Stories from the Botanical Underground

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Abstract:	Living simultaneously in worlds of subsurface darkness and cosmic light, plants transfer knowledge across time and place thresholds. They communicate through their interactions in plain sight and beyond view, often escaping the reaches of human imagination. Medicinal plants, in particular, offer the intimacy of embodied sensory knowledge. As we consume them, ecosystem functions are re-enacted inside our bodies through physiological actions. Drawing on botanically-centered practices incorporating field work, herbalism, and writing, this project expands creative methods within geography (Hawkins 2021; Magrane 2019). Through botanical stories, I build on established knowledge adding insights and interpretations derived from ecological observations and botanical medicine practices. These stories feature ecologically and culturally important species that serve as guides for navigating emerging and ongoing environmental and social issues. Through interconnectivity with betony (Pedicularis spp.), globemallow (Sphaeralcea spp.), and vervain (Verbena spp.), I explore plant perspectives for living relationally with environmental change.

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Abstract

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Stories may be seen as sites for interlacing varied simultaneous truths through the integration of knowledge and imagination. Responding to the need for new ways of making sense of current and future environmental-social realities (e.g., Castree 2015) and creating reparative possibilities (Gibson et al. 2015), geohumanities can illuminate extraordinary happenings in ordinary places (Bauch 2015) through stories of relationality, alterity, and persistence. Experiencing entwined bodily/planetary ecologies through field work, plants may exert agency over research questions and outcomes (Marr et al. 2022) and their stories offer modes of conceptualizing and living with environmental change, perceiving the sustaining agency of plants, and imagining possibilities of pluriversal futures. The following stories develop frameworks for understanding unravelling worlds based in botanical ways of living through innumerable generations of environmental change and continual reworlding. They present an alternative to transforming the landscape for colonial desires, instead allowing ourselves to be re-shaped by the will of the land, becoming more than we have imagined through relational embodied experience (Saville 2021). Betony shows us a model of equitable society through multispecies collaboration. Globemallow teaches people ways to live amidst increasing environmental toxicity and aridity. Vervain opens possibilities of belonging across worlds of time and space.

This trio of stories merges Indigenous, Western scientific, and plant knowledges with embodied personal encounters and herbalism to propose possibilities of multi-species continuance through environmental change. Considering place as a living/teaching organism (Larsen and Johnson 2016) and plants as primary knowledge contributors, I draw on plant knowledge arising through intimate relations I have developed over nearly three decades of collaborating with these species in field-based

botanical medicine practice and conservation work (Saville 2021). I am a community herbalist and land steward of mixed-European ancestry living in Tiwa territory of the Middle Rio Grande Valley. My work brings me into connection with plants and people within the herbal medicine community. It draws me into mountains, river valleys, and canyons where plants conduct their lives and teach me how to live in this place. Through methodological practices of consistent long-term ecological observations, making and consuming botanical medicine preparations, and stewarding plants and their habitats, I enter into relationships of respect, gratitude, and reciprocity. In these relationships and lived experiences, I learn from plants the many ways they heal land, people, and themselves. Being present in these healing encounters, plants reveal their agency and intelligence through the medicine stories of their lives in external and internal ecosystems, in land and bodies (Saville forthcoming). Working in relation with plants leads to theory and praxis intertwined by roots of eco-social transformation, healing, and living otherwise.

Attuning to botanical ways of living requires an epistemological understanding of land as an intelligent living source of knowledge (Watts 2013, Wier 2015, Whyte 2016) and plants as knowledge-holding storytellers (Salmon 2010, Watts 2013, Whyte 2016) capable of intentionally communicating with humans as equals, as kin (Bruchac 1995, Watts 2013). It recognizes stories as conveying lived realities, as bringing worlds into being (Momaday 1997, Simpson 2023). Botanical stories have the potential to bring forth more-than-human knowledge, relationships of mutual ongoingness, and re-imagining environmental futures. Through these methodological and epistemological underpinnings, knowledge is co-created across species, opening pluriversal ways of understanding environmental change. Knowledge is produced within relationships

between plants and people (Wilson 2008). It is a result of relational encounters between myself, plants, and the places they grow.

As noted by King (2003), we are made of stories and it matters what stories we tell and what stories we allow ourselves to be told. Stories are medicine that can harm or heal (King 2003) and now more than ever, we need life-affirming stories (Gibson et al. 2015), stories of many worlds converging (Simpson 2023). Indigenous and Western scientific knowledges bring forth the convergence of spirit and logic through plants teaching people how to rebalance our ecological-social lives. Following Indigenous ways of knowledge-building, these stories are open-ended events, affording multiple levels of engagement and the responsibility of readers to actively engage by making new connections and hopefully responding in their own unique ways (Bruchac 1995, Iseke 2013).

[Insert Figure 1 here]

txextxíta7kst (Colville, Similkameen Okanagan) (Turner et al. 1980),

cagacka'ndawe soanuk (Potawatomi) (Smith 1933),

mandamî' nîodji' bîkîns (Ojibwe) (Smith 1932),(Ren et al. 2010)

uku · khu · sto (Cherokee) (Perry 1974),

ussusaq (Inuit) (Kuhnlein and Turner 1991)

Betony, Lousewort (English)

Pedicularis species (western scientific)

…..

COLLABORATION

Submitting to the allure of Pedicularis (Figure 1), I am beckoned into subalpine landscapes, riotous wildflower meadows, mystic forest edges where plant knowledge pervades the activities of life. Botanical voices reverberate across the land and I am reminded that this is a space of ancient dwelling, knowing, being. These are places where plant ways of doing are uninterrupted throughout the seasons and encounters are everywhere. Obscured underground entanglements among mycorrhizae, endophytes, and plant roots form the ancient symbiotic relationships that balance the flow of vital forces among beings. Here Betony draws the essence of life across species, through

soils, transcending localities via bee pollination. It is a dramatic story in its own regard and humans are part of this underground network of collaborative multi-species wellbeing, too. Medicinal plants like Betony invite human participation in the natural world as caretakers and partakers in this shared vitality of botanical ways of being.

The subsurface of primordial Earth is a theatre of such enactments. It was here, in the slurry of microbe-laden proto-soils that Earth's first land plants dredge up one iteration of their origin story. This version is a tale of persistent sympoietic living, an ancient way of collaborative being that continues to unfold in Betony's rhizosphere beyond view. The botanical underground of the primeval planet holds stories of Earth-making and life-sharing. It is a place where the agency of plants permeates life and forms the foundations of land health and the health of all beings. Perhaps this is how plants learned to heal the land, ecosystems, and us.

