Digitizing Botanical Herstory:

Human-Plant Lives and the Collection of Dr. Dorothy Newton Swales

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Abstract

The history of women's relationship with botany and the study of the natural world is long and intertwined in the West. Despite their contributions to botanical knowledge, women have been historically pushed to the margins, overshadowed by male figures in the field. This thesis focuses on the intersection of women, plants, and botany, both in history and the digital sphere. Adopting a feminist epistemology of situated knowledge, I centre my thesis on the knowledge creation of Dr. Dorothy Swales, the first woman to curate the Macdonald College (later McGill University) Herbarium. Dr. Swales' life was inseparable from the natural world and telling her story as a woman in botanical curation necessitates weaving in the lives of the mosses, lichens, and flowering plants that she dedicated her career to better understanding and preserving. I draw on New Materialism and Critical Plant Studies to create space for the botanical lives whose histories are interlaced with Swales' life and career. The technological aspect of my research incorporates digitizing botanical vouchers from Dr. Swales' tenure as curator and culminates in a digital exhibit using Omeka.[1] Thus, an overarching objective of this project is to contribute to the growing field of Digital Environmental Humanities, demonstrating how digital tools can tell nuanced, interwoven stories about human-plant entanglements.

[1] https://digitizingbotanicalherstory.com

Résumé

L'histoire occidentale de la relation des femmes avec la botanique et l'étude du monde naturel est longue et entrelacée. Malgré les contributions des femmes aux connaissances botaniques, leur travail a toujours été marginalisé, éclipsé par des hommes scientifiques travaillant *dans ce domaine*. Cette thèse porte sur l'entrecroisement des femmes, des plantes et de la botanique, à la fois dans l'histoire et dans la sphère numérique. Adoptant une épistémologie féministe de la connaissance située, j'oriente ma thèse sur la création de connaissances du Dre Dorothy Swales, la première femme, directrice-*conservatrice* de l'herbier du Collège Macdonald (plus tard devenu l'Université McGill). La vie du Dr Swales était indissociable du monde naturel. Raconter l'histoire de cette femme pionnière dans la conservation botanique nécessite donc d'entrelacer la vie des mousses, des lichens et des plantes à fleurs, auxquels elle a consacré sa carrière afin de mieux les comprendre et mieux les préserver. Je m'inspire du nouveau matérialisme et des études végétales afin de raconter la vie des plantes dont les histoires sont entrelacées avec la vie et la carrière de Swales. L'aspect technologique de ma recherche comprend la numérisation des planches botaniques de la période de conservation du Dr Swales et la création d'une exposition numérique Omeka. L'objectif principal de ce projet est de contribuer au domaine, en plein essor, des humanités environnementales numériques, en démontrant comment les outils numériques peuvent raconter des histoires nuancées et entrelacées sur les enchevêtrements humain-plante.

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Introduction

"*The infectious allure of flowers, their stimulating aura, colours, smells, shapes, and semiotic and symbolic associations, is indefatigably enchanting. It is miraculous how powerfully these flowers, which we integrate into our constructed worlds, spread pleasant feelings, reminders that despite so many indications to the contrary, life can actually be quite beautiful*"

Randy Malamud, *Strange Bright Blooms*

Working with historical botanical specimens has instilled in me a newfound sense of unhurriedness. The slowness of gently moving each sheet, careful to hold opposite corners, at initially felt at odds with the hurried pace of graduate work that necessitates scouring resources for what you need and quickly moving on to the next. Gradually, though, the care and attention required for working with herbarium vouchers afforded me time to properly take in the details of each one. Soon my eyes would move on from the voucher label in the bottom right corner to scan the rest of the sheet. My gaze would fall on the rust-colored spots on certain sheets but not others, small roots still caked in soil, tufts of cotton caught in glue, pencil marks from curators past, plant parts sticking up despite earnest efforts by someone decades ago to affix everything flat and still to the paper. Even comparing two vouchers containing the same genus and species revealed that no two sheets were alike. Through noticing and paying attention, it became clear to me that a single sheet in an herbarium contains myriad stories, not all of which involve humans.

My research began with the question of who Dr. Dorothy Swales was as a female botanist at a time when it was difficult to reconcile one with the other in a field often dominated by men. Her enchantment with the natural world so evident in her writing for the *Montreal Star* and

herbarium documents captivated me. Tracing the botanical connections in Swales' life, though, ushered in new layers of curiosity about the plants she devoted her life to collecting, preserving, and researching. Often in botanical history, more-than-human actors stand by in the wings, existing as secondary characters to humans who take center stage. Telling the stories of women in botany, like Dr. Swales, the first woman to curate the Macdonald College (later McGill University) Herbarium, shines a light on those whose contributions to botanical knowledge were not as well known. It is key, though, to take one step further and bring botanical lives into the foreground as well thereby recognizing their role as co-creators of multispecies stories. This thesis attempts to let those stories, both human and vegetal, unfold in print and in a digital space. Specifically, my research foregrounds the flowering plants, grasses, lichens, and mosses that comprise the botanical assemblages that profoundly shaped Swales' life.

My first chapter experiments with a new materialist and critical plant studies approach to herbarium collections broadly. To do so, I draw on new materialists such as Iris Van der Tuin and Rick Dolphijn (2012) and Jane Bennett (2010), materialist ecocritics Serpil Oppermann and Serenella Iovino (2014), and the work of critical plant studies scholars Natasha Myers (2015) as well as Natania Meeker and Antónia Szabari (2019). I specifically shape my research using Bennett's vital materialism, which draws on the concepts of enchantment and vibrancy of the material world. As Bennett attests, the task for new materialists is to "cultivate the ability to discern nonhuman vitality, to become perceptually open to it" (14). I argue that herbaria are ideal spaces to witness that vitality. Doing research in the herbarium, I am guided by Bennett's call to remain open to the vibrant materiality that can be witnessed when engaging with botanical plant vouchers.

In my second chapter, I explore the long-intertwined Western history of women and the natural world in the West. Predicated on the sociocultural views of women as caregivers, midwives, or nurturers, women were viewed as possessing a deep-rooted natural connection to plants. However, their first-hand subjective knowledge of the botanical world was relegated to the margins by virtue of their sex. In this chapter, I foreground the life and curatorship of Dr. Dorothy Newton Swales (1901-2001), but also experiment with telling the story of Dr. Swales as botanist and herbarium curator by weaving in the lives of the lichens, mosses, and flowering plants who profoundly impacted her life and research. In this way, I explore how storying botanical matter can highlight the interconnectedness of human-botanical relations. As Gibson and Gagliano remind us, "plants are not the subject (nor the object) of science, the subject of writing or of thought. Instead, they are co-creators and collaborators, a different species to live with and alongside" (142). To tell the story of one requires telling the story of many others.

In the third chapter, I explore how Digital Environmental Humanities (DEH) can create space for women's contributions to botanical knowledge creation through digital storytelling tools such as Omeka and ArcGIS StoryMaps. As Charles Travis argues, "DEH holds the potential to weave millennial mythologies, narratives, and heuristics; contribute tools and methods to promote "out of the box" thinking; and promote agencies to address the ethical-technical-environmental dilemmas we are facing in the 21st century" (106). As part of the Ad Hoc Digital Humanities program at McGill University, my thesis involves both a written and digital component. I created an Omeka exhibit that would allow me to showcase each of the herbarium vouchers that I digitized and make Dr. Swales' work accessible online. Rhizomatic in structure, I argue that Omeka exhibits can be effective and visually engaging conduits for bringing together different ways of knowing and experiencing the natural world.

Throughout this thesis, I include italicized sections that capture my own thoughts, perspectives, and experiences during my hands-on research and digitization in the herbarium. I view this as a situated and embedded approach to botanical knowledge creation inspired by Donna Haraway's feminist epistemology. As Haraway explains, "feminist objectivity is about limited location and situated knowledge, not about transience and splitting of subject and object" (583). In lieu of the disembodied view from nowhere that proposes to offer a 'universal' scientific rationale, Haraway argues for embracing a situated, subjective, and embodied form of knowledge creation. I approach Swales' botanical legacy and the history of the plants housed in the herbarium from the vantage point of a humanities grad student and former academic librarian. My background in information studies instilled in me a focus not just on how information is organized and presented but assessing critically where that information is derived from. Such a position is one of the many that Haraway describes in terms of a "feminist embodiment [that] resists fixation and is insatiably curious about the webs of differential positioning" (590).

As Bennett explains, "vital materialists will thus try to linger in those moments during which they find themselves fascinated by objects, taking them as clues to the material vitality that they share with them" (*Vibrant Matter* 17). Situated in the herbarium navigating the physical material traces of Swales' fieldwork, I take up Bennett's call to linger in those moments. Sheet by sheet, I allow myself to be surprised and awed by the vibrancy before me.

Chapter One: Theorizing Botanical Matter in Herbaria

Vibrant Botanical Matter

New materialism, or neo-materialism, is an interdisciplinary field that foregrounds the vibrancy of matter to problematize and unsettle human-centered paradigms that deny matter agency and creativity. New materialism embraces the idea that life is, as Henri Bergson attests, "an unstoppable creative evolution" and as such requires more than reductive dualisms (qtd. in van der Tuin 277). The term 'new materialism' can be traced to Manual De Landa (1996) and Rosi Braidotti (2000), who draw on post-structuralist thinkers Gilles Deleuze and Felix Guattari to explore the idea of complex interconnectedness between bodies (Bexell 23). In focusing on the interconnectedness of humans and more-than-humans, new materialists seek to unsettle the idea that agency is restricted to humans and instead point to the agential forces that exist with the more-than-human world.[2] As Karen Barad attests, "matter does not require the mark of an external force like culture or history to complete it. Matter is always already an ongoing historicity" (150). Recognizing this ongoing historicity, to borrow Barad's description, also underscores that it is not only humans who can make things happen. As Jeffrey Scott Marchand powerfully explains, an expanded understanding of agency "forces us to reconfigure and 'reterritorialize' the human within a volatile mix of agencies, beings, and forces, where the

[2] I choose to use the term more-than-human rather non-human when describing beings within the natural world. As Carlos Roberto Bernardes de Souza Júnior explains, the term 'more-than-human' encompasses the interconnectedness between, with, and beyond humans and thereby rejects the binary of nature and culture. For more information, see Souza Júnior, Carlos Roberto Bernardes de. "MORE-THAN-HUMAN CULTURAL GEOGRAPHIES TOWARDS CO-DWELLING ON EARTH." *Mercator (Fortaleza)* 20 (2021).

human is only one among a multiplicity of agents who are active in determining and enacting our (human or not) future possibilities" (294).

A new materialist reconfiguring places humans within a network shared by the more-than-human world rather than separate from it. For Marchand attests, new materialists, in recognizing the agency of matter, seek to create "a reconfigured vision of the human located within a constant flux of material flows that enable uncertain becomings with (and within) a lively and agential more-than-human world" (293). However, acknowledging the agential abilities of matter does not mean "adding to them a sprinkling of agency;" rather, it means "restoring them to the generative fluxes of the world of materials in which they came into being and continue to subsist" (Ingold 12). This political perspective recognizes the human as only one part of an active force of materialities and asserts that matter can make things happen. Humans are part of a web that can affect but in turn be affected.

Challenging Western Cartesian dualistic paradigms of animate/inanimate, subject/object, and human/nonhuman, new materialism rejects the belief in the uniqueness of human agency in contrast to matter's passivity.[3] While some scholars critique this removal of dualisms as a flat ontology that completely erases differences between bodies, new materialism instead offers a complex, interwoven framing of bodies. In moving beyond binaries, new materialism serves as a "research methodology for the non-dualistic study of the world within, beside and among... the

[3] As Samantha Frost explains, "for René Descartes, matter is passive, unmoving and subject to the mechanistic laws of physical cause and effect when compelled to move by an external force. This conception of matter is central to his notorious metaphysical dualism and his claim that the thinking self is an immaterial substance ontologically distinct from the embodied, material self" (71). For a detailed discussion on new materialism, see Frost, Samantha. "The implications of the new materialisms for feminist epistemology." *Feminist epistemology and philosophy of science*. Springer, Dordrecht, 2011. 69-83.

world that precedes, includes and exceeds us" (van der Tuin 277). Alternatively, Diana Coole and Samantha Frost suggest that new materialism can be seen as post- rather than anti-Cartesian Dualism in advocating for looking to other ontologies that embrace the world as full of heterogenous, emergent, and vibrant interconnected matter (8). By rejecting reductive and separate categories for humans and more-than-humans, new materialism advocates for a relational ontology that acknowledges porous boundaries and complex interconnectedness. Such thinking underscores humans' connection to the material world through shared materiality and in doing so, advocates for a system of sustainability, care, and inclusivity of the more-than-human world.

In a time of ecological degradation and unsustainable resource consumption that has rippling effects throughout the botanical world, Bennett's vital materialism offers an ethical approach to more-than-human relations. As she posits in *Vibrant Matter*, "this sense of a strange and incomplete commonality with the out-side may induce vital materialists to treat nonhumans – animals, plants, earth, even artifacts and commodities – *more carefully, more strategically, more ecologically*" (Bennett 17-18).[4] In raising the status of materiality, Bennett advocates for a re-imagining of our place in the order of things, not at the center but *in relation with* more-than-human life. Entangled, connected, and linked, we affect but are in turn affected by a "a particularly rich and complex collection of materials" (Bennett 11).

