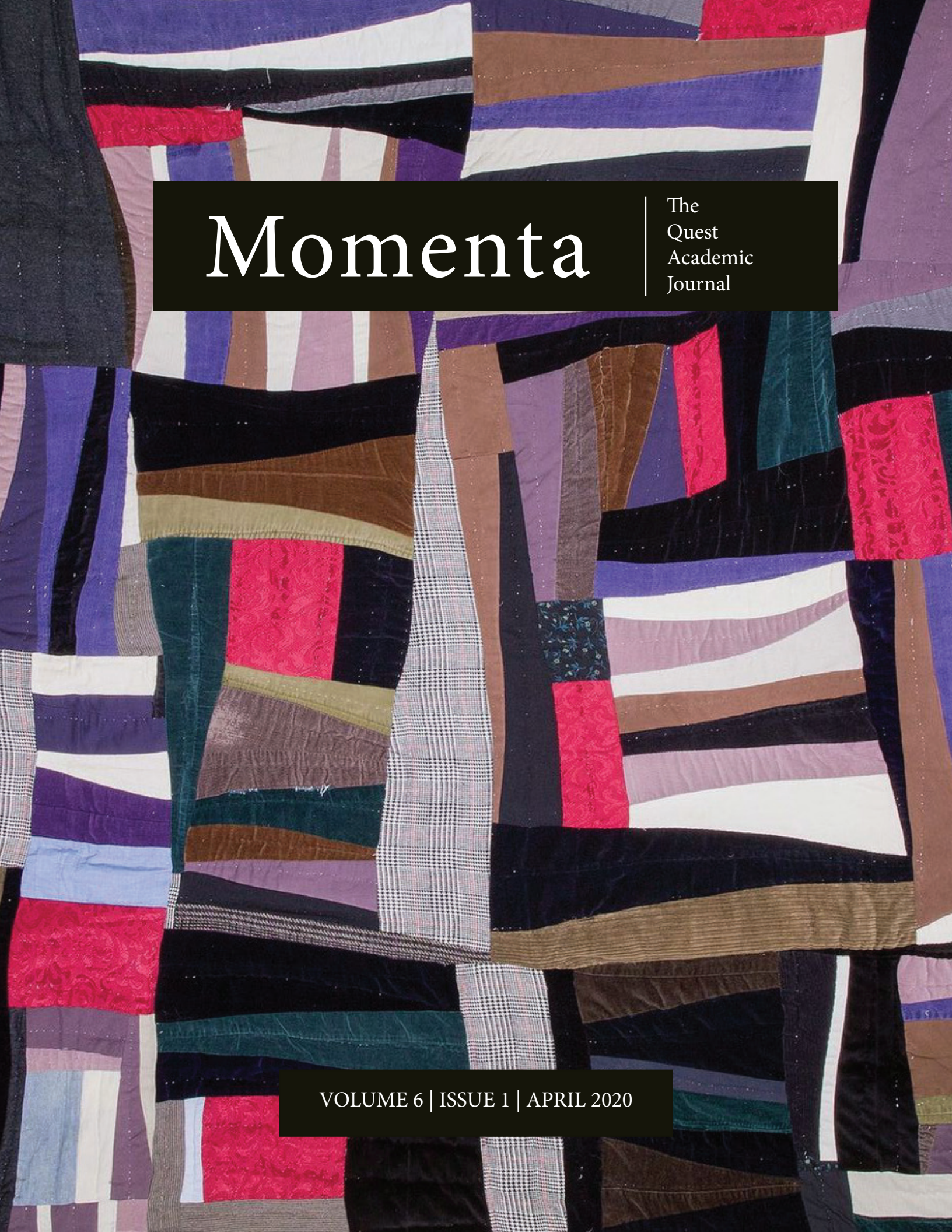

Momenta

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On the Cover

Husband Suit Clothes by Mary Lee Bendolph in 1990.

Quilted out of mixed fabrics, including corduroy, denim, velveteen, and synthetic brocade, Mary Lee Bendolphs' quilt is one of many Gee's Bend quilts. The women of Gee's Bend, a small black community in Alabama, have created quilts since the early twentieth century. The quiltmakers would use any material they could find, including work clothes, feed sacks, and fabric remnants. Each quilt has unexpected rhythm in its composition of patterns and colors in a style now termed "my way" quilts, wherein the quilter does not follow a preset pattern.

momenta (n. pl.) Latin

1. The indwelling forces that are the principle of change.

2. The circumstances that precipitate change.

The papers in this volume are momenta in the sense

[ii] that they are reactions to a set of circumstances (the ideas, the work of understanding, the opportunity to consider those ideas), and also in the sense

[i] that they make contribution to ongoing scholarly discussions and so inevitably change the course of those discussions.