According to western science, the co-evolution of terrestrial ecosystems has been occurring for hundreds of millions of years (Morris et al. 2018). Plant roots connected themselves with diverse endophytic and ectomycorrhizal networks 416-360 million years ago (Kenrick and Strullu-Derrien 2014, Morris et al. 2018). Some of these fungal organisms are considered to be living fossils, remaining unchanged through 400 million years of existence (Parniske 2008). Subsurface plant-fungi symbiosis involves the exchange of water and nutrients to the plant and carbohydrates transported back to the fungal partner (Parniske 2008). This fruitful relationship spawned cascading changes in Earth systems including alterations to the carbon cycle, atmospheric CO2, and oxygenation as well as the incubation of other forms of life through creation of new soil types, habitats, and landforms (Kenrick and Strullu-Derrien 2014, Morris et al. 2018). Betony and other plants express their agency forming critical links between

underground worlds, surface activity, and atmospheric changes. From these origins, the essential mutualistic relations between Betony and diverse organisms was further established as a way of knowing, of being. This includes what is likely to be the most widespread symbiotic intimacy on the planet, an enduring plant-fungi co-existence found in approximately 90% of living plant species today (Kenrick and Strullu-Derrien 2014). This foundational relationship continues to transform terrestrial environments in many ways including an estimated 5 billion tons of carbon sequestration annually (Parniske 2008).

Across many Indigenous philosophies, stories from the "First World" highlight similar realities of chaos, movement, and creative participation within the flow of life processes (Cajete 2000). Chaos and creativity drive the universal forces of life and show humans how everything is related and agential (Cajete 2000). This same chaos moves as creative force externally across landscapes and internally within the human mind and body, as exemplified by Betony's subsurface interactions and medicinal activity. Human consciousness, individually and collectively, is a permeable system subject to the universal flow of chaos and creativity (Cajete 2000) and medicinal plants are conduits for the transfer of such knowledge across species. According to Cajete (2000, 16), "Chaos is both movement and evolution…Chaos is the field from which all things come into being. No wonder Native Science envisions the spirit of the natural world alive with disorder becoming order and all the mystery of mirrored relationships." In this way, Betony characterizes and demonstrates the foundational idea that life is a state of perpetual movement with unfolding processes of transformation and renewal (Little Bear 2012). In the Pueblo world, movement has both practical and spiritual implications. As Naranjo (1995, 248) notes, movement is "the revered element of life….Movement must be emulated by the people." The movement of life energy across

the landscape is facilitated by Betony's collaborative relations. I feel this embodied botanical knowledge enacted inside my deepest tissues as I partake in herbal medicine, as my breath joins with that of the living landscape, merging my life force with that of plants, Earth, and sky.

These origins are part of Betony's inheritance, a story that it re-enacts through its ongoing work beneath grasslands and forests around the world. A genus of over 600 members, the many *Pedicularis* species originated in Asia, dispersing themselves millions of years ago through high elevation habitats across the Northern Hemisphere (Robart et al. 2015). Busily engaged with multi-faceted interactions in underground life, these plants avoid habitats with disturbance or fast-growing competition (Těšitel et al. 2015). An undisturbed subsurface allows for Betony's delicate work—the spreading of tiny root structures (haustoria) and the coordination of hidden cross-species alliances. Haustoria stretch through soil, penetrating roots and rhizomes of other plants (Pavlenko and Petrova 2017), creating an intimate connection between Betony and other plants by directly connecting its xylem with that of wide-ranging species from at least 35 different plant families (Piehl 1963). This attachment is not necessary for Betony to survive, but the bond is intensified by enjoining secretions (Baird and Riopel 1985) to secure the transfer of vital forces--water, minerals, and phytochemicals (Hedberg et al. 2005, Schneider and Stermitz 1990)—from one plant to another, sending them across the landscape. Betony uses these gains to produce its own nectar-rich flowers that attract bees (Macior 1970), enhancing fruit and seed setting of other plant species (Laverty 1992) while improving biodiversity and habitat health (Bao et al. 2015, Demey et al. 2013, DiGiovanni et al. 2017). This system is a model of social equality in diverse communities and an unrelenting act of fortifying the biosphere by spreading vitality through the network of life.

Pedicularis species are the grand coordinators of an interconnected biotic community creating a multitude of relationships with host plants and an array of fungal and bacterial organisms (Li and Guan 2008). Residing within plant roots, endophytes are essential vitality-building characters that may be activated by Betony's haustorial penetration (Pavlenko and Petrova 2017). Endophytes and mycorrhizae inhabiting some species parasitized by Betony increase the host plant's health while limiting haustorial penetration (Sui et al. 2022). This symbiotic relationship between endophytes and plants is an ancient and multi-faceted tale with many chapters, but here they balance the redistributing relationship and exemplify a supportive alliance that strengthens individuals and benefits the entire biotic community including the fortified plant host.

Being with Betony is participating in the ecological-social collaboration that underlies the continuation of botanical and human worlds. To think with Betony is to share cumulative botanical experiences of cooperative living in place over millions of years. These memories emplace me within distant and immediate worlds that encounter one another through the pulsations of life conducted through Betony's roots.

Cajete (2000, 20) described Native science as "a lived and creative relationship with the natural world…." This approach enables the embodied participation of humans and incorporation of the landscape into oneself (Johnson and Murton 2007). Through relationship with medicinal plants, people are presented with opportunities to perpetuate the planetary community through physical, emotional, and spiritual reciprocity with plants and place (Momaday 1976, Salmon 2010). Betony and its plant community are healing agents within ecosystems and human bodies as permeable components within botanical landscapes. Permeability is a state of openness and receptiveness that allows one to be co-present and interact with elements of the ecosystem in ways that

acknowledge ourselves and others as parts of the whole (Russo and Reed 2018). Allowing self-haustorial connectivity to be activated through shared experiences with Betony opens my body to the transfer of liveliness shared among species. Mimicking *Pedicularis centranthera's* seasonal shift underground through the extreme heat of summer, I rhythmically recede, gathering forces for impending resurgence.

Betony's medicinal activity reflects these pulsations with the land, enacting its lived knowledge inside human bodies. Softening resistance in my physical self, Betony dissolves blockages and ushers in flowingness, connectivity, relationality. It increases endurance (Zhu et al. 2016) and relaxes muscular tissues (Frezza et al. 2019), increasing conductivity within and between my ecosystem and that of the living world. This high-flow state of being catalyzes new possibilities for intellectual, emotional, creative, and spiritual wholeness in concert with the more-than-human world.