For Bennett, rekindling enchantment serves as a sort of new materialist methodology for relating to and viewing the more-than-human world differently. As she powerfully states, "we *are* vital materiality and we are surrounded by it, though we do not always see it that way" (*Vibrant Matter* 14). Bennett's enchanted materialism makes space for surprise, for allowing

[4] Italics mine.

oneself to be spellbound and awestruck by the world around them. The inability to perceive otherwise can be thought of as symptomatic of living in a disenchanted modern world. As Richard Jenkins explains, "in a disenchanted world everything becomes understandable and tamable…[and] increasingly the world becomes human-centred and the universe — only paradoxically — more impersonal" (Jenkins 12). Thus, when everything is predictable and conquerable by humans, there is little incentive to be captivated by how the natural world functions.

Flowers in a Disenchanted World

The botanical world, whether growing in the wild or preserved in herbaria, often goes unnoticed devastating effect. The disenchanted misconception of plants as immobile, rooted beings, perpetually fixed in the ground where they sprouted up feeds into forgetting the presence of plants in our everyday life, an unfortunate reality so pervasive that it warrants its own term, that is, plant blindness.[5] This is especially troublesome in light of the climate crisis. Rising temperatures, increase in atmospheric C02, drought, and other effects of a rapidly warming planet have taken their toll on plant life and, as a result, plants have been observed blooming in new areas, blooming less, or have disappeared entirely (Lang et al. 115). As Hubert Alain attests, "new materialists are motivated by an ecological imperative: in the age of the Anthropocene, global climate change, biodiversity loss, and environmental destruction, the very paradigm that assumes a separation between human and nature, and a dominance of the former on the latter,

[5] Plant blindness can be defined as the tendency to "overlook plants as living organisms, usually viewing them as unassuming backdrops" (Jose, Wu, & Kamoun, 169). For more information, see Sara B. Jose, Chih-Hang Wu, and Sophien Kamoun, "Overcoming Plant Blindness in Science, Education, and Society," *Plants, People, Planet* 1, no. 3 (2019), 169–72. https://doi.org/10.1002/ppp3.51.

must shift towards a comprehension of ourselves as integral to more-than-human ecologies" (57).[6]

Like new materialism, critical plant studies "forges new research paths for thinking (with) plants as a way of repositioning the human in the surrounding natural-cultural environment and human-vegetal knowledge" (Szczygielska and Cielemęcka 6). Critical plant studies, which draws on science, philosophy, art, and human-plant geographies, is a crucial step forward "in the way in which plants are regarded and researched socially and culturally [and] offer a way forward for contemporary perceptions of plants" (Ryan 103). Critical plant studies advocate for turning attention once more to the botanical world around us to reconceptualize human-plant relations in a deeper, more ethical way.

Rather than viewing the botanical world as passive, critical plant studies ask "how plants act upon us, contributing to the co-generation of our cultural practices, values, perceptions, relations, [and] artifacts" (Ryan 104).[7] I argue for extending this perspective to herbaria collections to learn how historical botanical collections act upon and continue to affect us.[8] As Natasha Myers states, "[plants] teach us the most nuanced lessons about mattering and what

[6] Hubert Alain argues that while proponents of historical materialism advocate for a return to focusing on systems of production and consumption under capitalism to address global problems, new materialism proposes a re-envisioning of human/more-than-human relations to address widespread environmental issues emblematic of the Anthropocene. See Alain, Hubert. *Vagabond: The Trans-Species Ecologies of Plant / Human Encounters*. Vol. 2, 2017, pp. 53–80

[7] Ryan draws on plant morphologist Rolf Sattler's research to explain that plants' perceived immobility in comparison to the mobility of humans reinforces the belief that plants are inert and static. See Ryan, John Charles. "Passive Flora? Reconsidering Nature's Agency through Human-Plant Studies (HPS)." *Societies*, vol. 2, no. 3, 2012, pp. 101–21, doi:10.3390/soc2030101.

[8] As Bennett attests, "human-plant affinity abounds once you become alert to them, and then there's a slight but real kaleidoscopic shift in everything you see, hear, smell, touch, taste, and think" (*Vegetal Life and Onto-Sympathy* 103).

really matters: their beings and doings have enormous planetary consequences."[9] While navigating herbaria collections can help bring previously unknown stories about historically marginalized botanists to the forefront, a new materialist and critical plant studies approach to botanical history asserts that the materiality within herbaria is also deserving of notice, curiosity, and exploration.

The Materiality of Herbaria

In the herbarium, Dr. Beauregard and a volunteer discuss the mounting of a Carex*, a group of grass-like plants also known as sedges. "What should we do with the rhizome?" asks the volunteer, as she points to the root-like base of the specimen that extended past the voucher sheet. Peering over the* Carex*, I was drawn in by the lattice of rooted matter. It was hard not to wonder about the various sedges or other plants that were once connected with this one unseen below ground. By tracing the rhizome, where would it lead us?*

New materialism's rethinking of matter can be described as transversal, challenging disciplinary boundaries to create what Iris Van der Tuin and Rick Dolphijn describe as a cartography that moves through, beyond, and across subjects.[10] As they attest, "new materialists open up the paradoxes inherent in those traditions by creating concepts that traverse the fluxes of matter and mind, body and soul, nature and culture, and opens up active theory formation" (Van der Tuin and Dolphijn 86).[11] This method of collaborative, post-disciplinarity is, as Rosi

[9] Natania Meeker and Antónia Szabari make the point that plants have an ontological uniqueness that allows them to straddle divides between animal and mineral, animate and inanimate. They attest that "plant life, a sign of the astonishing vigor and liveliness of matter, ... becomes a key figure in materialist rethinking" (29).
[10] The field of critical plant studies, too, approaches the botanical world through an interdisciplinary approach. Gagliano, Ryan, and Vieira borrow from the biologist Edward O. Wilson to refer to this approach as the "jumping together" of knowledge (xvii). See Gagliano, M., Ryan, J.C., & Vieira, P. (Eds.). (2017). *The Language of Plants: Science, Philosophy, Literature*. University of Minnesota Press.
[11] Rosi Braidotti refers to this as posthuman thinking, which she defines as "a relational activity that occurs by composing points of contact with a myriad of elements within the complex multiplicity of each subject and across multiple other subjects situated in the world" (*Posthuman Knowledge* 123).

Braidotti describes, a "highly ethical approach that demands collective praxis and implies a shift in habits, in frames of reference, but also in daily interactions and activities" (*Transversal Posthumanities* 1191). Approaching botanical history and herbaria collections from a new materialist approach requires a mode of interconnected knowledge production that draws on both the sciences and the humanities.[12] Doing so enables deeper ways of seeing and understanding the botanical world and can open new avenues for probing human-plant entanglements.

In working with the collections in the McGill Herbarium, my own transversal methods for navigating the different genera and species involved learning from the current Herbarium curator, Dr. Frieda Beauregard. Approaching botanical collections from a new materialist and critical plant studies perspective allows me to focus in and understand the convergence of matter and story in one way, but this vantage point only takes me so far. Working in the herbarium and learning from Dr. Beauregard fine-tuned my gaze to see the plants as a botanist and curator might see them. Bringing together concepts from both botanical science and the disciplines my research stems from enables a rhizomatic approach to multifaceted botanical stories.

Of Rhizomes and Assemblages

New materialist thought evokes the image of the rhizome as a model for articulating non-linear connection that extends out in multiple directions. As Michael Marder explains, rhizomic thinking "takes place in the interconnections between the nodes…across which differences are communicated and shared" (*Plant-Thinking* 169). Rhizomes, a type of modified stem that grows

[12] As Rosi Braidotti stresses, the climate crisis reveals an even greater need for posthuman convergence, that is, "new forms of solidarity social justice, and…the praxis of constructing affirmative values, relations and projects" (*Transversal Posthumanities* 1185). Doing so requires the humanities to draw on the sciences and vice versa, creating mutual respect and collaboration. For more detailed information on transversal posthumanities, see Braidotti, Rosi. "Transversal Posthumanities." *Philosophy Today*, vol. 63, no. 4, 2019, pp. 1181–95, doi:10.5840/philtoday2020128318.

horizontally underground, play important roles in clonal plant reproduction and energy storage (Guo et al. 1). From the nodes along the rhizome come growth of above-ground shoots, allowing the plant to extend itself while below ground, rhizomes store nutrients for the plant. While this more scientific understanding of the rhizome is key to critical plant studies, I am also drawing on the philosophical concept as explained by Gilles Deleuze and Félix Guattari: "A rhizome has no beginning or end; it is always in the middle, between things, interbeing, *intermezzo*" (25). Where the arboreal is hierarchical and organized, the rhizome is not limited by direction or structure and instead "connects and assembles in movement, without necessarily losing or gaining anything and without giving more importance to one element over another" (Klei 48). Where can following the rhizome, both the botanical specimen in the herbarium and a philosophical concept, lead us when digging through the complex histories of plants?

Herbaria are full of rhizomes, literally and metaphorically, that span across time. Plants might be collected and preserved in one decade, identified in another, and digitized many years later. Duplicates of botanical specimens might be exchanged to another herbarium to facilitate reciprocal partnerships between institutions. The metaphor of the rhizome thus re-envisions temporality as open-ended and continuous. The rhizome thus "accomplishes the work of the vegetal soul, traversing metaphysical distinctions between plants, animals, and human beings" (Marder, *Plant-Thinking* 168). Rhizomic thinking affirms that there are multiple nodes or points of entry to encountering the life of a plant, and like the rhizome underground it is non-linear, continuous, and expansive in its connections.

Like the philosophical application of the rhizome, new materialists evoke the Deleuzoguattarian concept of assemblages to visualize the diverse and emergent convergence of matter. As Deleuze writes, an assemblage "is a multiplicity which is made up of many

heterogeneous terms and which establishes liaisons, relations between them, across ages, sexes and reigns – different natures" (69). Assemblages straddle a liminal space where they are not merely reducible to the sum of their parts or all-encompassing such that each member loses its individuality. Open-ended and emergent, assemblages are "living, throbbing confederations" that derive agency from the mix of vital materialities within (Bennett 23).[13]

Jesse Bazzul and Shakhnoza Kayumova explain further that for Deleuze and Guattari, "assemblages offer a way to think about how component parts fit together, not necessarily in arborescent-like structures, but in more rhizomatic ways, which have emergent properties of their own, as well as the relations between parts and other assemblages" (286). A more scientific definition of assemblages can be useful to further illustrate the concept. Within ecological studies, the term assemblage is used to describe meta-communities comprised of multiple species that often interact; the term also points to "variation in either species' behavior, space or time that allows for the persistence of interlinked communities" (Stroud et al. 4761).[14] Thinking through the literal and metaphorical meanings of the assemblage helps to shift how humans see themselves in relation to the natural world.

Before discussing these concepts of rhizome and assemblage in terms of the materiality of herbaria, it is necessary to explain the origin and function of these repositories of botanical

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[13] Bennett draws on Deleuze's notion of adsorbsion to explain the relationship of parts of an assemblage to the larger collective. She explains that "adsorbsion is a gathering of elements in a way that both forms a coalition and yet preserves something of the agential impetus of each element" (*Vibrant Matter* 35)

[14] Stroud et al. explain that while assemblage and community have been used interchangeably, assemblage implies a phylogenetic relation between members of an assemblage. Members of an assemblage often interact but interaction is not required to consider them part of an assemblage. This is similar to Bennett's proposal that assemblages are topographically uneven because "some of the points at which the various affects and bodies cross paths are more heavily trafficked than others, and so power is not distributed equally across its surface" (*Vibrant Matter* 24).

collections. Herbaria find their origin in the work of Luca Ghini, a professor at the University of Bologna in the early 1500s (Thiers 14-15). Initially referred to as *Hortus Hiemalis* (winter garden) or *Hortus Siccus* (dry garden), herbaria were created by gathering fresh plants, pressing them between sheets of paper to look the way they did when they were collected, and flattened until ready to be mounted and described (Thiers 14). These plant specimens, referred to as vouchers, are comprised of "a pressed and dried sample of an individual containing aboveground structures (leaves, stems, flowers, and/or fruits) and below ground structures when possible" (Culley 1). Diane Bridson and Leonard Forman recognize diverse types of herbaria that serve different audiences and functions. While some are meant for educational purposes and are housed in universities and colleges, others are in the same category as museums and special collections meant for both educational and public interest.

Herbaria are themselves botanical assemblages in both the philosophical and scientific sense; vouchers with dried plant specimens that were collected, identified, and preserved across space and time uniquely shape the temporal rhythms of each herbarium collection.[15] Across the globe, 3,300 herbaria contain nearly 390 million specimens (Thiers 219). In terms of a new materialist perspective, this equals 390 million stories of the lives of humans and more-than-humans as they are preserved and intertwined. Examining herbarium collections and the unique assemblages of plants thus poses questions not only of what(who) but how, where, and why. The flowering plants, grasses, mosses, and lichens that might grow and flourish near one another or

[15] The plant itself is described as a specimen and once mounted on paper, is called a voucher. As Theresa M. Culley explains, "a voucher typically consists of an herbarium specimen, a pressed and dried sample of an individual containing aboveground structures (leaves, stems, flowers, and/or fruits) and belowground structures when possible." See Culley, Theresa M. "Why Vouchers Matter in Botanical Research." *Applications in Plant Sciences*, vol. 1, no. 11, 2013, https://doi.org/10.3732/apps.1300076.

in entirely different ecosystems are brought together through individual collectors or via botanical exchanges.

