considering [their] principal properties e.g. small molecular mass, polarity, chirality, chemical reactivity … it is possible to suggest that these molecules are messengers of information.

In discussing plant intelligence, Trewavas likewise points out that 'the suite of molecules used in signal transduction are entirely similar between [animal] nerve cells … and plant cells' (2003: 2). In this light, phytochemicals can be understood as the neurotransmitters powering a cosmic nervous system, carrying information across multiple levels, from the intra- and inter-cellular, to the inter-organismal and biospheric, and, in shamanic parlance, to different layers and beings of the cosmos. This synthetic approach provides new levels of insight into indigenous understandings of 'plants as teachers' (Shepard 2018).

Myers (2015) and Hustak and Myers (2012) marshal a feminist reading of research on plant communication into a critique of the reductionist, 'disenchanting', neo-Darwinian epistemologies infusing much scientific work. However, our purpose here is to show how indigenous knowledge and laboratory science, if treated with epistemological nuance and care, 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 outright for its colonial and patriarchal legacies.

There is of course 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 (cf. 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 & Nobre 2018). These escalating ecological impacts bring about cascading consequences for the lives and cultures of indigenous peoples, and everyone else.

Indigenous activists across Amazonia are campaigning against the appropriation of their lands and traditional environmental knowledge by corporate and state interests (Conklin & Graham 1995; Kopenawa & Albert 2013). Indigenous phytophilosophies can teach us a great deal about sustainability and multispecies relationality in the Anthropocene era (Brightman & Lewis 2017; Ingold 2013). Indeed, as an awareness of anthropogenic impacts on the environment increases, anthropologists are beginning to pay greater attention to chemical ecologies (Shapiro & Kirksey 2017; Tsing et al. 2017). In this vein, our research emphasizes the central role of plant compounds in mediating human-plant relationships and undergirding socioecological systems. If forests think (cf. Kohn 2013), they most certainly do so with phytochemicals, not with the kinds of signs and symbols that anthropologists are accustomed to studying.

## 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 & 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; Swanson 2017). As Eduardo Kohn (2013) has argued, interspecies relations are inherently semiotic, involving sign flows across species boundaries.

LEWIS DALY

GLENN SHEPARD

**Fig. 7.** *A Makushi shaman (*pia'san*) conducting a 'beating leaf' healing ritual.*
**Fig. 8.** *For the Matsigenka, the more painful the tobacco snuff, the more powerful the shaman.*

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. A significant part of the cultural knowledge and daily activity of tropical forest peoples revolves around the observation, recognition, preparation and use of wild and cultivated plants, a corpus of knowledge often underappreciated by mainstream anthropologists. If we are to take indigenous knowledge seriously, we must consider a broader range of insights across the socioecological repertoire, not just the ones that appeal most directly to our particular discipline. Such a 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 Association 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 therein. 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 sociocultural 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 enquiry and shamanism. ●


— 2018. Spirit bodies, plant teachers, and messenger molecules in Amazonian shamanism. In D. McKenna (ed.) *Ethnopharmacologic search for psychoactive drugs,* II: *50 years of research (1967-2017)*, 70-81. Santa Fe: Synergetic Press.

Swanson, H.A. 2017. Methods for multispecies anthropology: Thinking with salmon otoliths and scales. *Social Analysis* 61(2): 81-99.

Taylor, A. 1996. The soul's body and its states: An Amazonian perspective on the nature of being human. *Journal of the Royal Anthropological Institute* (N.S.) 2(2): 201-215.

Trewavas, A. 2003. Aspects of plant intelligence. *Annals of Botany* 92: 1-20.

Tsing, A.L. 2015. *The mushroom at the end of the world: On the possibility of life in capitalist ruins.* Princeton, NJ: Princeton University Press.

— et al. (eds) 2017. *Arts of living on a damaged planet: Ghosts and monsters of the Anthropocene.* Minneapolis, MN: University of Minnesota Press.

van Andel, T. et al. 2015. The use of Amerindian charm plants in the Guianas. *Journal of Ethnobiology and Ethnomedicine* 11: 66. https://doi.org/10.1186/s13002-015-0048-9.

Vilaça, A. 2002. Making kin out of others in Amazonia. *Journal of the Royal Anthropological Institute* (N.S.) 8: 347-365.

Viveiros de Castro, E. 1998. Cosmological deixis and Amerindian perspectivism. *Journal of the Royal Anthropological Institute* (N.S.) 4: 469-488.

Whitehead, 2002. *Dark shamans: Kanaimà and the poetics of violent death.* London: Duke University Press.

Wilbert, J. 2004. The order of dark shamans among the Warao. In N. Whitehead & R. Wright (eds) *In darkness and secrecy: The anthropology of assault sorcery and witchcraft in Amazonia.* London: Duke University Press.

Wright, R.M. & B. Taylor 2009. Editors' introduction: The religious lives of Amazonian plants. Special Issue. *Journal for the Study of Religion, Nature, and Culture* 3(1): 5-8.