These ecological, social, and physiological processes enacted inside our bodies are expressions of Betony's agency and knowledge. They encourage stewardship, reciprocity, and contributing to the continuance of life. They show humans how to live together in a co-created reality and shared destiny. Betony's activities, interactions, and effects are forms of language and social behavior that convey plant knowledge. Betony is a storyteller of how humans might live within the creative flow of nature that Cajete (2000) describes.

The everyday life of Betony concealed beneath the surface is more than moving plant alkaloids through root structures. It participates in the continuance of life-building work timelessly taking place since the formation of proto-soils in primordial Earth. It maintains this continuity through relations across species, transcending soils and air,

weaving humans into the fabric of the planetary story. Betony mobilizes the collective powers of the land and biosphere, initiating a state of unified living that underlies ecosystem health, botanical medicine practices, and collaborative visions for navigating environmental change. Betony's way of being suggests new possibilities for equitable social and environmental futures. Penetrating blockages and boundaries between species (permeability), Betony supplants individualism with collaboration, modelling more-than-human social systems of inclusion. Botanical social and ecological systems are integrated and mutually reinforcing, exemplifying how humans might also merge ecological and social knowledge (Muir et al. 2010). In a pluriversal world, plants and place are recognized as living sources of knowledge that bring insights from the depths into light. A botanical invitation to join the entanglements of place, to reaffirm plant-people relations, to re-establish coexistence is expressed through the reaches of Betony's haustoria. Many ways of knowing converge in the botanical underground, where Earth expresses itself through endophyte-plant-people kinship.

[Insert Figure 2 here]

Azeenitł'inii (Diné) (Navajo Tri-State Federally Recognized Tribes Extension and NMSU 2018),

Hadamdak (Pima) (Curtin 1984),

Ko'wa (Zuni) (Stevenson 1909),

Tishatse ityime (Acoma/Laguna) (Swank 1932),

Heyoka ta pezhuta (Dakota) (Gilmore 1991 [1919]),

Heyóka tapejúta (Oglala Sioux) (Morgan 1990)

Yerba de la Negrita, Yerba del Negro (Spanish)

Globemallow (English)

Sphaeralcea species (western scientific)

….

EQUILIBRIUM

Casting orange against blue, wildflower of my dreams draws me into otherworldly realities. Globemallow (Figure 2) creates my sense of place; it is my stabilizing force, my world, my globe. It guides me through dry meadows, desolate arroyos, rambling roadsides, micro-wildernesses of bryophytes, vast worlds of galactic light, and through balancing bodily journeys. Quintessential desert essence, a miniscule burst of beauty nearly lost within the grandeur of it all. Dazzled by stellate hairs reflecting the cosmos back at me, I am everywhere at once. Seeking life together, otherness is sameness.

Moving through an era of rapid change, persistent oscillations, and disorienting imbalance, one may be tempted to reach back into the nebulous realm of origins and slow-motion epochal evolutionary developments in search of equalizing stability. Globemallow is a subtle keeper of land and bodily equilibrium one may long for, balancing exogenous and endogenous health in defiance of widespread ecosystem destabilization characterized by Zimmerer (1994, 108) as "disequilibria, instability, and even chaotic fluctuations in biophysical environments." Origin stories are sites for merging multiple truths in a pluriverse where worlds intersect, entangle, and diverge. The story of microorganisms acting as secret agents nested inside other beings, plant roots inciting cascades of multi-species feedback loops, and proto-soils creating places where more-than-human knowledges coalesce and enact the ongoingness of planetary life has overlapping layers of realities. As noted by Naranjo (1995, 248), "there is never one version of any story." Innumerable ways of knowing and being—botanical, Indigenous, western scientific—weave the fluctuating fabric of the multi-world born from interacting unbounded dynamic actualities. As diverse as origin stories may be in their particulars, these narratives share common themes of creative mutualistic relationships bringing about the functionality of the world. As Swentzell (1993, 144) conveyed, "There is not one but many truths. Truth is dependent on context….We are many beings at once. We are not only human. This belief makes communication and interaction with houses, places, plants, and animals possible."

Globemallow's way of knowing is articulated to humans through encounters. Botanical communications include an astounding array of chemical signatures (Witzany 2006) and enactments of ecosystem functions inside our bodies. Plant communications

may be as concrete as the sensation of aromatic herbs or as subtle as inflammation gradually subsiding within the body. Field research takes place partly in places where plants grow and partly inside our own bodies. Knowledge is about participating in life; it is about relationships (Little Bear 2012). Embodied awareness enables movement beyond perceived boundaries of my individuality, sharing myself with the otherness of Globemallow. Entering into the otherness of Globemallow's world alleviates my separateness, emplaces me in shared realities, and recalibrates disequilibrium.

Plant communications sustain life through the perpetuation of origin stories into the present, creating a site for the convergence of time and knowledge. Cryptogamic ground covers (biotic soil crusts) were part of the ancient earth-making scene assisting with the creation of the primordial planet's surface soils (Mitchell et al. 2020). This primeval assemblage comprised of liverworts, hornworts, mosses, fungi, bacteria, algae, and lichens, has evolved to dwell within a multitude of environs including nearly all current Earth habitats. Their foundational life-sustaining contributions are essential to holding place in place: capturing dust, holding topsoil, mitigating erosion and water runoff, building soil, and providing seed germination sites (Mitchell et al. 2020). Cryptogamic ground covers participated in the life-building work of ancient endophytes, mycorrhizae, and plants by assisting with the draw-down of CO2 and expanding the potential habitability of Earth (Allen 2010). They contributed to the creation of worlds within worlds and the movement of knowledge through species, across temporal and spatial horizons.

Contemporary members of the biotic soil crust collectives commune across the American Southwest, forming supportive relations with *Sphaeralcea* species. Here they

merge the eternally occurring origin stories and knowledge derived from the recesses of botanical time with the present moment. Soil crusts cover large areas and continue their carbon sequestration work (Allen 2010) while acting as storage sites for high concentrations of nutrients that are slowly released into soil, boosting seed germination and mycorrhizal interconnectivity and increasing plant biomass and reproduction (Pendelton et al. 2003). These are acts of grand importance in arid lands where moisture and soil stability are crucial aspects of life. Cryptogamic communities act as critical ecological and social liaisons in Globemallow's story, implementing many place-making tasks while transferring vital energy and knowledge between the subsurface, botanical, and atmospheric worlds.