Studying a botanical voucher up close can reveal much about the life of the plant, both when it was part of an ecological assemblage and later as part of an herbarium assemblage.[16] Although herbarium sheet labels vary in detail, they tend to highlight the human actors involved in their collection and identification, as well as including information about the institutions where the voucher was housed. Found on the voucher label in the bottom right corner is the scientific name, the date of collection, the name(s) of the person(s) who did the collecting, and the name(s) of the person(s) who made the identification. Like the botanical world, herbarium collections are organized by the taxonomic system of family, genera, and species shaped by Linnaean taxonomic principles. Detailed in his *Systema Naturae* (1735) and *Species Plantarum* (1753), Swedish botanist Carl Linnaeus constructed a taxonomic system that would both organize the plant world and standardize plant naming (Kranz 204).

Herbarium vouchers also speak to cultural understandings through the inclusion of common names and how humans might engage with and use them. More detailed herbarium specimen labels might feature additional typed or handwritten notes with first-hand accounts of the environment where the plant lived and the ecological assemblage that they were part of. Regardless of the size of the institution or breadth of collection within, each herbarium is "a place, a landscape if you will, where the experience of people connecting with nature is revealed" (Humphreys 13). These vouchers are records of multispecies stories that reflect the interconnectedness that can be found when one looks closely around, at and with them.

[16] Herbarium voucher preparation follows standard guidelines and instructions: "plants not to be damp when brought together," "*dried* between dried paper" "with *flowers and fruiting* organs present" to capture the best representation of the plant's life cycle and attributes (Metsger and Byers 12). Italics mine.

Herbaria are ideal places for examining the convergence of different materialities where each voucher is itself an assemblage of chemical, abiotic, and biotic matter. As Dani Stuchel explains, "what we regularly describe as conservation or preservation can be reinterpreted as the selective unfolding of material possibilities to create a desired assemblage of vibrant matter" (15). At first glance, preserved plants in an herbarium might be perceived as dry, flat figures tucked away in cabinets until viewed in person or online. However, look closer and you can find that each sheet contains not only a preserved flower or lichen, but a unique array of chemicals, glue, dust, tape, labels, seeds, roots, and rhizome.

The effects of organic and non-organic matter can be seen in the mounting and preservation of specimens that differ depending on the organismal structure and DNA of the plant and the chemicals involved. For example, biodegradable plastics containing starch allow bacteria to infiltrate, destroying the plants in the collection. While alcohol can be used for animal preservation, it negatively affects the DNA of fungi and plants. Cellulose acetate, cellulose nitrate, poly(vinyl chloride), and vulcanized rubbers can cause damage to the plant, and there are only a few plastics considered safe and non-corrosive such as polyethylene and polypropylene.[17]

[17] According to Bridson and Forman, this type of glue was commonly used up until the 19th century but was susceptible to bacteria and so phased out. For more information, see Bridson, Diane and Leonard Forman, *Herbarium Handbook*, 3rd edition, Richmond, Surrey, Royal Botanic Gardens, Kew, 1999.

Figure 1: Assemblage of herbaria materiality. Images from left to right: oxidation left on paper from missing pieces of a fern potentially stained by the tannins in the leaves; glue with air bubbles over stem; cotton ball used to create shape within the labellum

Even in a preserved state, plants reject the misconception that once collected they cease to be active and agential. As Bridson and Forman explain, insect damage from aptly named herbarium beetles, booklice, and silverfish must be taken into consideration when preserving and maintaining herbarium collections. While specimens coming into the herbarium are placed in a freezer for decontamination before mounting, damage from potential insect damage must be factored in even after specimens are preserved and stored in the herbaria. Desiccant dust made from diatomaceous earth or silica can be spread around the cabinets to draw moisture from the bodies of insects, thereby killing them before they can damage the specimens. Biocides derived from plants themselves have also been used to prevent insect damage such as camphor, lavender oil-derived linalool, thymol, wild rosemary, and cedar oil (Kurmanow 123).[18] Until the 1980s, collections in herbaria were often disinfected using a mix of mercuric chloride and ethanol

[18] Magdalena Grenda Kurmanow notes that previously used natural mixtures of clove and aloe were used for glue, as well as a concoction of wormwood and santonica, although the latter was found to change the colour of the specimens themselves after mounting. For more information on an extensive list of herbaria preservation and biocides, see: Kurmanow, Magdalena Grenda. "Review of Biocides Used as Prevention and Intervention Measures for Historic Artefacts, with Special Regard to Herbaria Collections." *Notes Konservatorshki*, vol. 21, 2019, pp. 121–61, doi:10.36155/NK.21.00004.

(Havermans et al. 1). Known to pose health risks to humans as well as damage the DNA of the specimens, mercury is no longer recommended (studies have found that herbarium specimens can continue to emit metallic mercury decades later).[19]

The convergence of multiple materialities that continue to act upon one another can be found on each specimen sheet, making their way onto or into the specimens and even human bodies years after they were first collected. As Iovino and Opperman explain, "all matter—even the one that we do not see, sense, or suspect—constantly interacts with other matter, whether in human or nonhuman forms" (7). Herbarium specimens can be understood as living material texts that contain multiple stories of human-plant-matter entanglements. As Gibson and Gagliano attest, "we can't escape the bind of only understanding the state of being through the sieve of humanness but we can learn from what we newly see" (143). What does it mean, then, to tell stories with herbaria collections in a way that goes beyond the information contained on the voucher label and instead helps us to see each plant a as vibrant member of an assemblage that cut across time and place?[20]

Botanical Storied Matter

Over the summer of 2021, I began to sift through Dr. Swales's collections curious as to what I could learn about who she was and the plants she chose to collect and preserve. The first sheet was from a collection made during one of her summer trips to the Northwest Territories.

[19] John Havermans, René Dekker, and Ron Sportel also speculate that mercuric chloride's effect on herbarium specimens could be seen up close as discoloration. Bridson and Forman echo this by explaining how mercuric chloride will often crystallize, giving the specimens a hairy appearance.

[20] In an interview with Prudence Gibson, environmental philosopher Michael Marder cautions us against the pitfall of reducing a plant to something void of vitality when it was "cut, culled, [and] detached from its living source, and sacrificed to a reality higher than it" (27). See Gibson, Prudence. "Interview with Michael Marder." *Covert Plants: Vegetal Consciouness and Agency in an Anthropocentric World*, edited by Prudence Gibson and Baylee Brits, Brainstorm Books, 2018, pp. 25–34.

On the label read Leguminosae Hedysarum mackenzii Richards*, a type of pea plant also known as Mackenzie's sweet-vetch that grows in Arctic tundras. This sheet had additional information that detailed where the plant was found: "In life this member of the pea family is a bright magenta colour. It was a common plant in open spots among shrub willows on dry gravel at Inuvik. It grew in unbelievable masses on ground disturbed by bull-dozers around the town of Churchill on the Hudson Bay, and continues south to the shores of James' Bay." That it was June when I began my research on this collection, the same month when Dr. Swales collected the sweet vetch on dry gravel by the road over 50 years earlier, felt like a serendipitous connection. The once-magenta blossoms had taken on a dark purple colour tinged with orange. While examining the labels, I paused over the description that started with 'in life.' What about* ***this*** *life in the herbarium?*

The task of herbarium specimen preservation is both a technology and an artform in its own right, which involves interacting with botanical and chemical matter to create a long-lasting botanical memory.[21] The way plants appear in their natural environment provides a template for how the curator or herbarium assistant should affix the plant bodies to paper. When navigating botanical collections, it is common to find examples of a plant shown at different moments of its life cycle. Someone collecting a *vaccinium*, a genus which includes blueberries, cranberries, and huckleberries, might choose to select a shrub with fruits for one specimen sheet and one with just the flowers for another to provide botanical snapshots of the plant's life. Those involved with botanical preservation and identification thus leave their mark on the plant when arranging and preserving it as well as naming or re-naming it. The personality of the curator is visible, explains

[21] According to herbarium preservation guidelines, "properly prepared and well cared for mounted herbarium specimens will last indefinitely" (Bridson and Forman 65).

Helen Humphreys, in the arrangement, description, and degree to which preservation materials were used such that "the act of specimen preservation becomes a sort of signature of the collector" (28). Examining herbarium collections leads to learning the story of both specimens and the people involved in their lives even after preservation.

While herbarium vouchers contain different story threads of collection and preservation, the history of plants such as the *Hedysarum* did not end when they were collected nor begin only when they were accessioned into the herbarium's collection. Plants, whether rooted where they grow or mounted on plant sheets, are deeply storied matter. As Michael Marder posits, "plants, too, live through occurrences without formulating them in speech. Their articulations are wholly material".[22] Each individual plant or lichen in an herbarium has its own history that is deeply connected to the histories of other bodies – both human and more-than-human.[23] Adopting a new materialist and critical plant studies perspective when engaging with plants pushes back against the organic and inorganic binary and argues that the story of *Hedysarum* did not end on that summer day in June 1965. Moreover, it foregrounds the (after)lives of these plants, asserting that even in herbaria, preserved plants are vibrant beings.

[22] Marder, *Plant-Thinking* 24

[23] As Iovino and Oppermann state, to story matter is to recognize the narrative agency inherent in the more-than-human: "Every living creature, from humans to fungi, tells evolutionary stories of coexistence [and] … whether perceived or interpreted by the human mind or not, these stories shape trajectories that have a formative, enactive power" (7).

Chapter 2: Human-Plant Biographies

To understand Dorothy Swales' life, it is necessary to examine the gendered underpinnings of botanical history that gave rise to a set of dominant narratives. Even if this chapter begins with human lives – women in botanical history and Dorothy Swales' biography – it circles back to vegetal lives in the second part. In order to foreground the botanical lives that so impacted Swales, I experiment with storying some of the lichens, mosses, and flowering plants in her collection. To story matter is to recognize the narrative agency inherent in the more-than-human. As Serpil Opperman explains, "whether it is a cell, a singing whale, a whispering wind, a pebble on the beach, an erupting volcano, a hurricane, or a plastic bag, matter is encoded with meaningful narratives, or narrative agencies through which the world becomes eloquent" (2). By centering botanical narratives in tandem with Swales' history, I demonstrate how human-plant entanglements can be depicted and portrayed.

Women, Botany, and the Western World

The Western history of women's relationship with botany and the study of the natural world is long and intertwined. According to Stacy Alaimo, "'woman' has long been defined in Western thought as a being mired in 'nature' and thus outside the domain of human transcendence, rationality, subjectivity, and agency" (239).[24] In the 16th and 17th centuries in Europe, women were allowed "to practice midwifery, supply medical cures, and practice a variety of sciences" (Schiebinger 96).[25] Botanizing and administering plants for maladies and

[24] This connection between woman and nature, according to Rosi Braidotti, stemmed from women's ability to give birth and their roles as nurturers. As she explains in *Posthuman Feminism*, "positioned closer to nature and to living beings, women also act as intermediary spiritual figures in traditional practices of healing and mourning, birthing and dying. Throughout this political economy, binary oppositions act as instruments of power and governance: they divide and conquer" (72).

[25] As Londa Schiebinger explains, women with practical and medicinal knowledge of herbs and flowers were viewed as healers for their communities and referred to as "wise women" or "women root cutters" (96).

ailments were well suited to the role of caregiver that was aligned with traditional notions of femininity. Herborizing was not only for midwifery but was enjoyed by women across social classes; in many respects, it became popularized because it was one of Queen Charlotte's hobbies in the 1770s (Lindon et al. 214). During these times, "women were encouraged to 'herborize,' or collect and classify plants in their local environments," thereby deepening the associations between women and plants (Meeker and Szabari 155).

Women's botanical knowledge was shaped by collecting, studying, identifying, and administering local plants either as medicine or food. Although they developed empirical plant knowledge through first-hand experience, women's botanical knowledge was prevented from ascending to the same academic and scientific strata as their male contemporaries. While the practice of fieldwork and learning from observation rather than from books was encouraged by Enlightenment thinkers for all areas of science, it was used to steer women away from solitary scholarly pursuits associated with masculine knowledge. Botany was thus touted as a practice for women best learned outside through direct observation "in the fields and at home, within families, and among friends" (Shteir 57). Moreover, the knowledge women did acquire was not meant to be put on display or boasted about. As Shteir notes, botany's association with women raised questions over whether "botany [was] an academic area or a popular one [and] how [it] should […] be taught" (150). It can be inferred, then, that the association of femininity with both nature and disorder as to cast doubt whether women could or even should engage with scientific classification and identification. This distinction of "polite botany with women and botanical

science with men" cast women's knowledge of and experiences with the natural world as lacking in scientific rigour and reason until assessed and classified by men (Shteir 157).[26]

This gendered dichotomy extended to authorship and the production of botanical texts throughout the Enlightenment and later the Victorian era. The culture of literature in the Victorian age "edged out" women by devaluing their botanical work and narrowing the field to works created by professional (male) botanists (Shteir 166). Moreover, although women made notable contributions to the field through illustration, their work was often under-recognized if their names were even credited at all. There was, as Natania Meeker and Antónia Szabari note, a strong divide "between the scientists (the public face of scientific discovery) and the illustrator (often anonymous), with the latter role more regularly occupied by women" (156). Despite the use of women's artistic and scientific depictions of the natural world by men and women, women's contributions were not taken seriously by virtue of their gender.[27]

Delegation of women's involvement in botanical science to amateur or assistant status extended into the early 20th century in Canada. According to historian Ruby Heap, women with botanical training were often hired only as seed analysts, a low-level job classified as "women's work" that came with low pay and low status (12). Within the broader field of science, women gained limited entry in the field, usually through engaging with science in museums, schools, and "relatively small specialist organizations rather than in places which society as well as historians of science, have habitually associated with scientific accomplishment" (Toogood et al.

[26] As Sam George further explains, the belief that "femininity is close to nature but is also a potential source of disorder which needs to be tamed by reason" prevented women's botanical knowledge from entering academic circles (67). For more information, see George, Sam. *Botany, Sexuality and Women's Writing, 1760–1830: From Modest Shoot to Forward Plant.* Manchester University Press, 2017.