Translated by Dary Otto, Professor of Philosophy and Classics at Quest University Canada

ACKNOWLEDGEMENTS

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FOREWORD

Welcome to the 2020 edition of Momenta, Quest's peer-reviewed journal, produced by our students for the world. The subjects of the excellent papers range widely but they all share the critical intelligence that I have come to associate with all Quest students.

I found various points and pieces within me connecting, as I experienced this special edition. I relived my walks through the crowded pedways of Hong Kong on a Sunday afternoon, filled with foreign domestic workers on their day off, as I read about their marginalization. It's a reality lived by so many others, including homeless women in England. I was fascinated as my mind dove into the nucleus of a tumour cell watching platinum-based therapeutics binding with the DNA and inhibiting the growth of cancer. As I read, I felt guilt at my privileged position, not having to depend on my beloved VW Westy camper van as my only shelter in this expensive place and time. I also felt discomfort in the deeper reflection on the UN Declaration on the Rights of Indigenous Peoples and the structural issues that challenge a just implementation in Canada. I smiled at the the mutually supportive relationship between mycorrhizal networks and fungi underground, and how like biocultural diversity, these relationships can enhance diversity and resilience for all life on Turtle Island. As I read this, I recalled a conversation with a Mi'kmaq Elder, who put his fingers together, palms up, and told me how under these great and different trees, are roots and connections that support everything.

The heartache of social injustice and inequity; the stimulation of my imagination and thinking; the recalling of walks I've taken in cities around the world; the wise words of Indigenous Elders – all emerged and embraced each other as I experienced this wonderful collection.

Find a quiet time and place, take this precious treasure, and enjoy. You'll be glad you did.

George Iwama
President and Vice-Chancellor

Resisting Urban Marginality: Foreign Domestic Workers and Homeless Women Taking Up Public Space

Emi Kingan

Women have long been on the margins of public spaces. Not only have architecture and urban planning fields historically lacked women practitioners, but these institutions continue to reinforce the principle that "a woman's place is in the home" through exclusionary public space planning and maintenance practices (1)(2). For instance, Hayden (2) argues that the gendered exclusion of women within cities and public spaces can be traced to the structure of late 20th century American suburban homes, which constrained the housewife in the private realm. These privileged, middle-to-upper-class, and primarily white American suburban housewives were spatially distanced from the city and public spaces as well as structurally excluded from accessing them due to inadequate public transit (2). This gendered urban marginality served the purpose of keeping housewives in their own homes to guarantee the sexual division of labour; confined in the private realm, these women cooked, cleaned, and cared for their children—performing reproductive labour integral to economic development yet seldom acknowledged—and also conducted their female consumerist duties by filling their houses with commodities (2)(3). This example speaks to the blatant structural marginalization of women from public spaces, which is perpetuated by planning practices that fortify the public vs. private binary for the sake of using women to fuel capitalistic development.

While women continue to be excluded from public spaces due to their rigid association with the home, certain groups of women, with intersectionalities and associations to the private realm that differ from the aforementioned housewives, are actively resisting their urban marginality. Foreign domestic workers in Hong Kong, whom work in a home other than their own, encounter urban exclusion due to their gender, association with the private realm, as well as racial and class positionalities (4)(5). Homeless women in England, despite living outside the private realm and relying on public and semi-private spaces to survive, also experience marginalization from public spaces due to their gender, class, and racial intersectionalities (6). This paper argues that foreign domestic workers in Hong Kong and homeless women in England resist their urban marginality, and challenge the public vs. private dichotomy tying them to the private sphere, by taking up public space. Throughout this essay, Cynthia Enloe's (7) understanding of margins contextualizes the exclusion these groups of women experience in public spaces, while their active defiance of their marginality is described through bell hooks' (3) conception of the "power to disbelieve". In particular, these women disbelieve and break the public vs. private binary that seeks to shun them away from public spaces, while also avoiding oppressive capitalistic systems to establish their power and resistance. Furthermore, Kimberlé Crenshaw's (8) theory of intersectionality supports an understanding of the stigmas these women face in their resistance to their urban exclusion, and elucidates how these obstacles perpetuates their

marginality.