Globemallow's acts of equilibria extend beyond interactions with biotic soil crust communities, incorporating endophytic mutually sustaining ways of being. This intimate relationship dissolves boundaries that would clearly distinguish life forms from one another through horizontal gene transfer, or the movement of genetic knowledge between unrelated beings (Alam et al. 2021). Fungal endophytes ubiquitously found in plants produce an array of compounds with wide-ranging roles in building land health and human health as ecological-botanical medicines (Kaul et al. 2012). Bacterial endophytes also contribute to plant and people vitality through promotion of vegetative growth, resistance to pathogens and environmental stressors, and producing medicinal compounds (Wu et al. 2021). Bacterial endophytes found in Globemallow enhance the plant's ability to live in heavy metal contaminated soils associated with mine tailings (Roman-Ponce et al. 2016). These endophytic symbionts protect Globemallow's permeability barriers, divert metals away from cells, sequester contaminants, detoxify,

and stimulate plant growth (Roman-Ponce et al. 2016). Globemallow teaches humans how to live together where we are, in the mess that has been made.

This plant is a desert enchantress that has ensnared me into its realm of symbiotic relations. A singular love-at-first sight moment along a gravelly weed-filled roadside at dawn initiated our enduring affair. Globemallow flashed the sunrise through flowers positioned on leafless leggy stalks that swirled in the desert's unsettled air. In a moment of 'weave watching' (Russo and Reed 2018), I lost myself observing the otherworldliness of miniature orange blossoms waking to the sun's first rays and slipped into the flowingness of Globemallow. In this moment, the sameness of ourselves was established and its medicine moved me toward balance within myself, with nonhuman others, with multiple truths of the pluriverse. Globemallow is harmony fashioned from the chaos of origins. It is a remedy of equilibrium in unbalanced times. A plant that grows in the midst of disturbance and contamination, thriving in increasingly hot dry soils, is one that knows how to live in alignment with anthropogenic landscape change.

Globemallow represents balance and harmony at the core of Diné Hózhó wellness philosophy (Kahn-John 2015) and other Indigenous ways of knowing. Proper relations with the living world are essential components of balance and harmony, with illness or distress manifesting in its absence (Cajete 1994). In this way, herbalists are regarded as keepers of equilibrium for their communities (Cajete 1994), maintaining reciprocity with plants on behalf of the whole. Globemallow also embodies the concept of health within the Pueblo world "thought of as a state of balance or a state of harmony between the human and natural environments" (Naranjo and Swentzell 1989, 1). Deserts

are inherently prone to extremes and the concept of balance has been at the heart of this region's way of being since time immemorial. As explained by Silko (1986, 1012), "only at the moment the requisite balance between human and *other* was realized could the Pueblo people become a culture…".

Globemallow's medicinal activity is an expression of plant knowledge. It is an 'alterative', or remedy that recalibrates unbalanced systems, thus creating a state of 'otherness'. Achieving this altered state transports me beyond corporeal systems, into the world of globemallow, incorporating its way of being into mine. This plant's impressive adaptability to temperature and drought extremes is due, in part, to its steady state and willingness to balance activity in response to changing conditions (Brewster 1971). Globemallow's subtle yet captivating presence, its ability to hold moisture in its tissues, and its capacity to stabilize sites of disturbance correspond to its bodily effects connecting land health directly to human health. In human bodies, globemallow brings endogenous ecosystems into equilibrium by mucilaginous cooling and moistening of overheated and dehydrated tissues (Atwood and Welsh 2002, Chao 1943). It acts intuitively to balance overactive/underactive immune systems experiencing chronic inflammation of Anthroposcenic life across external and internal landscapes (Pérez-Herndández et al. 2017, Romero-Cerecero et al. 2013). Following Globemallow, my way of being undulates, shifting among worlds, undoing disequilibrium as I am/we are.

Through symbiotic place-based intelligence, globemallow establishes ecological-bodily balance, normalizing otherness within our deepest tissues, creating equilibrium across worlds. In relation with globemallow, humans may participate in the remediation of imbalances created through contemporary ways of living. Disturbed and

contaminated habitats become sites for mutualistic multi-species interactions born from cycles of chaos and order collapsing upon each other. Binary thinking dissolves, boundaries of beings are subsumed into continuums of material and knowledge unleashing collective creativity in the midst of destruction. Possibilities for perseverance, innovative imaginations, and remedial realities emerge from the dust interlacing globemallow's cryptogamic crust, sprawling roots, and the intersection of plant-human consciousness.

[Insert Figure 3 here]

Tshék'ihnaa'ahtc'íjiih (Diné) (Elmore 1944),

Tádídíín dootł'izh nitsaaígíí (Diné) (Mayes and Lacy 2012),

Cha^{n}haloga pezhuta (Dakota) (Gilmore 1991 [1919]),

Pezhe maka^{n} (Omaha-Ponca) (Gilmore 1991 [1919])

Verbena, Moradilla, Vervena Dormilón (Spanish)

Vervain (English)

Verbena species (western scientific)

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ROOTEDNESS

Reaching rigidly upward, stretching past grama grasses and mullein rosettes, purple ringlets of Vervain (Figure 3), aspire skyward. This enchanting display catches my eye, but what captures my imagination? The mysterious work of Vervain's fibrous roots spreading through subsurface spaces catalyzes visions of ancestors sharing my rooted relationship with this potent plant. Descendant from Celtic and Druid territories and the conquering forces who swept through these regions, I am drawn into connectivity with *Verbena macdougalli* in my adopted homeland in New Mexico and with *Verbena officinalis* in my ancestral homelands. I dwell within the ongoing past and unfolding

present. I am moved by imaginations of politically constructed concerns that mobilized medieval society and maintain their grip and control on people today. I embrace the medicine of purple ringlets from the multi-world, the eternal balm of the worried, fearful, controlling, or agitated mind. As ancestors string together sacred powers of Vervain, yarrow, and St. John's wort for protection against dark forces on the move, I am present with the same plant knowledge in arid mountain meadows. In relation with Vervain, I am descendant and ancestor as time falls back on itself.

Origin stories can be told in innumerable ways—invoking Earth's early organisms, symbiotic communities, and proto-soils or through the lens of roots. Roots sustain and anchor life, incorporate nourishment, stabilize surroundings, and provide crucial context for living. Roots are also seats of ancestral knowing, sentience, and intelligence. Non-cognitive thinking and consciousness of plants do not require a nervous system and may be understood as being 'aware' (Trewavas 2021; Marder 2013). Meristems (areas of actively dividing cells forming new tissues) found in roots and other plant parts are central points of assessment, response, learning, memory, and intelligence and may be singular within Earth's living systems (Trewavas 2021). Plant communication includes carrying on complex conversations with diverse species using a language system comprised of up to 100,000 different compounds (Witzany 2006). In plants, roots may be vertical, lateral, or fibrous, yet all move through the soil embedding themselves within the living structure of the subsurface. Roots ask what ancestral place-and-plant-based knowledge resides with us? Vervain summons that knowledge from the depths of my being, evoking distant and present places facilitating rooted connections where I am.