[27] As Nancy J. Turner states, this bias would have certainly extended to Indigenous women's first-hand knowledge of harvesting and foraging plants, which would have resulted in this knowledge being largely ignored in ethnographic research conducted by settler naturalists (265).

17). One notable example of a woman in natural science who felt the effects of these constraints was Faith Fyles, a McGill graduate who was appointed Assistant Botanist at the Government of Canada's Central Experiment Farm in 1911 (Heap 12; Loydlangton 127).[28] Her entry into the Department of Agriculture came at a time when the more valuable positions were in research, university education, and the private sector, which meant women with an undergraduate education were used to fill staff vacancies (Loydlangton 127). Despite the research requirements of her position, Fyles was also expected to provide volunteer services to her male colleagues through botanical drawings and watercolour paintings (Loydlangton 128). Regardless of their qualifications, women such as Fyles saw their knowledge and capabilities devalued and relegated to support for male colleagues.[29]

Women's marriage status also played a role in keeping them from advancing in their careers. In the curation of an exhibition on the history of Canadian women scientists, artist Cindy Stelmackowich came across a memo from the Public Service Commission of Canada created in June 1920 regarding regulations that were approved to "govern the employment of married women" (62). The beginning of the regulation written by Clerk of the Privy Council, Rodolphe Boudreau, states that "hereafter no married woman, whose husband is living, shall be eligible for appointment in the Public Service" (qtd. in Stelmackowich 63). This policy of requiring women to resign from their posts after marriage did not end until 1955 (Stelmackowich 62). 20th century barriers that forced women in botany to choose between their career and marriage are reminiscent of Enlightenment-era sentiments that cast women who used Latin nomenclature as

[28] An overview of Faith Fyles's botanical collections can be found here: https://bionomia.net/Q29558869

[29] Fyles would, unfortunately, be incorrectly classified as an artist in 1919 when the department titles underwent reclassification and her supervisor, Mr. E.S. Archibald, did little to rectify the situation while recommending she be reclassified from artist to simply junior technical assistant, a clear demotion from her previous title (Heap 12; Loydlangton 129).

"masculine, unmarriageable, and unmaternal" (Shteir 56-57). The barriers that kept women like Fyles from being justly valued and credited for their scientific work were baked into both social norms and government regulations and would certainly be felt in how botanical knowledge would be classified and who would have a visible role in its organization and preservation.

Situated Knowledge of the Botanical World

Applying a feminist epistemology to botanical history creates space for the situated knowledges of women and other historically marginalized communities. This approach unsettles the idea that only certain kinds of botanical knowledge creation are valued and therefore worthy of consideration. A feminist epistemological approach instead advocates for a broader, inclusive mosaic of human and vegetal stories. In turning to the histories of women and plants, gaps in records and narratives about contributions to botanical knowledge creation and preservation can be filled by incorporating subjective, situated experiences.

Coining the expression 'situated knowledge', Haraway's feminist epistemology advocates for elevating the position of the partial, subjective knower in knowledge creation. Situated knowledge thus creates space for personal experiences and observations and, in doing so, argues for "a more adequate, richer, better account of a world, in order to live in it well and in critical, reflexive relation to our own as well as others' practices" (579).[30] To achieve such an equitable account, situated knowledge posits that what counts as "objective knowledge, even our best scientific knowledge of the natural world, depends on the *partiality* of its material, technical, social, semiotic, and embodied means of being promulgated" (Thompson 1).[31]

[30] As Braidotti states, "recognizing the embodied and embedded, relational and affective positions of humans is a form of situated knowledge that enhances the singular and collective capacity for both ethical accountability and alternative ways of producing knowledge" (*Posthuman Knowledge* 12).
[31] As Haraway attests, "subjectivity is multidimensional…and therefore able to join with another, *to see together* without claiming to be another" (586). Italics mine.

From a critical plant studies perspective, situated knowledge grows "through lived experiences within the multispecies plant world" (Alain 73). This embedded approach is well suited to the work of botanists such as Dr. Dorothy Swales for whom locatedness and physical proximity to the natural life she researched is part-and-parcel for both botanical knowledge creation and plant/specimen preservation. A situated knowledge approach is thus suited for examining the life and work of Dr. Swales, the first woman to curate the Macdonald College Herbarium from 1964 to 1971. Since Dr. Swales' life was inseparable from the natural world, I will recount her biography by weaving together the lives of the mosses, lichens, grasses, and flowering plants that Dr. Swales dedicated her life and career to better understanding and preserving.

Beginnings

"Flowers have bloomed every year of my life, the brightest being the close ties with three family generations (including a son, his wife and three grandsons), a husband who opened my eyes and ears to the creatures of the wild, and botanists, students and friends who have added warmth to each decade" – Dorothy Swales, *The Outdoor Trail from Farm to University*

Born in 1901 in Quebec and raised on a farm in the village of Plaisance, Dorothy Newton Swales grew up surrounded by an abundance of nature. In her memoir *From the Outdoor Trail from Farm to University,* Swales cites the pivotal moment when, at eight years old, she entered and won a competition for children that involved planting a garden, taking notes, and sending in observations of the natural world. The prize, a book by W. I. Beecroft called "*Who's Who Among the Wild Flowers?*" provided Swales with descriptions of local plants and became her guide to learning about the flora surrounding her. As Swales recalls, "I watched the bees pollinating the flowers and was fascinated at the way they combed their bodies with their two front legs and

packed pollen in a pollen basket on their hind legs … It opened a door to me which has never closed" (Swales, *From the Outdoor Trail* 4). Enchantment, fascination, and curiosity – these early experiences with the natural world would profoundly shape not only how Swales would see the myriad connections between humans and more-than-human lives but influence how she approached the more-than-human world in her interactions as an educator, botanist, and herbarium curator.

Inspired by her love of the natural world and encouraged by her siblings who all went on to pursue higher education in the natural sciences, Swales received a Bachelor of Science in Plant Pathology at Macdonald College in 1921, where she was one of the only female students in her cohort. It was at this time that Dorothy Swales, among other women in the sciences like Fyles, would have been trained as a specialist while learning to swim against the tide of gendered conceptions about what a scientist should look like and the kind of research that they were qualified to undertake.[32]

[32] In *The Outdoor Trail from Farm to University*, Swales describes how her older sister Margaret, who would later become a specialist in wheat rust pathogens, was discouraged by colleagues from applying to an agricultural college as "no women had entered an agricultural college in Canada before 1914…[and] she would probably fail the practical courses." Margaret refused to give up and, as Swales attests, "opened a door to women in agriculture."

Figure 2: Image of Dorothy Swales (centre - white blouse) as an undergraduate student at Macdonald college in Sainte-Anne-de-Bellevue, Quebec. Photo courtesy of Dr. David Swales.

Swales pursued a Master of Science in Bacteriology at Macdonald in 1923. For her graduate research, she travelled to the Atlantic Biological Station in St. Andrews, New Brunswick to research under the guidance of the director of the station, Dr. A.G. Huntsman. Swales was tasked with exploring how to better understand the relationship between marine spore-forming bacteria and the canning industry, primarily herring, lobster, and shellfish. Swales' investigation into spore-forming bacteria at Passamaquoddy Bay is an example of witnessing the "small agencies" of the tiniest actors (Bennett, *Vibrant Matter* 94). After the successful completion of her degree, she later received a Hudson Bay Scholarship to pursue a PhD in Mycology at the University of Manitoba with a focus on fungal sexuality. This accomplishment made Swales the first woman to receive a PhD from the University in 1931. During her PhD, Swales travelled to Europe to both improve her German language skills, a

university requirement for acquiring her PhD, and also to deepen her understanding of botany through course lectures and hands-on field work.[33]

Figure 3: Image of Dorothy Swales and fellow botanists hiking in Switzerland. Photo courtesy of Dr. David Swales.

Swales returned to Macdonald College as a lecturer in plant pathology, though her role as educator and botanist would take on a new position when she became curator of the College's herbarium in 1964. Swales' curation was shaped by the view that an herbarium was more than just a room full of cabinets and plant sheets. In her unprocessed notes entitled "The Herbarium", Swales writes that an herbarium "at its best can be a lively useful centre reflecting the outdoors of your own locality, of far parts of Canada, and even of the mysteries of Lappland and Siberia." Upon taking over the curatorship of the Macdonald College Herbarium, Dr. Swales chose to specialize in the Arctic and sub-Arctic, regions which touched the northernmost part of Quebec.

[33] In her memoir, she recounts travelling to Berninahäuser in Switzerland where her doctoral supervisor, Dr. A.H. Reginald Buller, had arranged for her to meet Swiss botanist and alpine flora specialist Dr. Carl Joseph Schröter. Dr. Schröter, who Swales described as "a dear old gentleman of 75 with a white beard" loaned Swales a plant press so she could collect in the Engadine Valley in Berninahäuser and later connected her with botanists at the Geobotanishes Institut in Zurich to identify her specimens. There in the meadows of Berninahäuser she was surrounded by "primulas gentians, alpine Forget-me-nots, Edelweiss, and a number of ericaceous species which I saw years later in our Arctic" (*From the Outdoor Trail*).

Plants collected by students had provided a solid start to the Arctic collection, raising the Herbarium to International Herbarium Status. However, Swales decided to conduct her own fieldwork across the Canadian Arctic, collecting plants that could be exchanged abroad, thus building and sustaining connections with international herbaria. The beauty of the Arctic fascinated Swales. As she writes in her unprocessed notes entitled "Gardens of the Eastern Canadian Arctic" on her travels to Iqaluit, "Arctic flowers are beautiful. There are few people who are not awed into silence and wonder in the midst of the tundra in July, covered literally with thousands of plants in bloom at once." The plants that inspired a sense of awe and wonder would play a key role in her curatorship and her contributions to the Herbarium's collection.

Swales' life was shaped by both a sense of wonder with the natural world and the desire to share that wonderment with others. In 1962, Swales started writing a nature column for the *Montreal Star* recounting the nature she found in her own backyard in Ste. Anne de Bellevue and the flora and fauna she encountered during her summer fieldwork. Her articles invited readers to notice the beauty of the nature around them, and one finds glimpses of enchantment woven into her scientific prose. For her readers, Swales possessed "a gifted pen and detailed knowledge of the small things that are all around us" (Renouf 6). Another reader expressed gratitude for her words: "Thank Dorothy Swales and THE STAR for making some of us feel part of a larger and fascinating universe" (Hobbs 6). In Dr. Swales' nature writing, scientific terminology is intermixed with glimpses of a new materialist vibrancy that speaks to her enchantment with the more-than-human world.[34] At the core of her practice both as a botanist and educator was an

[34] In one article from the May 11th, 1968, *Montreal Star* issue, Swales beautifully writes: "Now, in May, the woods are dotted with the white of the heavenly-scented Wild Plum blossoms and the graceful flowers of the Shadbusk, a close relative of the prairie 'Saskatoon.' Under the trees the yellow Dog's-Tooth Violets and Bellwort, the Trilliums and Spring Beauties spread a forest-floor cover as beautiful as the alpine meadows. The trees form briefly a delicate, colored lace curtain with tiny leaves of purplish-red on the red maples, pale green on the birches and elms, and

engagement with the natural world, a full immersion into its beauty found by the simple act of noticing.

Figure 4: Image of Dorothy Swales in the Arctic. Photo courtesy of Dr. David Swales.

The following section makes space for the botanical lives that Swales encountered during her time as curator. While Swales collected, preserved, and identified a large number of genera and species during her curatorship from 1964 to 1971, I selected the following lichen, hedysarum, and orchid because of what they can tell us about who Swales was as a botanist and about the interconnectedness in the natural world that can be seen and traced when botanical lives take centre stage. Storying botanical matter brings into view rhizomatic connections that allow us to reflect on more-than-human ways of being. As Anna Tsing succinctly states, "these livelihoods make worlds too – and they show us how to look around rather than ahead" (22).

yellowish-green on the willows and poplars. Out from this fairyland comes the bubbling song of the first Warbling Vireo." Swales, Dorothy E. "Belle Province in springtime." *The Montreal Star*, 11 May 1968, p. 6.

Like Swales during her fieldwork, navigating her legacy requires looking closely around at the botanical lives whose stories are linked to her own.

Noticing: Reindeer Moss (Cladonia rangiferina)[35]

Figure 5: Image of Reindeer Moss (*Cladonia rangiferina*) collected by Dorothy Swales in July 1964 while travelling across Nunavut. Image taken by me.

The letters exchanged between Dr. Swales and curators of herbaria in Sweden and the former Soviet Union detailed lists of lichen and moss specimens collected in the Northwest Territories available for exchange, as well as requests for identification. The lichen lists were peppered with names like Cetraria nivalis *and* Cladonia alpestris*, names that certainly did not easily roll off the tongue for someone new to this world. I set off to the far corner of the herbarium to the lichen cabinet to start my search. Unlike their flowering plant specimen neighbors in nearby cabinets preserved on flat sheets of paper, lichens are stored upright in*

[35] Although they are commonly referred to as Reindeer Moss, these *Cladonia* are actually lichen.

small envelopes organized by genus and species. Gently browsing through the rows of envelopes felt like navigating a delicate card catalogue as my eyes scanned the labels for the familiar marker that had become my signpost: Collector: Dorothy E. Swales. Cladonia rangiferina *was the first that I came across and there I saw its other name, Reindeer Moss. While including the Scientific name is standard for herbarium labels, common names can evoke images of how the plant or lichen looked or resembled to those who encountered it most. As I slowly unfolded the envelope, the dirt and dried lichen matter that had collected at the bottom over the years jumped and vibrated with each movement of the stiff paper. Glued to a piece of paper the size of an index card,* the bone-white lichen seemed to resemble the antlers of reindeer stacked one upon another.