Following Hong Kong's booming socioeconomic climate in the 70s and 80s, sparked partly by the empowerment of local women to work in manufacturing and service industries, Hong Kong society was in need of domestic workers. Since then, Hong Kong families have relied on the influx of foreign domestic workers—who are primarily Filipino and Indonesian women—to cook, care for children, and clean the home (4). By conducting domestic duties, foreign domestic workers not only assume the reproductive labour in a home that isn't their own, which would otherwise be performed by the wives of the house, but they also face the brunt of gendered stereotypes and a lack of recognition associated with labour in the private sphere. Therefore, the empowerment of local Hong Kong and expatriate women to leave their private home is often at the expense of foreign domestic workers' disempowerment and confinement in the home they work in but do not call home. Foreign domestic workers are, according to Enloe's (7) description of the "margins, silences, and bottom rungs", marginalized by international-, national-, and city-level politics for they have a "lack of public power" and are "the object of other people's power". These women are fundamental to Southeast Asian socioeconomic and political systems: they support Hong Kong's development by working in local people's homes, contribute to socioeconomic progress in their origin countries through remittances, and are thus crucial to the international relations between these countries in the region (5)(9). Despite continuing to fuel the capitalist project focused on economic and social improvement, foreign domestic workers are confined to Hong Kong's private sphere and rendered powerless in shaping international, national, and local political processes. Foreign domestic workers' lack of power in local-level processes enables the Hong Kong government and corporations to develop exclusionary public space maintenance practices targeted at these workers.

Foreign domestic worker's political marginality, due to their double bind in the private sphere as women and as domestic labourers, contributes to their geographical marginality in Hong Kong's urban public spaces. During the week, foreign domestic workers work long hours—almost exclusively in Hong Kong family's private homes—whereby their lives are often regimented by employers who set curfews and control what they can look like and wear (4). Therefore, foreign domestic workers' day off, usually on Sunday, represents an opportunity for these women not just to connect with family and home cultures but also to break free from the restrictions they experience during the week. Hong Kong's capitalist society, however, enables land developers and corporations to control public spaces, leading to the "demise of public spaces" and thus making it difficult for these women to find places to congregate (5). As the city's economy is rooted in the real estate market, the government enables land developers to control public spaces such as pedestrian walkways that connect the city's buildings; these public spaces, under corporate control, are no longer public spaces. Instead, these supposed public spaces are often taped up or "protected" by security guards hired by private businesses, with the explicit purpose of deterring foreign domestic workers from gathering nearby (5)(9). Despite having hundreds of thousands of foreign domestic workers, Hong Kong has not designed a broad range of public spaces to accommodate them; their gender, occupational, and status positionalities place them in the private sphere and limit their political influence, and thus they are largely ignored from consideration in planning decisions in the public sphere. These women are designed into the margins of urban public space, and hence, on their days off, must make temporary homes in the city's nooks and crannies: they set up cardboard and straw mats wherever they can, for instance in public parks, on some street overpasses, outside of banks, and in city squares (4)(10). As a result of their public space occupation, some Hong Kong locals perceive these domestic workers as "taking over" the city (4). Such sentiments permeated into

news media during the 80s and 90s, whereby one article titled "Let Unhappy Maids Return to the Philippines" regarded these workers as a "nuisance" and as rude, complaining guests (4). These negative societal views of female domestic workers triggered the government to prohibit "hawking" in public spaces where these women tended to spend their days off (10). Not only do urban planning practices place foreign domestic workers in the margins of public space, but the public's perception of these workers on their days off others these women even more, solidifying their place in the margins of urban life.

Homeless women in England, as described by Casey and others (6), experience a similar urban marginality due to their double and conflicting bind as women and as people without a home. While their positionality as women binds them to the private sphere and portrays any use of public space as endangering their safety, homeless women are without a private home of their own. Some of these women occupy the private sphere of their friends and extended family by spending time in their homes, while other homeless women occupy public and semi-private spaces such as streets, parks, malls, and airports (6). As Casey and others (6) state: "it is homeless women's gender that excludes them from rightfully consuming or claiming public space"; the gendered association between women and the private realm puts homeless women in the margins of the very public spaces they rely on to get by and survive. Yet, by virtue of also being homeless, these women encounter strict rules, regulations, and gatekeepers of public and semi-private spaces that attempt to exclude all homeless people from occupying these spaces (6). Therefore, as women and as homeless people, homeless women are not expected to be in public spaces let alone tolerated in them. In the margins of public spaces and suffering the stigmas of being homeless and female, homeless women "are actually those at the bottom of the pyramid of power" (7). Hence, like foreign domestic workers in Hong Kong, homeless women are rendered silent in social and political systems and have little influence in urban planning decisions that impact where and how they can live their lives.