Genealogical connectivity is part of one's experience of plants and place. We may be part of multiple places at once through relationships with plants such as Vervain whose lineages are intercontinental, reflecting the stories of migrations in botanical and human timescales. *Verbena*'s ancestral origins are thought to be 40-50 million years ago in South America, with numerous species arising and dispersing primarily across arid and semi-arid environments throughout the Americas (Frost 2017). Such movement characterizes ancestor stories across species and invokes the relationality of the biological world. Discussing migration stories at Santa Clara Pueblo, Naranjo (1995, 248) explains the central concept of stories by stating "Movement…is necessary for the perpetuation of life…explanations are not necessary—only stories which remind, acknowledge, and honor the power and force of movement." One species, *Verbena officinalis*, is native to Europe with documented ethnobotanical histories across the region (e.g., Akerreta et al. 2007, Wagner et al. 2020). Having resettled generations ago, *Verbena* species connect me to both ancestral and adopted homes and recall the movement and migrations of human and nonhuman beings. Yet ancestor stories simultaneously root people in place merging humanity with the land and the more-than-human community. Momaday (2020) succinctly articulates that Earth and humanity belong to each other. Verbena reinforces an enduring connectivity to plants and the earth from which they spring forth, recognizing them as teachers of ancestor stories and responsibilities to the land.

Nash (2006) noted that although the body is immersed in present moment workings, it is simultaneously capable of experiencing transhistorical time. As the body undergoes birth, death, deep fatigue, or illness, we are connected with the timeless corporeal realities of transition and struggle that our forebearers' bodies knew. The

shared ancestry of life can be felt through plant medicine as eternal ecological rhythms reverberate throughout our bodies in what are called 'herbal actions'. Herbal actions are the performance of plant knowledge inside our bodies, manifested as physiological responses to phytochemicals. For example, *Verbena macdougalii* imbues me with the soft serenity of sunny mountain meadows, harmonious relations with native bees, and rootedness in the story of life, subtly calming nervous agitation as it evokes rhythmic continuance of ancestral cycles. Consumed as botanical medicine, hastatoside, verbenalin, verbascoside and other compounds produced within the plant act on the depleted nervous system to promote sleep, calm anxiety, and reduce seizures among its myriad actions (Khan et al. 2016, Kubica et al. 2020, Makino et al. 2009).

Ancestors felt similar re-enactments inside their bodies as they incorporated Vervain into their lives for spiritual protection and health benefits. With echoes of previous times effecting current events, past and present may be seen as synchronistic co-creators of any moment. Little Bear (2012, 524-525) describes the Blackfoot concept of time by explaining "beyond the two-day limit, forward or backward, past and present amalgamate and become one and the same…One of the implications arising out of this notion of time is that the ancestors are always only two days away." Ancestral knowledge is always active and present. Working with Vervain is a way for humans to root into stories of continuance; it is a way to participate in the vibrance of life. Rose (2017, G54) described the lure of *bir'yun*, or 'shimmer' of life, that grabs us and enables us to "see and experience ancestral power…When captured by shimmer, one experiences not only the joy of the visual capture but also, …ancestral power as it moves actively across the world." Allowing myself to be captivated by the brilliance of Vervain, I am lured into imaginations of sustaining relationships of mutualism, a

persistence of life that defies rolling extinctions, a flourishing of beings alongside devastation.

Vervain is a storyteller of imaginations born from a time horizon beyond that of common contemporary human conceptualizations that seek to separate us from ancestors and descendants. The corresponding dissolution of binary thinking allows for simultaneous dismantling of human separateness from Earth processes and the ancestral kinship of all planetary co-evolving life. Yusoff (2013, 780) suggested thinking on the epochal and species scales, referring to humanity's "being as geological." Reimagining human existence as geological affords a return to forgotten origins of co-existence among multi-species planetary life and the placement of people within the chronology of Earth's ongoing formation (Yusoff 2013). Framing time in terms of species, epochs, or geology may actualize the capacity for humans to remember and re-embody our ongoing enmeshment with life systems but such thinking is constrained by linear progressions, evolutions, and depositions. It fails to acknowledge the effects of timelessness on thought or incorporate temporal notions that conceive of actively and eternally echoing pasts. Nonlinear time, as described by Whorf (1956, 60) in reference to Hopi People is "a realm of expectancy, of desire and purpose, of vitalizing life, of efficient causes, of thought thinking itself out from inner realm (the Hopian heart) into manifestation. It is…already within us in vital form."

Instead, Vervain invites seekers of life into botanical time. Thinking with Vervain suggests a cyclical understanding of temporal realities that bend, fold, and swirl events into simultaneously ongoing happenings of past, present, and future. These are eternal reverberations of creativity. This is a deeper rootedness, one that plunges

beneath subsurface horizons, beyond the bedrock of Earth, into nebulous spaces formed before the invention of time. Vervain calls not only for the embrace of nonlinear time, but for intuition that emerges from the cycles of chaos and creativity that drive nature and human consciousness (Cajete 2000). Opportunities arise for humans to re-become an ancestral force of nature that participates in life cooperatively with nonhuman others. Reframing the human perspective to one of botanical timescales, provides a stabilizing counter-reference that roots people into relation like the first land plants weaving themselves through microbial worlds enshrined within the proto-soils of early Earth.

From a planetary perspective, ancestry is more than human relatives. It is conceiving humanity's story as ancestral with life itself and considering our place in the evolution of nested ecologies and intermingled organisms within planetary systems. Hall (2020) observed that many mythological traditions and scientific phylogenetics share the belief in a common ancestry for plants and people. Vervain embodies the rootedness of nonlinear, intuitive, planetary knowledge by summoning ancestors to the fore, distilling the present moment, and inciting futures infused with inheritances of multi-species persistence. Botanical time is enfolded into the human body, mind, and spirit, reflecting the planetary-wide experience of contributing to earth-making. Embracing such an origin catalyzes new imaginations not only of humanity's past but also our present and future existence. Instead of envisioning futures built upon the rotting decay of ancient carboniferous plant matter combusted into the atmosphere, imaginaries founded in the reconvened symbiotic building of lively worlds among microorganisms, plants, people, and ancestors are equally real.