Swales' curatorship involved establishing connections with herbaria abroad to increase the Macdonald College Herbarium's collection, exchange preserved specimens, and obtain assistance with identification. According to Dr. Swales, exchanges between herbaria were considered essential. During her tenure, she established relationships with the Naturhistoriska Riksmuseet in Sweden, the Universitetets Botaniske Museum in Denmark, and the Komarov Botanical Institute of the Academy of Sciences in the U.S.S.R. Dr. Swales sent plants collected during trips to the Northwest Territories, Quebec, and other locations across Canada in exchange for plants from Greenland, Swedish Lapland, and Siberia. As she explains, "we are fairly unique in Canada in establishing an exchange of Siberian plants with the Soviet Union as so far, they have not exchanged freely with Canada, outside of the National Herbarium in Ottawa" ("The Herbarium"). Correspondence between Dr. Swales and her colleagues overseas detailed the genera and species available to send, made requests for assistance with identification, and offered the occasional apology for delayed responses due to summer fieldwork. Moss and lichen,

though small and often unnoticed in the wild, helped fill the gaps caused by geographic distance and international rifts that were so prevalent during the Cold War.

As she writes in a Montreal Star article on her time in Iqaluit (then known as Frobisher Bay), moss and lichen were the few signs of growth among the rocks except for small plants aptly known as rockfoil ("Winter's Touch Felt at Frobisher Bay"). To gather lichen and moss, Swales would have needed to turn her gaze down to the ground, paying close attention to what is often missed by others. In her unprocessed notes, "Gardens of the Eastern Canadian Arctic", Swales remarks that "much of arctic beauty and interest lies in the 'microhabitat', or the small things you discover at your feet". The reindeer mosses she encountered in the summer of 1964 were found in rock crevices where other forms of life might not have been able to survive and in doing so supported life for bodies larger than their own. Their ability to persist despite cold winds, enables life for reindeer and caribou in the colder regions of North America, Scandinavia, and Russia who subsist on certain lichen for food during the winter months, as well as for the Indigenous communities whose culture and way of life centres around these animals (Sandström et al. 417).[36]

Lichens are the very definition of symbiotic matter. Formed through the union of fungus and algae, lichens are seen in the scientific world as a "classic case of mutualism, where all partners gain benefits from the association" (Nash 1). As Braidotti explains, symbiogenesis, used to describe bacteria merging to form new organisms, was initially disregarded by the scientific community, but became accepted as a way of understanding emergence, relations, and creation

[36] In her writing on her travels to Iqaluit, Swales noted the smaller size and longer growth patterns of plants in the arctic, including reindeer moss. She writes that "such discoveries should make Canadians proceed with the utmost caution in the inevitable opening up of the north to oil and mining companies, for what they destroy of our national arctic gardens will not come back within our lifetime...Let us pray that the stupidity of man will never pollute and destroy that land."

in the natural world (Posthuman Feminism 122). Braidotti's focus on symbiotic matter draws on research from the work of biologist Lynn Margulis, who argued for the concept of symbiotic life, and from Deleuze and Guattari's "notion that life is a net of interconnected collaborative systems of symbiotic communities" (qtd. in Braidotti, Posthuman Feminism 123).

In quiet ways, lichens speak to the presence of environmental damage and pollution. As James Walton explains, since lichen "do not have an outer epidermal layer, they cannot discriminate between nutrients and pollutants, and absorb both" ("Lichens of the Arctic"). Thus, as a canary in the coal mine, a decrease in their presence can point to poor air quality and unseen pollution, which in turn helps environmental scientists understand the development of local pollution over time.[37] That something as small as lichen can contain within it the larger story of human impact on the environment speaks to the importance of bringing into focus that which is often missed.

Similarly, the world of moss has often been overlooked despite their abundance in ecosystems (Kimmerer 12). Though small, moss can occupy spaces where larger vascular plants cannot, such as hard rock surfaces and tree bark. In lieu of roots that ground vascular plants like ferns and flowering plants, mosses have rhizoids which anchor them to soil, bark, or otherwise inhospitable rocky surfaces. Existing in these micro-environments, moss thrive. Understanding mosses challenges perceptions of liveliness itself. Due to their morphology, mosses enter a sort of dormancy when water is not available. While drought would spell the end for larger plants,

[37] Lichens respond to different air pollutants in their own ways. As Jessica L. Allen and James C. Lendemer explain, while some species of lichen such as *Cladonia cristatella (*British Soldier Lichen*)* can tolerate air pollution in urban areas such as New York City, other species such as *Punctelia rudecta* (Rough Speckled Shield Lichen) are considered sensitive. For more information, see Allen, Jessica L, et al. *Urban Lichens: A Field Guide for Northeastern North America : Including New York City, Chicago, Toronto, Boston, New Haven, Philadelphia, Baltimore, Washington, D.C.* Yale University Press, 2021.

mosses become desiccated in the absence of moisture, a process involving self-preservation at the cellular level to prevent sustaining damage over extended periods of dryness. The renewed presence of water allows moss to come alive once more. Thus, the mosses do not die but hover in an in-between space, and with each period of rainfall mosses unfurl in all their vibrancy and resilience. To know moss better invites closer inspection and doing so creates closer intimacy with vegetal life that often goes unnoticed.

Connection: Sweet vetch (*Hedysarum sp*.)

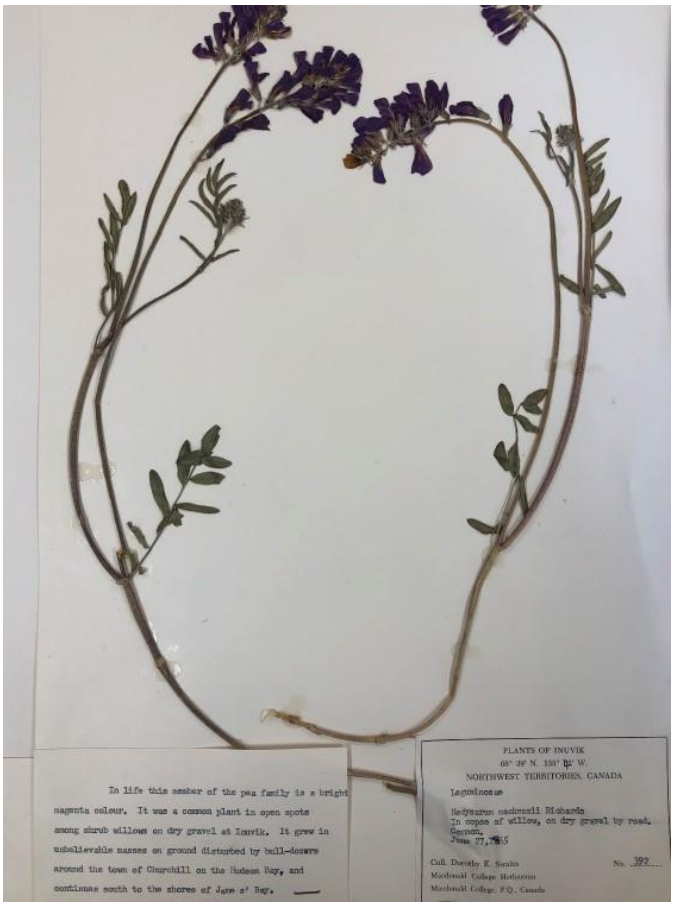

Figure 6: Herbarium voucher of *Hedysarum mackenzii Richards* (Wild Sweet Pea or Bear Root) that Swales encountered in June 1965 in Inuvik. Image taken by me.

The *Hedysarum mackenzii* that I came across early in my exploration of Dr. Swales' life would have been considered valuable as part of exchanges on both sides of the world to better understand the Arctic. The petals of the *Hedysarum*, even after all these years, were still a vibrant purple colour tinged with orange, likely from oxidation. Large enough to cover the entire sheet, the *Hedysarum* had been delicately secured with glue at various points, fixed in a position where the flowers on either end seemed to be reaching out to one another. The specimen label that my eyes had been trained to look for first to find Dr. Swales' name had been placed over the stem. The *hedysarum* seemed so expansive on the page there was nowhere left for whoever preserved the plant to place the small square label, and so they placed it over the stem, permanently curving it to the shape of the plant pushing up the words: "In copse of willow, on dry gravel by road. Common." Noting plants as 'common' is considered standard when describing an expected member of an assemblage in different habitats. Swales would certainly have considered this member of the pea family as a familiar presence during her summer field work. However, botanical preservation description only captures a small part of the hedysarum's story both before and after collection.

The area known as the Arctic is "defined as that part of the Northern Hemisphere where the sun is visible above the horizon for 24 hours during the summer solstice (around June 21) and is hidden below the horizon for 24 hours during the winter solstice (around December 22)" (Huryn and Hobbie 1). Locales within the High Arctic close to the North Pole contain sedge meadows and fewer than 150 vascular plant species, while the low Arctic closer to the Arctic Circle has a much wider variety of plant species. Arctic plants tend to be smaller, growing closer to the ground as a defense against desiccation from the harsh winds. Many plants in the Arctic have adapted through rooting strategies where the roots spread close to the surface, seeking out

the warmest parts of the soil or partnering with symbiotrophic fungi which, in return for carbon, can aid plants in reaching nutrients from newly thawed permafrost (Peterson 379; Wutkowska et al. 1).[38] Flowering plants such as Avens are known to track the movement of the sun, creating a welcoming warm enclosure for pollinators (Peterson 376).

It is in this climate that the *Hedysarum* can be found. The *Hedysarum's* versatile use across Canada led it to become known for its medicinal properties and its ability to thrive in the tundra. Known broadly as sweet vetches, the roots of *Hedysarum* species such as the Hedysarum alpinum have been used by Indigenous communities across Canada for their sweet licorice taste and source of vitamin C. For the Inuit and Dene (Athabaskan) peoples, the sweet roots can be enjoyed boiled or raw (Turner 65). For babies, the roots are known to have been used as pacifiers or softened into baby food (MacKinnon et al. 265). Grizzly bears, too, are known to consume the roots of *Hedysarum* plants, which earned the flower the common name bear root. Like moss and lichen, the licorice root exists on the edges of the Canadian Arctic in conditions that might not be hospitable to other life and yet they thrive, sustaining life for humans and more-than-humans alike.

Botanists like Swales and those overseas with whom she exchanged letters/specimens would immerse themselves in their fieldwork during the short Arctic summer period. The Canadian Arctic where Dr. Swales conducted her summer fieldwork was not unlike the arctic that the botanists in Stockholm and Leningrad would have come to know through their trips and work with the herbaria at their institutions. In recalling her trips to the Arctic and sub-Arctic during the quiet summers in between school years, Dr. Swales was captivated by the natural life

[38] While both short and tall plants have rhizomes, for vegetal life in the Canadian Arctic, rhizomes also play an especially important role by enabling vegetative propagation in the face of harsh climates (Mallory and Aiken 10).

around her: “The whole world of plants adapted to high winds, short seasons, biting snow spicules and intense winter cold spread out before me in all their brilliant colours” (“The Herbarium”). Swales was fascinated with these flowers and their pollinators, observing their relationship over the course of the short Arctic summers. In exchanges with international herbaria, botanists sent lists of plants collected during summer trips available for exchange. In one of the earliest correspondences, the Komarov Herbarium in St. Petersburg (then known as Leningrad) stated that all subspecies of *Hedysarum*, such as *Hedysarum boreale* (Northern sweet-vetch) and *Hedysarum alpinum* (Alpine sweet-vetch or licorice root), would be welcome for exchange. The *Hedysarum* that Swales collected during her travels to the Canadian Arctic would have been a familiar sight to her Russian colleagues whose fieldwork took them to the northern corners of Siberia. Despite global divisions caused by the Cold War, a love of Arctic plants like the *Hedysarum* bridged the divide between Swales and botanists in the USSR. As Dr. Swales writes in her memoir, “the Iron Curtain faded to a slight shadow between us”.

Reciprocity: Lady's Slipper (Cypripedium reginae)

Figure 7: Cypripedium reginae Walt (Showy Lady's Slipper) collected by Swales on Rigaud Mountain in June 1966. This orchid is considered rare within Quebec. Image taken by me.

*In an interview with Dr. David Swales, Dorothy Swales' son, I asked if his mother had a favourite flower of all the ones that she had encountered in her life. He responded that it was by far the yellow lady-slipper orchid (*Cypripedium parviflorum*). It was fitting that orchids, with their unique life-giving and sustaining bond with underground fungi, were Swales' favourite flower. Much of her life was shaped by partnerships with other women in the sciences. Sifting through the different sheets, Dorothy Swales' name jumped out at me time and again. It was clear that even after her tenure as herbarium curator ended, her involvement with botanical preservation and education carried on. Despite retiring from the role of curator, her name can be found on vouchers as the identifier for specimens collected by students, indicating her continued involvement as educator and collaborator. I imagined the threads of her life that were intertwined with other botanists like the unseen roots of the lady-slipper orchid flower. As*

Swales loved orchids best of all flowers, it felt fitting to look closer at the orchids she encountered and added to the Herbarium assemblage during her life.