Although foreign domestic workers in Hong Kong and homeless women in England are in the margins of urban public space and urban life, the mere fact they occupy public and semi-private spaces represents their resistance to their urban marginality. Despite the criticisms foreign domestic workers in Hong Kong face, these women have for decades persisted to occupy public spaces in the city on their day off. Homeless women also challenge societal expectations that place them in the private realm, ultimately testing "the rules of legitimate occupancy which render them unwelcome [in public spaces]" by instead occupying these spaces and defending their right to do so (6). On the one hand, both groups of women resist their urban exclusion, employing what bell hooks (3) refers to as the "power to disbelieve" by rejecting "the powerful's definition of their reality" that attempts to control where they can be. Even though these women's occupation of public spaces is not a visible nor blatant form of resistance, it is still significant for these women in that they challenge normative ideas imposed on them. Their act of establishing power through disbelieving reveals that there are "many more forms of power in international relations [and other levels of political processes] than is conventionally assumed" (7). Yet, on the other hand, this subtle form of resistance is limited as it does little to improve these women's political status and still leaves them excluded from the design and maintenance of public spaces. These women may resist their urban marginality by taking up public spaces, but they often occupy these spaces, and persist through their exclusion, as a last resort with no other place to go. Through their use of the "power to disbelieve" (3), the foreign domestic workers of Hong Kong and homeless women in England resist their urban marginality in the private sphere by taking up public space. By resisting, these women simultaneously challenge political systems that put them in the margins while remaining subjugated by these systems and thus still in the margins.

The ways in which these groups of women overcome their position in the margins of urban public space is equally important to their resistance. Not only do these women actively break the public vs. private binary—thus threatening patriarchal power systems founded on this distinction—they also deny the dominant patriarchal systems of capitalism by not engaging with it to establish their power. Foreign domestic workers do not merely occupy public areas on their days off, they transform them into vibrant spaces in which they play cards and gamble, cut each other's hair, share their own prepared food, write letters back home, and perform other activities to relax (4)(5)(10). Some Hong Kong locals view these activities as private rituals that are "scandalous, immoral," and improper for the public domain (4). While these associations continue to marginalize foreign domestic workers in Hong Kong society and urban life, it also illuminates the threat these women pose to the manufactured public vs. private dichotomy that upholds patriarchal power and attempts to marginalize these women in the home. In taking up public space, bearing exclusionary practices and derogatory societal perceptions, and opposing the public vs. private binary, foreign domestic workers do so by disbelieving the capitalist system entrenched within Hong Kong that systematically excludes them from public spaces in the first place. For instance, in 1982, a Hong Kong real estate company, Hong Kong Land, closed roads in the city's shopping centre to encourage pedestrian shopping and spur capitalist consumption (5). Foreign domestic workers in the city used this opportunity to congregate on the newly opened roads, not to conform to the corporation's desires to spend money in their shops, but instead to meet up with friends (5). Instead of shopping at the same stores and malls that put up tape and hire security guards to push them away, these foreign domestic workers create their own entertainment with each other on their days off. In this sense, these women evade capitalistic consumption by both populating free public spaces and by relying on their own social capital and informal economies to socialize. At the same time, due to these women's low wages and the large portion of their earnings that go back home in the form of remittances, these women are often unable to afford to engage in the capitalist systems of consumption. Therefore, foreign domestic workers' refusal to engage with capitalistic consumption is both vital to their resistance movement against the exclusionary planning system in Hong Kong that marginalizes them from public spaces, but is also a result of their political and economic marginalization. Homeless women also fracture the public vs. private binary by using public facilities—such as washrooms, libraries, and art galleries—to fulfil their daily "private" needs including maintaining personal hygiene, washing clothes, and sleeping (6). Although public spaces tend to be portrayed as dangerous and corrupting for women, some women who find themselves homeless by escaping an abusive relationship feel the public realm, even if that means sleeping on the streets, is safer than remaining in their current harmful situation (6). The public realm can also be safer than semi-private and masculinized institutional spaces, such as homeless shelters, in which some women are ignored, discriminated against, and sexually abused (6)(8). Homeless women break not just the public vs. private binary but also challenge and correct the assumption that the former is dangerous, and the latter is safe. Yet, to ensure their safety and build a reliable schedule to fulfil their daily needs, homeless women often negotiate agreements and establish supportive relationships with gatekeepers of public spaces, whom include park staff, librarians, and toilet attendants. These relationships require trust building and pose a level of risk for both parties, yet they often create mutual benefit: in one instance, museum security guards let a homeless lady sleep on the steps, which made their job easier as "she kept the steps free of litter… and her presence was thought to deter other, more troublesome persons" (6). Homeless women intentionally engage in mutual aid relationships with public space gatekeepers to occupy these spaces, which enables them to

resist their urban exclusion by circumventing the capitalist systems that continually marginalize them (11). Both homeless women and foreign domestic workers use their limited power to challenge and disbelieve the public vs. private binary, while also abstaining—by choice or due to necessity—from consumption and oppressive capitalistic systems through utilizing their own social capital and mutual aid networks.