Conclusion

The stories of *Pedicularis*, *Sphaeralcea*, and *Verbena* expand theory and practice in geohumanities through place-based botanical knowledge. These accounts may be seen as acts of resistance against extinction of symbiosis, healing, and imagination underlying the co-creation of novel worlds. These plants ask us to attune ourselves to botanical languages through relationality. Rose et al. (2012) propose reconsidering the exceptionalism of humans and ways in which we might align our being with other living entities. For Marder (2013, 124), plant intelligence includes not only plant thinking but how human thinking can become "de-humanized and rendered more plant-like." While questions surrounding who can produce knowledge and what knowledge is legitimate abound in academic literature (e.g., Bastian et al. 2017, Hawkins 2021), plant knowledges offer other ways of being within rapidly changing worlds.

Pedicularis is a coordinator of sympoietic living, tenatacular-haustorial multi-species connectivity, and collective ongoingness of Haraway's (2016) vision. Thinking through the continuity of bodies and environment, it exemplifies notions of trans-corporeality (Alaimo 2010), interconnectivity of exogenous and endogenous ecosystems, and repositioning humans within the flow of the biosphere. Globemallow models re-balancing relationships, possibilities of recovery, living in the midst of catastrophe, and making external and internal worlds more habitable. It is a storyteller for how to live in place (Salmon 2010). Verbena teaches connectivity with land, ancestors, and plants, invoking imagination across worlds. How one views themself and their environment has as much to do with physical perceptions as with the imagination (Momaday 1976). Imaginations are shaped by cultural situatedness and generational

relationships. According to Momaday (1976, 81), "We see [the world around us] with the physical eye. We see it as it appears to us, in one dimension of reality. But we also see it with the eye of the mind."

Stories from the Botanical Underground are tales of healing existing worlds and making new worlds, relentlessly. Plant ways of being show people realities rooted in communities of mutualistic vitality and refusal to become characters in narratives of doom. As Nigerian storyteller Ben Okri reminds us, "We live stories that either give our lives meaning or negate it with meaninglessness. If we change the stories we live by, quite possibly we change our lives" (King, 2003, 153). Living in relation with plants brings gifts and responsibilities. In reciprocity, I story botanical worlds of possibilities and persistence.

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References

Akerreta, S., R. Y. Cavero, and M. I. Calvo. 2007. First comprehensive contribution to medical ethnobotany of Western Pyrenees. *Journal of Ethnobiology and Ethnomedicine* 3:26.

Alaimo, S. 2010. *Bodily natures: Science, environment, and the material self*. Bloomington: Indian University Press.

Alam, B., J. Li, Q. Ge, M. A. Khan, J. Gong, S. Mehmood, Y. Yuan, and W. Gong. 2021. Endophytic fungi: From symbiosis to secondary metabolite communications or vice versa? *Frontiers in Plant Science* 12:791033.

Allen, C. D. 2010. Biogeomorphology and biological soil crusts: A symbiotic research relationship. *Géomorphologie: Relief, Processus, Environnement* 16 (4):347-358.

Atwood, D. N., and S. L. Welsh. 2002. Overview of Sphaeralcea (Malvaceae) in Southern Utah and Northern Arizona, U.S.A., and description of a new species. *Novon* 12 (2):159-166.

Baird, W. V., and J. T. Riopel. 1985. Surface characteristics of root haustorial hairs of parasitic Scrophulariaceae. *Botanical Gazette* 146 (1):63-69.

Bao, G., K. Suetsugu, H. Wang, X. Yao, L. Liu, J. Ou, and C. Li. 2015. Effects of the hemiparasitic plant Pedicularis kansuensis on plant community structure in a degraded grassland. *Ecological Research* 30 (3):507-515.

Bastian, M., O. Jones, N. Moore, and E. Roe. 2017. Introduction: More-than-human participatory research contexts, challenges, possibilities. In *Participatory Research in*

More-Than-Human Worlds, eds. M. Bastian, O. Jones, N. Moore and E. Roe, 1-15. London: Routledge.

Bauch, N. 2015. A Scapelore Manifesto: Creative Geographical Practice in a Mythless Age. *GeoHumanities* 1 (1):103-123.

Brewster, S. F. 1971. The physiological vitality of scarlet globemallow, Sphaeralcea grossulariaefolia (Hook. and Arn.) Rydgerb, under drought, Botany and Range Science, Brigham Young University.

Bruchac, J. 2095. *Native Plant Stories*. Golden, CO: Fulcrum Publishing.

Cajete, G. 1994. *Look to the mountain: An ecology of Indigenous education*. Denver: Kivaki Press.

Cajete, G. 2000. *Native science*: Clear Light Publishers.

Chao, C. F. 1943. The composition of mucilage of globe mallow, Sphaeralcea laxa, Woot and Standl, Chemistry, University of Arizona.

Curtin, L. S. M. 1984. *By the prophet of the earth: Ethnobotany of the Pima*. Tucson: University of Arizona Press.

Demey, A., E. Ameloot, J. Staelens, A. De Schrijver, G. Verstraeten, P. Boeckx, M. Hermy, and K. Verheyen. 2013. Effects of two contrasting hemiparasitic plant species on biomass production and nitrogen availability. *Oecologia* 173 (1):293-303.

DiGiovanni, J. P., W. P. Wysocki, S. V. Burke, M. R. Duvall, and N. A. Barber. 2017. The role of hemiparasitic plants: Influencing tallgrass prairie quality, diversity, and structure. *Restoration Ecology* 25 (3):405-413.

Elmore, F. H. 1944. Ethnobotany of the Navajo. Santa Fe: University of New Mexico and the School of American Research.

Frezza, C., A. Venditti, C. Toniolo, D. Vita, I. Serafini, A. Ciccola, M. Franceschin, A. Ventrone, L. Tomassini, S. Foddai, M. Guiso, M. Nicoletti, A. Bianco, and M. Serafini. 2019. Pedicularis L. genus: Systematics, botany, phytochemistry, chemotaxonomy, ethnopharmacology, and other. *Plants (Basel)* 8 (9).

Frost, L. A., S. M. Tyson, P. Lu-Irving, N. O'Leary, and R. G. Olmstead. 2017. Origins of North American arid-land Verbenaceae: More than one way to skin a cat. *American Journal of Botany* 104 (11):1708-1716.

Gibson, K., D. B. Rose, and R. Fincher. 2015. Manifesto for living in the Anthropocene. In *Manifesto for living in the Anthropocene*, eds. K. Gibson, D. B. Rose and R. Fincher, i-iv: Punctum Books.

Gilmore, M. R. 1991. *Uses of plants by the Indians of the Missouri River Region*: University of Nebraska Press.

Hall, M. 2020. *The imagination of plants: A book of botanical mythology*. Albany: SUNY Press.

Haraway, D. 2016. *Staying with the trouble: Making kin in the Chthulucene*. Durham: Duke University Press.