Although Swales spent summers travelling to northern regions to collect and identify plants, the beauty of the flora of southern Quebec enthralled her. Within Quebec, Swales made several trips to Mont Rigaud and encountered rare species of orchids growing on the western slope of the mountain in the Cedar-Orchid Swamp.[39] Orchids, known for their reciprocal relationship with fungi, would have especially appealed to Swales as someone who specialized in fungi during her years in Manitoba as a doctoral student. Like the connections that shaped Swales' life, the orchid is synonymous with reciprocity. Unseen below ground, orchids and fungi engage in a mutually beneficial relationship. For cypripedium orchids, life begins with creating a fungal relationship as orchid seeds need fungi to germinate and grow (Shefferson et al., 614).)[40] For lady-slipper orchids in particular, the partnership with fungi has also been found to extend into the roots of trees, forming interconnected relations of exchanged minerals and nutrients (Weerasuriya et al. 1).

The kind of interconnectedness and reciprocity that enables orchids to grow and thrive defined Swales' life as a botanist and mentor. As her son Dr. David Swales recounts, his mother was considered a mother away from home for many international students who came to McGill to study plant science, and this mentorship led to friendships with students around the world.

[39] A *Montreal Star* article from July 1975 on Hydro-Québec's proposed route over Rigaud Mountain (Mont Rigaud) points out that Dr. Swales' discovery of five rare species of plants, including three species of orchids, would have been at risk had Hydro-Québec's power line route cut through the area. See Lord, Marc. "Farmer looking for support for war on Hydro." *The Montreal Star* [Montreal], 17 July 1975, p.45

[40] Orchids are considered mycoheterotrophic, a term that denotes the shared reciprocity between plants and fungi. For more information, see: Jąkalski, Marcin, et al. "The Genomic Impact of Mycoheterotrophy in Orchids." *Frontiers in Plant Science*, vol. 12, 2021, pp.1-16, doi:10.3389/fpls.2021.632033 and Merckx, Vincent, et al. "Myco-Heterotrophy: When Fungi Host Plants." *Annals of Botany* vol. 104, no. 7, 2009, pp. 1255-61, doi:10.1093/aob/mcp235.

Even in retirement, Swales was seen as a role model for many young women in the sciences, and she encouraged her students much the same way Faith Fyles inspired Swales as a child. In a letter to Swales, Joanne Marchand, a former student who went on to teach biology, wrote, "every time I am asked who my inspirations have been… I always tell them about my summer at the herbarium [and] I tell them about you, your life's work, about how you accomplished what most women (then and even now) could only dream of. And I tell them how fortunate I am to have worked with you, to have your friendship… your influence and inspiration continues even though you are miles away."[41]

[41] Personal correspondence referenced in Swales' memoir.

Chapter 3: Digital Storied Matter

The digital component of my thesis is an extension of the written portion where I story the life and curatorship of Dr. Swales alongside the botanical lives she encountered and preserved. In this chapter, I explore how the field of Digital Environmental Humanities (DEH), which merges digital tools with environmental humanities research, can serve as a conduit for telling human-plant stories.[42] My exhibit approaches botanical history and herbarium digital preservation through the lens of storied matter. Storied matter attests that the material world of "ice or a stone, a fossil fragment or bacteria, no matter which form it takes, ... yields terrestrial tales of resilience, creativities, uncertainties, evolution, and dissolution in nondeterministic ways" (Oppermann 1). I detail my process for creating and curating the digital exhibit and provide an example of how botanical vouchers can be storied beyond what is included in the label. Lastly, I explore limitations and possibilities for DEH projects that incorporate herbarium collections.

Herbaria in the Digital Sphere

Sifting through herbarium vouchers can feel as though you are jumping across time and place. After locating the correct folder containing the genus and species that I was searching for, I needed to sort through each of the plant specimens, sheet by sheet. Working with herbarium specimens necessitates slowness and delicacy, which affords me the chance to admire each plant until I find the one that I need. As the herbarium is organized by family, then by genus and species rather than by botanist, the plant vouchers that Swales collected during her tenure might be sandwiched between sheets containing plants collected a century earlier. While searching for a plant in the Rubiaceae family that Swales collected in 1965, a label reading 'coffee arabica'

[42] I will use the abbreviation DEH to refer to Digital Environmental Humanities.

caught my eye. Inside the folder was a single coffee plant collected in 1895 in Kauai, Hawaii. It is hard not to stop and wonder about the journey each member of the herbarium takes from where it grew and was encountered by botanists, then transferred to an herbarium assemblage. Where can tracing the histories of these plants lead us? By following their rhizomatic paths, what can we discover not only about the plants themselves, but also about the interwoven dimensions of human-plant encounters?

While herbarium collections can provide a wealth of knowledge about where the plants were collected, when, and what type of environment they were found growing in, there is often little information about their journey from collection to preservation. The growth and cultivation of coffee, like sugar, tobacco, and cinchona, are often synonymous with ecological imperialism and colonialism resulting in the displacement of Indigenous peoples, ecological alteration, and the global movement of plants as resources.[43] Herbaria are full of plants whose stories are indeed linked to individual botanists and institutions, but they are also woven into larger histories that profoundly shaped people's relationships to the land. Many of these historical plant collections that were curated during periods of colonization and transferred to institutions abroad represent a piece of botanical history that, if not digitized, remains inaccessible to those outside of the institution.[44]

To explain underrepresentation in archival collections, Sara Ahmed points to screening techniques – the practice of providing credit for only some but not all contributors, thereby

[43] Alfred Crosby coined the term 'ecological imperialism' in 1968 to describe the movement of plants that coincided with European colonization in North America and the Global South. For more information see Crosby, Alfred W. *Ecological Imperialism : The Biological Expansion of Europe, 900-1900*. 2nd ed., Cambridge University Press, 2015.

[44] With a focus on the *Rubiaceae* (coffee) family, Figueiredo and Smith found that although a large amount of Rubiaceae genera can be found within Angola, the majority of Rubiaceae collected in Angola are deposited in European herbaria. This disparity highlights the lingering effects of colonization while underscoring the problem of scholars being unable to access their own botanical history.

rendering them invisible and uncredited for their work (qtd. in D'Ignazio and Klein 184).[45] This lack of credit is ubiquitous within botanical history collections when it comes to the women involved in the collecting, pressing, and identification of plants. As a result, these collections contain only a "sliver of a sliver of a sliver" of the knowledge that shaped understandings of the natural world (Verne qtd. in Carter 221). Women's contributions to botanical knowledge, as well as that of historically marginalized communities, are erased, resulting in the false impression that women were somehow just not involved, or their knowledge not considered valuable enough to record.

For biodiversity collections, Groom et al. partially attribute these incomplete narratives to deficiencies in Darwin Core (DwC) metadata standards ("Improved Standardization" 12). Created by the Biodiversity Information Standards (known as TDWG), the agency in charge of biodiversity data standards, Darwin Core was envisioned as a set of metadata organizational principles that could usher in standardization to rectify the differences in individual institutional curation practices that have changed over time and to address the problem of the silo effect created by cultural and academic institutions not sharing their data.[46] With a focus on accurately describing biodiversity collections, Darwin Core is "primarily based on taxa, their occurrence in nature as documented by observations, specimens, samples, and related information" ("Darwin Core").

[45] As for institutions, these screening techniques, and the decisions made about whose work to devalue accrues into what Carbajal and Caswell call "historical debt" or the work of "redoing or undoing work as a result of previous person's or people's decision to pursue a cheaper, quicker, or incorrect solution" for organizing and describing collections (1110).

[46] According to John Wieczorek et al., the Biodiversity Information Standards (TDWG), the education organization in charge of biodiversity data standards, modelled the metadata specifications of Darwin Core after Dublin Core Metadata Initiative and was officially ratified in 2009. Wieczorek, John, et al. "Darwin Core: An Evolving Community-Developed Biodiversity Data Standard." *PLoS ONE*, vol. 7, no. 1, 2012, doi: 10.1371/journal.pone.0029715.

While Darwin Core metadata standards allow for uniformity, the information supplied for collector(s) and identifier(s) may not have captured all those involved.[47] As Groom et al. explain, "the people associated with the specimens have generally played a subsidiary role to that of the taxonomic identification, the geographical origin and even the date of collection" ("People" 12). As such, the metadata conventions for collector name, collector record number, and information on shared collections may not have been fully representative or standardized. This results in naming disambiguation where a person might be known by different names across specimens, have their first and middle names initials only, or have their first name missing entirely. While famous historical academics and naturalists were likely to have their correspondences and documents preserved, "the scientific legacies of the amateur botanists are their herbarium specimens" (Groom et al., "Herbarium specimens" 96). For historical collections of women's botanical specimens, it is common to find them listed under their husband's names, adding an extra layer of complication to researching women's botanical knowledge creation.

Within Quebec's naturalist history, names such as Brother Marie-Victorin and Lionel Cinq-Mars are synonymous with botany, with the former memorialized in the creation of Montreal's Botanical Garden. Despite being the first woman to curate the herbarium at Macdonald College, Dorothy Swales' life, career, and contributions to botanical preservation are not widely known or as visible online. Within the herbarium, however, her presence could be felt throughout the collections. It was a common occurrence that while looking for a certain species in a stack of folders, I would come across another that she had collected during her curatorship.

[47] At the heart of Darwin Core's creation was the focus on flexibility and interoperability, where scientific collections could be described in human readable language independent of any single format (e.g., XML, RDF, etc). For more information, see Beaman, Reed S., and Nico Cellinese. "Mass Digitization of Scientific Collections: New Opportunities to Transform the Use of Biological Specimens and Underwrite Biodiversity Science." *ZooKeys*, vol. 209, 2012, pp. 7–17, doi:10.3897/zookeys.209.3313.

Her name became a recurring and familiar marker next to the collector and identifier headings on herbarium vouchers. The flowering plants, grasses, mosses, and lichens that she studied, encountered, and preserved are her legacy. To create space for her name within Quebec's botanical history begins with making her collection visible and findable online.

Prior to creating this digital exhibit and digitizing Dr. Swales' specimens, I created a Wikidata profile for Dorothy Swales, which generated a digital identifier known as a Q number and began attributing records to her on Bionomia.[48] Created in 2018 by Agriculture and Agri-Food Canada Biodiversity Data Manager David P. Shorthouse, Bionomia uses data from the Global Biodiversity Information Facility (GBIF), Wikidata Q numbers, and ORCID (Open Researcher and Contributor IDentifier) to "help maximize downstream data integration, engagement, and as a means to discover errors or inconsistencies in natural history specimen data" ("How It Works").[49] Across records, Dorothy Swales was listed as: Dorothy E. Swales, Mrs. Dorothy E. Swales, DE Swales, and Dorothy Newton. Disambiguating her digital legacy by linking her collections to one profile using Bionomia allows for others to accurately credit her for specimens that she either collected, identified, or both and learn more about her contributions to botanical science.[50]

[48] To accurately disambiguate biodiversity collections, Groom et al. recommend using a Wikidata Q number for contributors to historical collections and ORCID (Open Researcher and Contributor IDentifier) persistent identifier for contemporary scientists. While ORCIDs are maintained by the person themselves, Wikidata profiles can be created by volunteers, linking together information available on the internet to create a full profile of that person's education and research. See Groom, Quentin, et al. "The Disambiguation of People Names in Biological Collections." *Biodiversity Data Journal*, vol. 10, 2022, doi:10.3897/BDJ.10.e86089.

[49] In addition to creating identifiers for historical collectors, Bionomia provides credit for those who help attribute unclaimed specimens to botanists and fix incorrect attributions, listing their names on the digital record for the specimen. Bionomia is an example of how citizen science can be used to accurately disambiguate biodiversity records, giving botanists, especially those whose name might not be as well known, credit for their work.

[50] I am very grateful to David Shorthouse for demonstrating how Bionomia can be used and explaining the importance of citizen science and collective disambiguation efforts. In addition to assisting me with getting Dr. Swales included on Bionomia, he helped accurately attribute over 800 records to her. Swales' Bionomia profile can be found here: https://bionomia.net/Q109910927

While large-scale digitization of botanical specimens creates a wealth of knowledge about the botanical world, there is still much work to be done disambiguating the numerous people who participate in the story: from the first stages of collection to curation, description, and identification. Since locating the names of all contributors can be difficult, it is critical that data collection and documentation be done from a feminist perspective from the start, thereby ensuring that names and contributions from the entire lifecycle are included (D'Ignazio and Klein 189). In the face of institutional structures that devalued the knowledge of historically marginalized communities, a feminist ethics of care can be applied to data collection, organization, and description levels, creating more inclusive and equitable digital records.[51]

Digital Environmental Humanities

Digital Environmental Humanities can help provide access to physical plant sheets, feature detailed information such as place of collection and the surrounding ecosystem, and make visible the names of those involved with collection and identification. DEH projects can expand on those efforts by creating space for storying the lives of botanists who might otherwise be just a name on a label. DEH is particularly beneficial for situated knowledge in its engagement with different ways of knowing and displaying histories of human-plant relations. As Charles Travis explains, "the humanities can be expanded by the DEH to operate on widely interactive and multiple modalities and dimensions of the human relation to the environment, incorporating textual, tactile, visual, and auditory mediations in the pursuit and creation of knowledge" (106). Moreover, DEH projects allow for bringing together multiple ways of understanding human-

[51] Luka and Millette explain that ethics of care stems from second- and third-wave feminist psychology and, when applied to projects involving data analysis and critical data studies, underscores the importance of feminist and intersectional values. These values include creating space for and respecting diversity, acknowledging one's own positionality, and how one's research can be used to engage audiences. For more information, see Luka, Mary Elizabeth, and Mélanie Millette. "(Re)Framing Big Data: Activating Situated Knowledges and a Feminist Ethics of Care in Social Media Research." *Social Media and Society*, vol. 4, no. 2, 2018, doi:10.1177/2056305118768297.

vegetal entanglements, creating nonlinear digital ecologies that link together multiple nodes of information and collectively help us to create a fuller, more detailed understanding of individual botanical lives.