Despite resisting their position in the margins of public space, foreign domestic workers in Hong Kong and homeless women in England still face stigmas due to their intersectional positionalities, hindering their ability to overcome their urban marginalization. Foreign domestic workers in Hong Kong experience subordination due to their "age, gender, menial status, and temporary legal residence [status]", and also encounter discrimination related to their ethnicity and as minority women of colour in a primarily Hong Kong Chinese population (4). These women's intersectionalities cause them to be sexualized by Hong Kong society and media. The perception that foreign domestic workers are "a potential seductress" to men and fathers in Hong Kong transcends into the public perception of these women on their days off (4). While foreign domestic workers relax in the city's public spaces, some view their activities as "provocative", sometimes going as far as to conflate these women with prostitutes (4). Their sexualization is explained by Crenshaw's (8) theory of intersectionality which states that "racial and sexual subordination are mutually reinforcing". While foreign domestic workers' positions as women and domestic labourers place them in the private sphere, the discrimination they experience due to their race also leads to their sexual subordination, and vice versa. This is exemplified by an instance where an agency recruiting women from abroad, to work as foreign domestic workers in Hong Kong, stopped welcoming Thai women over societal fears that they would become prostitutes in the city (4). Therefore, not only do all foreign domestic workers experience sexualization due to their positionalities, but some women, dependent on their race, are targeted more than others. Homeless women are similarly sexualized due to their gender, class, and race. Despite trying to distance themselves from prostitutes through intentional clothing choices and avoiding red-light districts, homeless women are still mistaken for sex workers and as a result are sometimes forced out of the spaces they were occupying by the police and other institutionalized gatekeepers (6). Homeless women's sexualization, differing dependent on each woman's identity categories, forces them to leave spaces they have established as safe and subsequently marginalizes them from urban public spaces even more. In foreign domestic worker's and homeless women's efforts to resist their urban marginality, they experience discrimination and sexualization that prevents them from fully escaping their position in the margins and from taking up public space without judgement.

Even though women have been designed into the margins of public space by the patriarchal planning and capitalistic institutions, as well as by their association with the private realm, foreign domestic workers in Hong Kong and homeless women in England continue to resist their urban marginalization. These women employ hooks' (3) "power to disbelieve" by simultaneously taking up public space, disrupting the public vs. private binary, and by bypassing the capitalist systems that marginalize them, instead relying on social capital and mutual aid to establish their power. However, these women's resistance efforts are also a result of, and are limited by, their lack of political and economic power that gives them few choices as to where to go as well as not much money to spend. While these women are empowered by occupying public spaces, they still face challenges in reaching full citizenship and political influence that would give them more power in how these spaces are designed and maintained as well as in how they can use them. Additionally, the stigmas these women face due to their intersectional positionalities inhibits their resistance to the fullest extent possible. Furthermore, cities are

the centres of other resistance movements—such as the current pro-democracy protests in Hong Kong—which can take away public space from other users, such as foreign domestic workers and homeless women, and thus threaten their livelihoods. Women can resist their exclusion in public space, but in a city and a society that does not include them in the design and management of that space, such resistance efforts and their successful occupation in public spaces can only go so far. For women to fully escape their urban marginality, a lot more from all levels of society—including the government, planning institutions, and corporate bodies—must be done.

The analysis and conclusions in this paper regarding women's marginal position in urban public spaces, as well as their resistance to this exclusion, is focused on specific demographics within Hong Kong and England. However, these findings also apply to other contexts, such as domestic workers in other Southeast Asian countries like Singapore as well as homeless women around the world. Further research into these other geographical contexts is needed to better understand the relationship between groups of women and urban public space, which can help identify larger patterns and effective ways in which women can resist their urban marginality. Efforts should also be focused on understanding the exclusion that male foreign domestic workers and migrant workers face in public spaces, leading to richer intersectional analyses relating to urban marginality. Many groups of people are excluded from the city's they live in, and thus a larger array of research into urban marginality is paramount to critique city planning practices and make cities more inclusive for everyone.

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Characterizing Drug Design: A Review of Platinum-Based Chemotherapy Drugs

Liam Johnston

Introduction

Chemotherapy drugs are designed in such a way that they can interact with DNA and cellular replication mechanisms to shut down cell division. One of the most crucial breakthroughs in chemotherapy drug design was the incorporation of the platinum (Pt) transition metal as the central atom of these cancer drugs. This review examines the family of platinum-based chemotherapy drugs to examine distinct design features that medicinal chemists incorporate into precursor compounds to create more effective drugs.