Hawkins, H. 2021. *Geography, art, research: Artistic research in the geohumanities*. New York: Routledge.

Hedberg, A. M., V. A. Borowicz, and J. E. Armstrong. 2005. Interactions between a hemiparasitic plant, Pedicularis canadensis L. (Orobanchaceae), and members of a tallgrass prairie community. *The Journal of the Torrey Botanical Society* 132 (3):401-410.

Iseke, J. 2013. Indigenous Storytelling as Research. *International Review of Qualitative Research* 6 (4):559-577.

Johnson, J. T., and B. Murton. 2007. Re/placing Native science: Indigenous voices in contemporary constructions of nature. *Geographical Research* 45 (2):121-129.

Kahn-John, M., and M. Koithan. 2015. Living in health, harmony, and beauty: The Dine (Navajo) Hozho wellness philosophy. *Global Advances in Health and Medicine* 4 (3):24-30.

Kaul, S., S. Gupta, M. Ahmed, and M. K. Dhar. 2012. Endophytic fungi from medicinal plants: A treasure hunt for bioactive metabolites. *Phytochemistry Reviews* 11 (4):487-505.

Kenrick, P., and C. Strullu-Derrien. 2014. The origin and early evolution of roots. *Plant Physiology* 166 (2):550-580.

Khan, A. W., A. U. Khan, and T. Ahmed. 2016. Anticonvulsant, anxiolytic, and sedative activities of Verbena officinalis. *Frontiers in Pharmacololgy* 7:499.

King, T. 2003. *The truth about stories: A Native narrative*. Minneapolis: University of Minnesota Press.

Kubica, P., A. Szopa, J. Dominiak, M. Luczkiewicz, and H. Ekiert. 2020. Verbena officinalis (Common Vervain) - A review on the investigations of this medicinally important plant species. *Planta Medica* 86 (17):1241-1257.

Kuhnlein, H. V., and N. J. Turner. 1991. *Traditional plant foods of Canadian Indigenous Peoples*: Gordon and Breach Publishers.

Larsen, S. C., and J. T. Johnson. 2016. The agency of place: Toward a more-than-human geographical self. *GeoHumanities* 2 (1):149-166.

Laverty, T. M. 1992. Plant interactions for pollinator visits: A test of the magnet species effect. *Oecologia* 89 (4):502-508.

Li, A. R., and K. Y. Guan. 2008. Arbuscular mycorrhizal fungi may serve as another nutrient strategy for some hemiparasitic species of Pedicularis (Orobanchaceae). *Mycorrhiza* 18 (8):429-436.

Little Bear, L. 2012. Traditional knowledge and humanities: A perspective by a Blackfoot. *Journal of Chinese Philosophy* 39 (4):518-527.

Macior, L. W. 1970. The pollination ecology of Pedicularis in Colorado. *American Journal of Botany* 57 (6):716-728.

Makino, Y., S. Kondo, Y. Nishimura, Y. Tsukamoto, Z.-L. Huang, and Y. Urade. 2009. Hastatoside and verbenalin are sleep-promoting components in Verbena officinalis. *Sleep and Biological Rhythms* 7 (3):211-217.

Marder, M. 2013. What Is plant-thinking? *Philosophies de la nature* 25:124-143.

Marr, N., M. Lantto, M. Larsen, K. Judith, S. Brice, J. Phoenix, C. Oliver, O. Mason, and S. Thomas. 2022. Sharing the field: Reflections of more-than-human fieldwork encounters. *GeoHumanities*:1-31.

Mayes, V. O., and B. B. Lacy. 2012. *Nanise': A Navajo herbal*. Paradise Valley: Lacypress.

Mitchell, R. L., C. Strullu-Derrien, D. Sykes, S. Pressel, J. G. Duckett, and P. Kenrick. 2020. Cryptogamic ground covers as analogues for early terrestrial biospheres: Initiation and evolution of biologically mediated proto-soils. *Geobiology* 19 (3):292-306.

Momaday, N. S. 1976. Native American attitudes to the environment. In *Seeing with a Native eye*, ed. W. H. Capps. New York: Harper Forum.

Momaday, N. S. 1997. *The man made of words*. New York: St. Martin's Press.

Morgan, G. R., and R. R. Weedon. 1990. Oglala Sioux use of medicinal herbs. *Great Plains Quarterly* 506:18-35.

Morris, J. L., M. N. Puttick, J. W. Clark, D. Edwards, P. Kenrick, S. Pressel, C. H. Wellman, Z. Yang, H. Schneider, and P. C. J. Donoghue. 2018. The timescale of early land plant evolution. *Proceedings of the National Academy of Science* 115 (10): E2274-E2283.

Muir, C., D. B. Rose, and P. Sullivan. 2010. From the other side of the knowledge frontier: Indigenous knowledge, social-ecological relationships and new perspectives. *The Rangeland Journal* 32:259-265.

Naranjo, T. 1995. Thoughts on migration by Santa Clara Pueblo. *Journal of Anthropological Archaeology* 14 (2):247-250.

Naranjo, T., and R. Swentzell. 1989. Healing spaces in the Tewa Pueblo world. *American Indian Culture and Research Journal* 13 (3 & 4):257-265.

Nash, L. 2006. *Inescapable ecologies: A history of environment, disease, and knowledge*. Berkeley: University of California Press.

Parniske, M. 2008. Arbuscularm: The mother of plant root endosymbioses. *Nature Reviews Microbiology* 6 (10):763-75.

Pavlenko, E. V., and S. E. Petrova. 2017. Anatomy of the roots of some northern hemiparasites (Orobanchaceae). *Turczaninowia* 20 (1):107-117.

Pendelton, R. L., B. K. Pendelton, G. L. Howard, and S. D. Warren. 2003. Growth and nutrient content of herbaceous seedlings associated with biological soil crusts. *Arid Land Research and Management* 17 (3):271-281.

Perez-Hernandez, J., M. del Pilar Nicasio-Torres, S.-L.-L. Gerardo, and M. Rodriguez-Monroy. 2019. Production of anti-inflammatory compounds in Sphaeralcea angustifolia cell suspension cultivated in stirred tank bioreactor. *Engineering in Life Sciences* 19:196-205.

Perry, M. J. 1974. Food use of wild plants by Cherokee Indians, University of Tennessee, Knoxville.

Piehl, M. A. 1963. Mode of attachment, haustorium structure, and hosts of Pedicularis canadensis. *American Journal of Botany* 50 (10):978-985.