Where does a critical plant studies perspective intersect with DEH projects that focus on carving out space for historically marginalized botanists and plant lives? As environmental philosopher Michael Marder argues, "before we consume, burn, decorate and pay tributes with, or contemplate them, plants irradiate a meaning of their own. Each branch, shoot, and leaf located in a particular portion of a geranium, or any other plant, is the outcome of a lived vegetal interpretation of the environment" (20). DEH projects that focus on botanical history specifically create ample space for foregrounding multiple ways of knowing plant lives that might have been missed or disregarded when the plants were studied and collected. It is in the Digital Humanities that we can find, as Travis argues, a "convergence of the world's complex cultural heritage and technological innovations that are both disrupting and transforming relationships between peoples, terrains, and non-human habitats" (97). Therefore, rather than attempt to speak for a plant, humans can engage with vegetal life by putting aside their exceptionalism and by telling vegetal stories that "sit[s] alongside [plants], rather than in critical domination of" (127). This approach redefines the location of the human in the environmental humanities by fostering a practice of viewing humans differently, especially in light of ecological degradation, loss of biodiversity, and climate change.

Digital humanities tools, such as Omeka and ArcGIS StoryMaps, can be used to create a curated representation of the natural world that incorporates text, images, and sound. These tools can provide a means of "seeing and experiencing nature differently than would be otherwise possible" (Posthumus and Sinclair 3). As Paolo Giardullo argues, "the ubiquity of digitally

produced and disseminated images of nature offers an opportunity for scholars in DEH to understand representations of environments as narrative proxies of individual relationships with nature" (318). There have been several DEH projects that have creatively and interactively placed multifaceted plant stories in the foreground. One such example is the Alpine Garden Misguide. Created as an app by Dr. Jill Didur, the Misguide uses locative mobile media to help situate the user within the Montreal Botanical Garden and in doing so, "rejects the idea of the detached observer who encounters the garden from an innocent vantage point" (Didur and Fan 2018).[52] This interactive situated method merges technology with botanical history, thereby emphasizing the colonial history of botanical gardens and stories of the plants housed within.

In centering botanical and Indigenous history of plants of the high line in Manhattan in their ArcGIS StoryMap, Dennis et al. employ a method of critical countermapping, which "seek(s) to disrupt dominant narratives and (re)surface knowledge and stories that have been silenced" (129). The team behind the Native Plants of the High Line project challenge the assumption that plants people encounter in their daily lives have always grown there irrespective of people and larger systems of power.[53] Using maps, images, and text, Herbaria 3.0 is another example of how digital spaces can provide space for collaborative human/vegetal storytelling. The environmental humanists behind Herbaria 3.0 "aim to reveal hidden histories, to provoke new narratives, and to create a bright spot of hope" ("About Herbaria 3.0").

Unlike museum exhibits, there is no barrier or divide between people and herbarium plant collections. To hold an envelope containing preserved lichen and watch the broken pieces vibrate

[52] For more information on the Misguide, see: https://greeningnarrative.wordpress.com/home/projects/alpine-garden-misguide/
[53] For the full map and project details, see Native Plants of the High Line: https://storymaps.arcgis.com/stories/26fcb1ceb52145449362979e0d7365c6.

with each unfolding of its protective envelope or examine up close the wisps of a cotton ball that a botanist stuffed into an orchid's labellum decades before is to feel connected with a botanical memory. As John Charles Ryan explains, "memory is latent and affective—its dimensions contingent upon, and instigated by, the materiality of objects" ("The Substance of Memory" 93).[54] There is affective element to interacting with digital representations of materiality or 'distant nature' (Jørgensen), that is nature that is not experienced directly in person but transmitted using digital media and data. The digital offers a multitude of ways to view, experience, and connect with the vegetal. Anna Lawrence attests that "experiment and speculative play with vegetal life invites different modes of attention" (12). Zooming in on an image of a preserved plant, one can see traces of cotton inside a flower, foxed sheets covered in rust-coloured spots that have oxidized over time, air bubbles in glue formed when a plant was mounted, discoloration in the shape of leaves once affixed to paper but perhaps lost.[55] Such zoom-ins can happen quite easily in a digital world, allowing the user to discover the plant specimen from a new perspective and brings previously unseen attributes into focus.

[54] Ryan acknowledges a kind of botanical memory, which he defines as a "form of environmental or place-based memory focused on remembrances of plants; and encompassing individual and collective practices that instigate and sustain such recollections" ("The Substance of Memory" 89-90).
[55] Small rust-coloured spots on herbarium specimen sheets are known as foxing since they resemble the colour of fox fur. As Bridson and Forman explain, while foxing does not detract from the scientific value of the specimen, it is indicative of poor-quality paper and the sheets should be replaced.

Figure 8: Image of close-ups of two plants in Swales' collection: (Left*: Potentilla fruticose L.* Right: *Dryas octopetala L.*) Looking closely at a botanical specimen often reveals finer details on the plant as the material traces of preservation. Image taken by me.

Applying a new materialist approach to digital environmental humanities, I view digital exhibits as rhizomic. Each item or aspect of a collection can be treated as a node that connects and links to other nodes. In merging digital storytelling with environmental history, the field of Digital Environmental Humanities (DEH) provides a space for drawing connections between human/more-than-human narratives that span across time and place. Thus, DEH scholarship unsettles the human/more-than-human binary and makes it possible to "conceive of the human being ecologically [and] as a part of a series of structures that cross nature and culture, organic and inorganic, flesh and machine" (Weidner et al. 21). Although Omeka exhibits are built on an arboreal structure where items are part of a collection, which can then be incorporated into an exhibit, each item can be treated as a node that links out to other sources of information in Omeka or elsewhere on the web. As Finn Arne Jørgensen attests, "the ways in which we experience, navigate, and ultimately know natural environments and landscapes today have

become suffused with digital information structures" (108). Therefore, this Omeka exhibit serves as a conduit for bringing together diverse ways of knowing and understanding plants in a digital assemblage.

Digital Exhibit Methodology

Initially, to trace Dr. Swales' contributions to the herbarium, I used exchange lists created from 1964 to 1971 with other herbaria and lists indicating plants she collected for the herbarium to identify family and species. As I began to navigate the herbarium, however, I came across specimens she collected during her PhD when travelling through Switzerland, as well as collections made across Canada during her curatorship.[56] For the Omeka exhibit, I treated each herbarium voucher as an item described using Dublin Core metadata schema. I chose the scientific name that Swales listed on the voucher label for the item title; I organized the exhibit using the nomenclature that Swales herself would have used to understand the natural world.[57] If the currently accepted scientific name differed from the one given by Swales, I included this additional name as a subtitle. While my focus for each item entry of the Omeka exhibit was to bring together information about each plant or lichen, I used metadata fields to include information related to the people involved with collection and identification. If other names were listed on the label, such as the determiner who identified the species, their name was added as a contributor and their Bionomia profile, if available, was linked to their name.

[56] As of December 2022, I have digitized 230 sheets. As I went through Swales' specimens, there were some that had not been accessioned into the collection and given an official collection number. The process of accessioning and uploading digitized specimens with metadata that I've compiled will continue into 2023.

[57] While herbarium digitization guidelines recommend assigning file names that involve a combination of taxon, genus, species, and herbarium acronym, and accession number, for the purposes of this Omeka exhibit, files were named using the surname of the collector, plant family, month/date of collection, and McGill University Herbarium accession number (e.g., Newton_Boraginaceae_July1930_104437.JPG). For more information on natural history digitization file naming, see Häuser, CL, Steiner, A., Holstein, J. & Scoble, MJ (eds.) (2005): Digital Imaging of Biological Type Specimens. A Manual of Best Practice. Results from a study of the European Network for

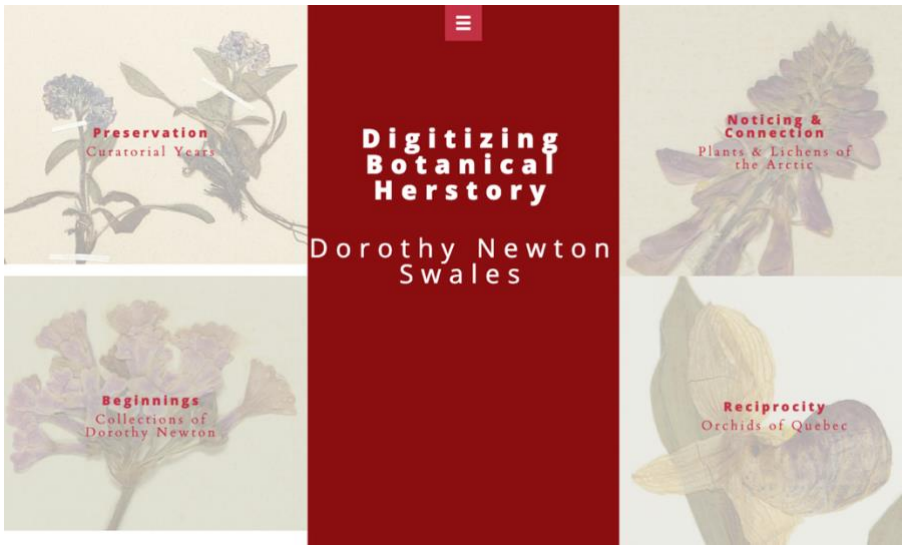

Figure 9: Screenshot of digital exhibit homepage featuring the four main exhibits.[58]

The Omeka site consists of six collections spanning Swales' career from her time as a doctoral candidate travelling across Switzerland in 1930 to her years as herbarium curator in the mid-1960s to 1971. These collections make up four main exhibits that speak to key aspects of Swales' life and work: Beginnings (The Collections of Dorothy Newton), Preservation (Curatorial Years), Noticing & Connection (Plants and Lichens in the Arctic), and Reciprocity (Orchids of Quebec). Omeka also allows for adding Simple Pages that serve as locations for text and images. There are four Simple Pages on the exhibit: Swales' biography detailing her life and career, the purpose of the digital exhibit, the materiality of herbaria, and a note about naming.

Although botanical taxonomy has not changed radically since Linnean taxonomic principles became the accepted method for naming, a search in botanical databases will often show several synonyms for botanical nomenclature. This meant that I had to check names on voucher labels and exchange lists against currently accepted naming standards, as the names

Biodiversity Information, https://www.gbif.org/fr/document/80576/digital-imaging-of-biological-type-specimens-a-manual-of-best-practice.

[58] The digital exhibit can be accessed here: https://digitizingbotanicalherstory.com/.

Swales would have used for some plants have changed. For example, while the Bedstraw that Swales encountered in Switzerland in the summer of 1930 was known then as *Galium sylvestre,* the current accepted scientific name is *Galium pumilum.* Within the herbarium cabinets, notes indicating genus and species name changes were helpful wayfinding markers as I attempted to locate the vouchers.

Figure 10: Image of notes in herbarium case that identify changes to genus and species naming. These notes helped re-direct me to the correct folder for the herbarium voucher using the currently accepted scientific name.

In order to expand on voucher label information and story each plant and lichen featured in the Omeka exhibit, I researched what could be found about the genus and species such as scientific name changes and common names in English, French, German, and Inuktitut.[59] Information on environment, appearance, and how the plants were used and valued by nearby communities was also incorporated.[60] To do so, I consulted virtual and print resources such as

[59] The herbarium voucher labels for the Swiss collection had space for English and German common names. For Arctic plants, only the English common names were listed on the voucher label, so it was important to include those as well on the Omeka item entry.

[60] For the plants that Swales collected while travelling in Switzerland, she often noted the German common name on the voucher label, which I also included in the item description in Omeka. For Arctic plants that Swales collected during her tenure as curatorship, I included the name in Inuktitut if they were available in print or digital resources.

the Global Biodiversity Information Facility (GBIF), Canadensys, Flora of the Canadian Arctic Archipelago, Floras of North America, Native American Ethnobotany Database (NAED), and Royal Botanic Gardens Kew Plants of the World Online.[61] For the flowering plants, grasses, mosses, and lichens that Swales encountered in the northern regions of Canada, I drew on *Edible & Medicinal Plants of Canada*, *Common Plants of Nunavut*, and *Edible and Medicinal Arctic Plants: An Inuit Elder's Perspective*. The latter two texts include information not only about basic morphology, but also about how Arctic plants are named, treated, and incorporated into daily life by Inuit communities.[62]

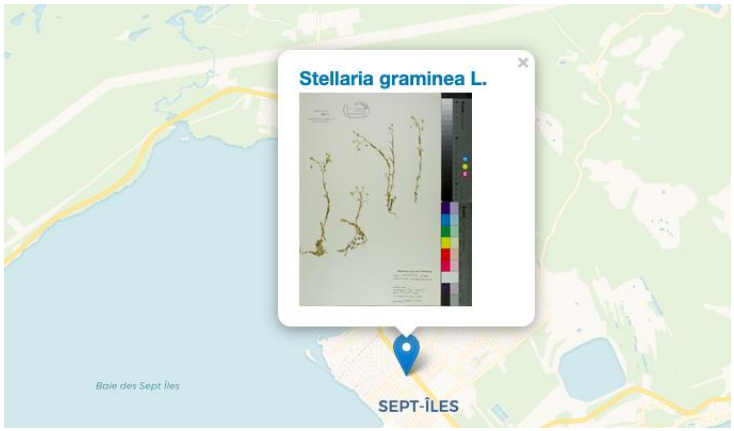

Figure 11: Screenshot of exhibit's mapping component featuring *Stellaria graminea L.* Herbarium vouchers often include geocoordinates that make it possible to mark where they were encountered and collected.