Synthesis and Discovery

Cis-dichlorodiaminoplatin (tradename Cisplatin, *cis*-[PtCl2(NH3)2]) was originally synthesized in 1844 by Michele Peyrone (1). Fifty years later, in 1893, Alfred Werner successfully characterized the structure of Cisplatin, winning him the Nobel prize in 1913. Werner's elucidation of Cisplatin's structure helped scientists understand prevalent chemical theory such as isomerism (compounds with identical formulas but distinct chemical structures) and chemical coordination (where atoms or groups are located around a central atom) (2). Interestingly, the cytotoxic (toxic to the body) qualities of Cisplatin and its potential use in the clinic were not realized until the 1960s, whereby it began trials for use as a chemotherapy drug (1).

The discovery of Cisplatin's ability to inhibit cellular replication came around somewhat by accident, when Dr. Barnett Rosenberg was examining the effects of electric current on cellular division in *Escherichia coli* bacteria (3). Dr. Rosenberg used platinum electrodes to apply current to *E. coli* growing in an ammonium chloride buffer, which altered *E. coli's* normal sausage-like shape to be long and filamentous, indicative of damage to the bacteria (4–6). Upon further research, it was determined that this denaturation was not due to the electrical current applied to the bacteria, but rather the inhibition of cell growth due to the platinum electrodes. This discovery catalyzed further research into other transition metals (groups of metals found in the middle of the periodic table) and their effects on *E. coli* bacteria, with platinum-based compounds being the most effective at inhibiting cellular replication (5). Further, the team discovered that the cis- isomer of the tested platinum complex was more effective at inhibiting cell growth than the trans- isomer (2,6,7) (**Figure 1**).

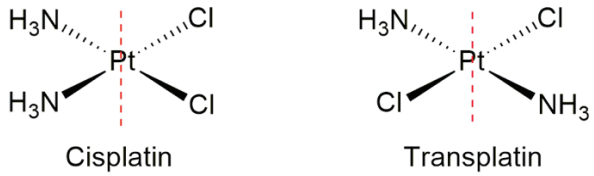

Figure 1. Cis- vs trans- isomers of platinum (II). The dashed red line is used as a reference to distinguish between the two species. Note the cis-isomer, has both types of substituents (Cl- and NH3) on the same side of the central platinum atom, whereas the trans-isomer has both types of substituents on opposite sides of the central atom. The colouration of the triangles indicates the location of the atoms in space (dark triangles indicate the atom is coming out of the page, and the dashed triangles indicate the atom is going into the page).

These results led to further testing of platinum complexes on sarcoma tumors in mice. The potency of the these compounds shrank the solid tumours aggressively and many samples remained cancer-free six months after drug injection (8). This led to the enrollment of Cisplatin in clinical trials, later becoming one of the most commonly used chemotherapy drugs for a variety of cancers, including ovarian, testicular and bladder cancer (7,9). In addition to helping us understand fundamental chemical concepts, Cisplatin also proved to be a potent chemotherapy drug and is one of the most widely used chemotherapy drugs in the clinic today (5,10).

In addition to being incredibly useful in the clinic, the collection of platinum-based analogues proves to be a pertinent example to discuss features that medicinal chemists include when designing drugs (**Figure 2**). Certain chemical motifs that will be discussed in this review include carbon-based rings, unnatural elements (e.g. fluorine) as well as other transition metals. In order to properly understand the chemical qualities that medicinal chemists have incorporated into Cisplatin (and other platinum-based chemotherapy drugs), we must first understand the mechanism by which Cisplatin works as well as gain an understanding of how the body can become resistant to the drug. Understanding these concepts will help elucidate the reasoning behind the specific chemical motifs discussed in the later sections of this review.

Mechanism of Cisplatin

Cisplatin causes cell death by binding to DNA, inhibiting cellular replication (11). Another term for these Cisplatin-DNA complexes are DNA adducts, which are a form of DNA damage caused by covalent bonding of other foreign molecules to DNA (2,12–14).

Administration of Cisplatin

In order for Cisplatin to react properly with the target cells in the body, the drug is administered to patients intravenously (IV). The IV administration of Cisplatin is crucial simply because of the high chloride concentration in human blood (which is approximately 100mM) (3). Due to this high concentration of chloride ions, it is unfavourable for the chloride ions attached to Cisplatin to leave (**Figure 1**), which allows for dispersion of the drug throughout the body (think chemical favourability; it is less favourable for the ions to leave in a solution which contains a lot of that ion). Cisplatin will subsequently diffuse into cancer cells without losing its chloride substituents (substituents are simply groups attached to the central atom) (2,3). Comparatively, if the chloride concentration in human blood was much lower, we can imagine that there would be less "pressure" to keep the chloride substituents stuck to the central platinum atom.