Ren, Y.-Q., K.-Y. Guan, A.-R. Li, X.-J. Hu, and L. Zhang. 2010. Host dependence and preference of the root hemiparasite, Pedicularis cephalantha Franch. (Orobanchaceae). *Folia Geobotanica* 45 (4):443-455.

Robart, B. W., C. Gladys, T. Frank, and S. Kilpatrick. 2015. Phylogeny and biogeography of North American and Asian Pedicularis (Orobanchaceae). *Systematic Botany* 40 (1):229-258.

Roman-Ponce, B., J. Ramos-Garza, M. S. Vasquez-Murrieta, F. N. Rivera-Orduna, W. F. Chen, J. Yan, P. Estrada-de Los Santos, and E. T. Wang. 2016. Cultivable endophytic bacteria from heavy metal(loid)-tolerant plants. *Archives of Microbiology* 198 (10):941-956.

Romero-Cerecero, O., M. Meckes-Fischer, A. Zamilpa, J. Enrique Jimenez-Ferrer, P. Nicasio-Torres, D. Perez-Garcia, and J. Tortoriello. 2013. Clinical trial for evaluating the effectiveness and tolerability of topical Sphaeralcea angustifolia treatment in hand osteoarthritis. *Journal of Ethnopharmacology* 147 (2):467-73.

Rose, D. B., T. vanDooren, M. Chrulew, S. Cooke, M. Kearnes, and E. O'Gorman. 2012. Thinking through the environment, unsettling the humanities. *Environmental Humanities* 1:1-5.

Rose, D. R. 2017. Shimmer: When all you love is being trashed. In *Arts of living on a damaged planet*, eds. A. Tsing, H. Swanson, E. Gan and N. Bubandt, G51-G64. Minneapolis: University of Minnesota Press.

Russo, L., and M. Reed eds. 2018. *Counter-desecration*. Middletown: Wesleyan University Press.

Salmon, E. 2010. Sharing breath: Some links between land, plants, and people. In *Colors of Nature*, i-x.

Saville, D. 2021. *The ecology of herbal medicine: a guide to plants and living landscapes of the American Southwest*. Albuquerque: University of New Mexico Press.

Saville, D. Forthcoming. Medicinal landscapes and kinship communities: plants of the Organ Mountains. In *Coexistence: biodiversity in New Mexico*, ed. S. Banerjee. Albuquerque: University of New Mexico Press.

Schneider, M., and F. Stermitz. 1990. Uptake of host plant alkaloids by root parasitic Pedicularis ssp. *Phytochemistry* 29:1811-1814.

Selected Plants of Navajo Rangelands. 2018. Navajo Tri-State Federally Recognized Tribes Extension and New Mexico State University.

Silko, L. M. 1986. Landscape, history, and the Pueblo imagination. *Antaeus* 57:1003-1014.

Simpson, L. B. 2023. *A short history of the blockade: giant beavers, diplomacy, and regeneration in Nishnaabewin*: University of Alberta Press.

Smith, H. H. 1932. Ethnobotany of the Ojibwe Indians. *Bulletin of the Public Museum of the City of Milwaukee* 4 (3):327-525.

Smith, H. H. 1933. Ethnobotany of the forest Potawatomi Indians. *Bulletin of the Public Museum of the City of Milwaukee* 7 (1):1-230.

Stevenson, M. C. 1909. Ethnobotany of the Zuni Indians, ed. S. I. B. o. A. Ethnology. Washington D.C.: Government Printing Office.

Sui, X., K.-Y. Guan, Y. Chen, R. Xue, and A.-R. Li. 2022. A legume host benefits more from arbuscular mycorrhizal fungi than a grass host in the presence of a root hemiparasitic plant. *Microorganisms* 10 (440):440.

Swank, G. R. 1932. The Ethnobotany of the Acoma and Laguna Indians, Biology, University of New Mexico.

Swentzell, R. 1993. Mountain form, village form: Unity in the Pueblo world. In *Ancient Land, Ancestral Places: Paul Logsdon in the Pueblo Southwest*. Santa Fe: Museum of New Mexico press.

Těšitel, J., P. Fibich, F. Bello, M. Chytrý, and J. Lepš. 2015. Habitats and ecological niches of root-hemiparasitic plants: An assessment based on a large database of vegetation plots. *Preslia* 87:87-108.

Trewavas, A. 2021. Awareness and integrated information theory identify plant meristems as sites of conscious activity. *Protoplasma* 258 (3):673-679.

Turner, N. J., R. Bouchard, and D. I. D. Kennedy. 1980. Ethnobotany of the Okanagan-Colville Indians of British Columbia and Washington. In *Occasional Papers of the British Columbia Provincial Museum*. Victoria: British Columbia Provincial Museum.

Wagner, C., J. De Gezelle, and S. Komarnytsky. 2020. Celtic provenance in traditional herbal medicine of medieval Wales and classical antiquity. *Frontiers in Pharmacology* 11:105.

Watts, V. 2013. Indigenous place-thought and agency amongst humans and non-humans (First Woman and Sky Woman go on a European world tour!). *Decolonization: Indigeneity, Education & Society* 2 (1):20-34.

Weir, J. K. 2015. Lives in connection. In *Manifesto for living in the Anthropocene*, eds. K. Gibson, D. B. Rose and R. Fincher, 17-22: Punctum Books.

Whorf, Benjamin L. 1956. An American Indian model of the universe. In *Language, thought, and reality*, ed. J. B. Carroll, 57-64. New York: Massachusetts Institute of Technology and John Wiley and Sons.

Whyte, K. 2016. Our Ancestors' dystopia now: Indigenous conservation and the Anthropocene. In *Routledge Companion to the Environmental Humanities* eds. U. Heise, J. Christensen and M. Niemann.

Wilson, S. 2008. *Research is ceremony: Indigenous research methods*. Halifax: Fernwood.

Witzany, G. 2006. Plant communication from biosemiotic perspective. *Plant Signaling and Behavior* 1 (4):169-178.

Wu, W., W. Chen, S. Liu, J. Wu, Y. Zhu, L. Qin, and B. Zhu. 2021. Beneficial relationships between endophytic bacteria and medicinal plants. *Frontiers in Plant Science* 12:646146.

Yusoff, K. 2013. Geologic life: Prehistory, climate, futures in the Anthropocene. *Environment and Planning D: Society and Space* 31 (5):779-795.

Zhu, M., H. Zhu, N. Tan, H. Wang, H. Chu, and C. Zhang. 2016. Central anti-fatigue activity of verbascoside. *Neuroscience Letters* 616:75-9.

Zimmerer, K. 1994. Human geography and the "new ecology": The prospect and promise of integration. *Annals of the American Association of Geographers* 84 (1):108-125.

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