[61] Additional resources such as Bionomia, Canadensys, Biodiversity Heritage Library (BHL), and the Université du Québec en Abitibi-Témiscamingue were used to compile information about items in Swales' collections.
[62] Several plant vouchers had the label *Plants of Frobisher Bay*, the previous name of Iqaluit at the time the plants were collected, so named for the English mariner Sir Martin Frobisher who is credited with "discovering" the bay. Frobisher Bay would be renamed Iqaluit in 1987, its original name in Inuktitut. Plants and lichens that had a Plants of Frobisher Bay label were described as collected in Iqaluit to reflect the original name of the location and not the colonial name. For more information on key milestones in Iqaluit's history, see https://www.iqaluit.ca/visitors/explore-iqaluit/history#:~:text=1987%20%2D%20Frobisher%20Bay%20officially%20becomes,the%20new%20territory%20of%20Nunavut.

Digital Botanical Storied Matter: The Omeka item "Alpine Bistort"

Figure 12: Image of *Polygonum viviparum L.* collected by Swales in July 1964 in Nunavut taken from Digitizing Botanical Herstory Omeka exhibit. Image taken by me.

Known as Alpine Bistort in English and *Renouée vivipare* in French, Swales encountered this perennial herb in "dry sandy soil" in July 1964 while travelling across Nunavut.[63] The Bistort's scientific name, vivipara, is derived from the Latin *vivus* (to live), stemming from the plant's ability to self-propagate from tiny bulblets that grow directly below the flowers, sprouting where they drop. Swales would likely have seen this thin plant with small white flowers and

[63] Although the current commonly accepted name is *Bistorta vivipara (L.) Delarbre* (confirmed in 2007 by T.L. Eades as noted on the voucher), Swales would have recognized the Bistort she brought back to Montreal with her as *Polygonum viviparum*.

bead-like bulblets during her travels to northern regions, as the Bistort is known to grow across the Arctic favouring alpine meadows. Across alpine regions, the roots of the Bistort engage in a symbiotic relationship with fungi who exchange nitrogen for carbon, while above ground the plant itself provides essential nutrients for ptarmigans, geese, and reindeer (Wutkowska et al.6-7).

For the Inuit, too, the Alpine Bistort is a familiar presence across the alpine meadows known as *Sapangaralaannguat Tuqtallu*, which translates to "miniature imitation beads" in Inuktitut. In conversations with Inuit elder Aalasi Joamie, Anna Ziegler and Rebecca Hainnu explain that before blossoming into white flowers, the red beads of the Bistort can be eaten and fashioned into a type of stress ball when tied into a sack. The *tugtat* (rhizomes), favoured for their almond-like taste when cooked, are considered a source of nutrition. Both the distinctive beads and clusters of white flowers are visible on the two plants that Swales brought back to the Herbarium.

The Bistort was an Arctic plant of interest to Swales during her summer fieldwork. In her 1979 *Rhodora* article that drew on her research on nectaries and Arctic plants in the mid-60s, she noted that the bulbils of the Bistort she encountered in Iqaluit were already germinating while attached to the parent plant, a sign that "this species [is] increasingly viviparous as the climate deteriorates" (364).[64] To a botanist like Swales, the changes to the Bistort's growth would have

[64] By viviparous she means ability to germinate a new plant while still attached to the parent plant. The Bistort's self-sufficiency through propagation and the establishment of new plants quickly without the need of wind to disperse the seeds or pollinators would have been of keen interest to Swales. In addition to collecting plants, her Arctic fieldwork also involved observing relationships between different pollinators and flowers. For more information on the Arctic plants she observed, see Swales, Dorothy E. "Nectaries of Certain Arctic and Sub-Arctic Plants with Notes on Pollination." *Rhodora*, vol. 81, no. 827, 1979, pp. 363-407, https://www.jstor.org/stable/23311088

embodied a forewarning about the larger impact of a rapidly warming climate on Arctic flora that could only be noticed through careful attention.

Challenges & Possibilities

Throughout my time in the herbarium, the guiding principle for engaging with herbarium vouchers was Bennett's call to noticing that which is often overlooked, the small details, and allowing myself to be surprised by what I could find. Herbaria are indeed ideal places for that kind of discovery, curiosity, and pursuing even more botanical threads across time and place. Looking through one part of a cabinet dedicated to related genera, I came across plant vouchers not only with Swales' name, but the names of others. Often, I wondered who these other botanists were and how they were guided by Swales. On a voucher label, it was not uncommon to find the names of other members of the ecological assemblage that grew nearby. What connections might unfold by storying these other botanical lives? Common names, too, were often included, though only in English. Indigenous communities in Nunavut and other Arctic locales where Swales collected would certainly have considered the lichens and plants, like the Bistort, to be familiar presences across the alpine meadows. Herbarium vouchers can reveal so much while still leaving room for even more questions.

Creating digital projects using natural history collections presents the challenge of addressing head on incorrect and often harmful language or information regarding Indigenous communities, settler-colonial names for locations rather than Indigenous names, and descriptions that diminish or ignore Indigenous knowledge.[65] As the Biodiversity Heritage Library (BHL)

[65] As Smith and Figueiredo explain, colonial legacies are often enshrined in plant nomenclature. For example, there has been momentum to rename plants that bear the epithet *Rhodes* and are named after imperialist Cecil John Rhodes, who made his fortune exploiting diamond reserves in South Africa. However, changing official plant names is not an easy process and can take up to six years if the petition to change is accepted by Nomenclature Section (NS) meetings that are held during the week before the International Botanical Congress or the International Mycological Congress.

states in their harmful content acknowledgement, "at best these views are outdated; at worst, the legacy of natural sciences is unjust and inhumane."[66]

While building the exhibit, I learned that the task of storying botanical matter is to not only look closer at the different threads, but to acknowledge one's own vantage point and positionality. A feminist epistemology asserts that there can be no disconnected all-encompassing view from nowhere. Thus, storying botanical vouchers like the Alpine Bistort beyond what was included on vouchers necessitated carefully negotiating my own position as a white settler-scholar with respect to botanical knowledge from Indigenous communities. In researching Indigenous uses for Arctic plants, the extensive amount of information available on NAED made it a beneficial tool. However, as Talbot et al. explain in their own research on native plants of the High Line, much of the research in NAED was compiled by settler-scientists in the 19th and 20th centuries and therefore using the information critically and with care is essential.[67] In the creation of Omeka items for Arctic plants, I echoed their approach to creating visibility for Indigenous usage while refraining from including sacred knowledge or ceremonial uses of plants. Recognizing one's positionality means not speaking for, but rather engaging in conversation with other voices and vantage points that frame ways of being with the botanical world.

While including affective storied matter in the Omeka digital exhibit, I was forced to realize that no single resource can cover the breadth of human knowledge about plants. Certain websites will be limited to information about plant morphology and blooming periods, while

[66] For more information, see https://about.biodiversitylibrary.org/about/harmful-content/
[67] See Talbot, Blair, Claudia Berger, Jiyoung Lee, Kelli Hayes, Mickey Dennis, and Chris Alen Sula. *Tending to Turtle Island: Indigenous Peoples, Settler Colonialism, and Plants in North America.* Pratt Institute: 2020. https://studentwork.prattsi.org/plants.

others will provide historical information such as the first known recorded mention in a publication. Other sites incorporate cultural aspects that speak to the role plants play in the lives of nearby communities and the more-than-human lives in the local assemblages where the plants can be found, such as pollinators and animals.

Therein lies the challenge and promise of storying botanical matter. How far do we trace these stories? How can we use digital projects to create connections that others can use and build on? I quote Gibson and Gagliano at length: "While we may not have the right lexicon to speak with plants, it is possible to propose that paying greater attention to the scientific, biological and ontological ways that plant life exist may open up better channels of communication for a wider slice of humans to appreciate and act with great care in an ecologically-endangered epoch" (132). DEH projects can serve as a kind of interactive channel that allows users to experience representations of nature from anywhere, while also bringing together new and diverse forms of botanical knowledge presentation, which can subsequently alter how we understand human-plant entanglements. Swales' experiences with these plants are an important node within multiple plant histories, but so too are the other narratives waiting to be told. DEH offers opportunities to shine light on those stories and weave them into a larger botanical tapestry. More botanical stories can be told if we learn how to listen, more invitations to "suivre les plantes" wherever they may lead (Deleuze and Guattari 11).

Conclusion

At the outset of my thesis, I wondered where following the rhizome would lead when tracing the connections between human and plant lives. While my research stemmed from the goal of telling the story of Dr. Swales, directing a new materialist lens to her botanical collections brought me to the most minute level of each voucher, looking closely to see the vibrancy that each sheet held. By exploring the material convergence in herbaria that links together bodies, both human and vegetal, as well as chemical and abiotic matter, it become clear to me that "we are entangled with their material agency and emerge *together* as storied beings" (Iovino and Oppermann 8). The curiosity to let these narratives emerge and unfold shaped the trajectory of the written and digital aspects of this thesis.

In the preceding chapters, I experimented with a new materialist and critical plant studies approach to storying the human and botanical lives that can be found in herbaria. The culmination of engaging with, digitizing, and researching the individual species that Swales encountered took the shape of an Omeka exhibit. My exhibit serves as one example of how to approach botanical history and herbarium digital preservation through the lens of storied matter. In their growth and death, through connections above and below ground, plants such as the Alpine Bistort convey "terrestrial tales of resilience, creativities, uncertainties, evolution, and dissolution in nondeterministic ways" (Oppermann 1). With each Omeka item creation, I aimed to weave together as many threads as I could find to create an individual multilayered narrative that users could explore and perhaps build from themselves, creating a rhizomatic network of digital storied matter.

When designing a digital humanities project, it is inevitable that you begin to look ahead and envision how your project could expand. Projects such as this thesis that incorporate Arctic

plants collected in the mid-20th century or earlier can add to a larger conversation about looking to historical herbarium records as a valuable source of information for analyzing the state of present-day environments. Arctic plants like the ones Swales encountered are experiencing the fastest increase in global temperature and, as a result, changes to their growth or ecosystem can speak volumes about the effects of climate change above and below ground (Wutkowska et al. 2). Herbarium labels provide geolocations that pinpoint where the plant was found and first-hand accounts of the assemblage it grew within. Historical herbarium collections invite the viewer to ask if the same plant collected decades ago can still be found in the same location. Have they disappeared or migrated? What can be found growing nearby?[68]

As Ursula Heise argues, "biodiversity, endangered species, and extinction are primarily cultural issues, questions of what we value and what stories we tell" (5). The presence of plants, or lack thereof, speaks to larger, more interconnected current environmental issues that are deserving of attention. Digital exhibits can both capture and facilitate that attention through detailed description, images, and maps.[69] Moreover, Jennifer K. Ladino attests that in the face of digitally capturing and storying biodiversity loss, DEH scholars "need to think more carefully about affect: the powerful, visceral, pre-or even non-cognitive feelings that arise and are transmitted in both virtual and actual environments" (189). A careful, inclusive approach to telling entangled stories might help us to understand what Bennett means when she sharply states

[68] Studies have found that herbarium collections provide a wealth of robust data on the effects of climate change on blooming patterns that have yet to be captured by current observational field work, as well as the identification of extinct species that no longer grow where they once existed. See Jones, Casey A., and Curtis C. Daehler. "Herbarium specimens can reveal impacts of climate change on plant phenology; a review of methods and applications." *PeerJ* 6 (2018): e4576 and Feeley Kenneth J., "Distributional Migrations, Expansions, and Contractions of Tropical Plant Species as Revealed in Dated Herbarium Records." *Global Change Biology* 18, no. 4 (2012): 1335–41. https://doi.org/10.1111/j.1365-2486.2011.02602.x

[69] Ann Cvetkovich poetically explains that "lost worlds often linger beyond reach of the material practice or image in the gallery" (289). Digital exhibits involving natural history collections can hopefully pique the interest of the viewer to look beyond the screen at the natural world nearby with an attuned focus on what grows around them.

that "in a knotted world of vibrant matter, to harm one section of the web may very well be to harm oneself" (13).[70] DEH can help to visualize that web in a way that reaches across disciplines and audiences.

Additionally, DEH projects can paint a nuanced, more complex portrait of botanical stories through creating space for traditional ecological knowledge alongside other forms of botanical knowledge. In this way, DEH offers the chance to peel back the layers of settler-colonial knowledge structures that perpetuate the misconception that there is only one accepted way to understand, name, and interact with the natural world. Doing so echoes what Donna Haraway describes as "staying with the trouble of inheriting the damages and achievements of colonial and postcolonial naturalcultural histories" (125). The beauty of DEH is that it removes the silo-effect of scholarship by building connections for multidisciplinary research creation. Future research involving Arctic plants in the McGill University Herbarium could expand to incorporate and centre on localized Indigenous ways of knowing and being with the plant world beyond what was captured on the voucher.

As Swales writes of the beauty that captivated her during fieldwork in the Arctic, "some day we may see it all again — if only in a dream" (*More than Gold* 8). Handling the physical material traces of Swales' botanical legacy, some created nearly a century ago during her own graduate studies, was a transportive experience that allowed me to see the beauty of the natural world through her eyes. Through digitizing and storying her collections, others might see the natural world in the enchanted and connected way that she did. There is no need to wait to see it all again. Rather, one need only notice the beauty that exists around them.

[70] According to Bennett, "a newfound attentiveness to matter and its powers will not solve the problem of human exploitation or oppression, but it can inspire a greater sense of the extent to which all bodies are kin in the sense of inextricably enmeshed in a dense network of relations." (*Vibrant Matter* 13).

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