Diffusion into Cells

There has been evidence to support the hypotheses that Cisplatin undergoes both passive diffusion (along the chloride concentration gradient, as the chloride ion concentration is much lower in the cytoplasm of cells) and active diffusion facilitated by membrane-bound proteins such as CTR1 (a membrane transfer protein crucial to cellular function) (9,15,16). Once inside the cell, the chloride concentration decreases significantly, from 100mM in the blood to ~4-20mM in the cytoplasm (2,3,12). The decreased chloride concentration provides favourable conditions for the chloro-substituents to be replaced by water molecules, which causes hydrolysis of Cisplatin (12) (**Figure 2**). If we use the same example as the previous section, there is now much less "pressure" to keep the chloride substituents attached to the central platinum atom.

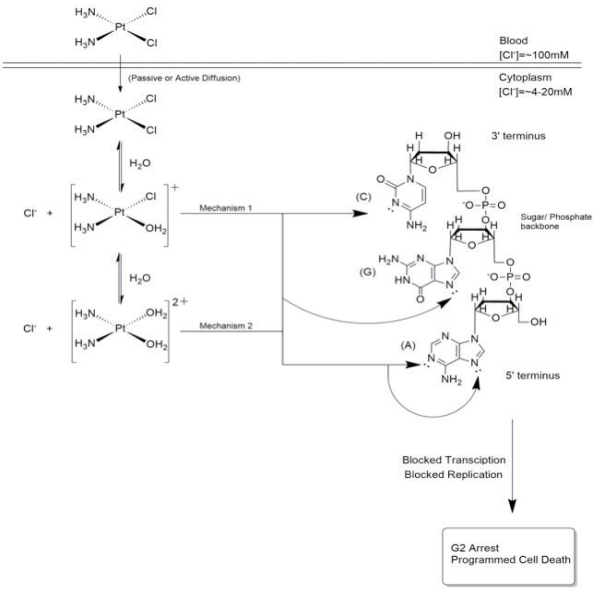

Figure 2. Proposed Cisplatin mechanisms of action. The drug diffuses across the cellular membrane along the chloride concentration gradient (or via active transport) and loses a chloro- group due to lower overall [Cl-]. Mechanism 1 is the 2-step process, whereby Cisplatin binds after hydrolysis of the first chloro-group. DNA replication is not halted until the second chloro-group is hydrolyzed, allowing for the formation of a bifunctional adduct (bi-functional meaning 2 guanine molecules attached through the Cisplatin scaffold). Mechanism 2 is the 1-step process, whereby both chloro-groups are hydrolyzed prior to Cisplatin binding. Once bifunctional adducts are formed, the cell either undergoes apoptosis or cell cycle arrest. Additional outcomes include DNA repair, which has consequences for Cisplatin resistance.

Cisplatin-Induced DNA Damage

Once inside the cell, Cisplatin gets activated through replacement of the chloride groups with water, giving it a positive charge and creating a highly reactive compound (17). Upon hydrolysis (water added to it), Cisplatin is highly electrophilic (electron-loving) and interacts with the nucleophilic (attracted to positively charged atomic nucleus) DNA base pairs. Although guanine is the primary target of Cisplatin due to the lone pair of electrons present on the 7th nitrogen of the ring, the drug also targets adenine, subsequently creating DNA adducts and inhibiting DNA replication (Figure 3) (2,12). DNA replication is not halted until both chloride groups present in Cisplatin are hydrolyzed, allowing the drug to create bifunctional adducts, or cross-links between 2 guanine bases. These adducts/ crosslinks can be imagined as bridges that form between DNA strands (remember DNA is double stranded), which restricts the function of DNA replication mechanisms, since the strands need to be split apart during replication (14). Once the body realizes that there is a fatal error in the DNA, it theoretically destroys the cell (this isn't always the case in cancer cells, hence the occurrence of resistance). Since cancer cells are replicating at rates that exceed normal cell growth, Cisplatin has a "greater" apparent effect on tumor cells, although it does technically impact normal DNA as well (2).

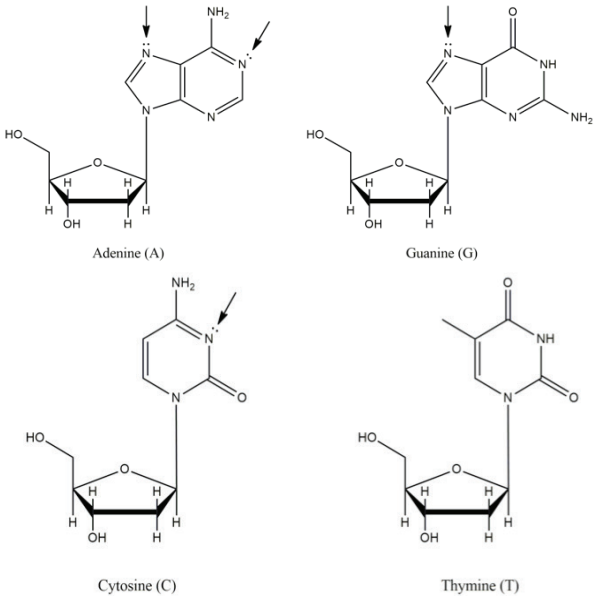

Figure 3. Primary binding sites for Cisplatin upon removal of chloro- groups in intracellular fluid. Guanine, cytosine and adenine all exhibit nucleophilicity with the lone pairs of electrons present in the nitrogenous-base rings. Guanine is the most nucleophilic, and hence is the primary location of Cisplatin binding however, there are additional binding sites present on both adenine and cytosine (although interactions between Cisplatin and cytosine are very rare).

Cisplatin Resistance

Cells can develop a resistance to Cisplatin and other anticancer drugs through a self-defence pathway, effectively removing these cytotoxic compounds from the cell. This is done either

because the cell was never affected by the specific mechanism of the drug (intrinsic resistance) or through the development of genetic mutations which alter cellular structure and composition (18). Since cancer cells are replicating at rates that exceed normal cell growth, their mutation rates are greater (as mutations frequently occur during DNA replication), further increasing their likelihood of evading chemotherapy drugs (19,20). Although the mechanism is not fully understood, Cisplatin resistance is likely due to a combination of distinct factors including: decreased drug *influx*, increased drug *efflux*, *alterations in tumor suppressor gene expression*, as well as loss of function in *DNA repair* mechanisms (2,12,18).

Alterations of influx and efflux

Cisplatin resistance has been correlated with both reduced cellular influx of the drug, as well as and increased efflux of the drug that is already present in tumor cells. First, reduced influx of Cisplatin has been attributed to characteristics affecting both active and passive transport mechanisms in cells. Cells showing a decreased accumulation of Cisplatin also displayed a lower expression of a 48kDa membrane protein, providing both evidence supporting the concept that Cisplatin is taken up actively, as well as a potential therapeutic target (9,12). Reduced Cisplatin influx can also be a product of overdosage, as increased concentrations of Cisplatin augments the chloride concentration intracellularly (3). Since Cisplatin has also shown to diffuse along the chloride gradient (high in blood to low in cells), a lower differential between the cytoplasm and the blood will decrease Cisplatin uptake (9).

On the other hand, increased drug efflux (removing the drug from the cell through membrane-bound proteins) has also shown to be a mechanism for Cisplatin-resistant cells (12,21). Cells can efflux Cisplatin as a one-step process, or by first inactivating it with intracellular proteins in the cytoplasm. An example of this is *glutathione* (GSH), a natural molecule which can covalently bond to Cisplatin (through a nucleophilic attack by the glutathione thiolate anion). Again, since the chloro- substituents are good leaving groups, they are replaced by GSH, which can thus be pumped out of the cell (22,23). In addition to increasing membrane pump activity, GSH inhibits the cross-linking described in the Mechanism of Cisplatin section, reducing the amount of damage done to DNA. Testicular and ovarian cancers, which are more susceptible to Cisplatin treatment than bladder tumors, have shown decreased levels of GSH, indicating a correlation between GSH levels and Cisplatin effectiveness (12,23,24).

Inactivation due to altered expression of tumor suppressor genes

Cisplatin-resistant cells can also show altered expression in tumor-suppressor genes (genes that suppress uncontrollable cell growth) such as *p53*, which is involved in cell cycle control and is one of the most commonly mutated tumor suppressor genes (12,25–27). Mutations in this gene reduce the effectiveness of cellular checkpoints that restrain heathy cells from unregulated growth (28,29). Reduction of checkpoint efficacy reduces Cisplatin's effectiveness by providing cancer cells more time to initiate DNA repair mechanisms to fix the DNA adducts described in the Mechanisms of Cisplatin section. Clinical studies have shown that 83% of Cisplatin-resistant ovarian cancers had mutations in *p53*, indicating that loss of function mutations in *p53* give the cells more time to repair the DNA damage caused by Cisplatin (26). Additionally, injection of wild type *p53* into ovarian cancer cells in mice created a widespread apoptotic event (cell killing), displaying a re-sensitization event to the drug and a potential combination therapy for this specific ovarian cancer (30).

DNA repair mechanism activity

Lastly, cellular resistance to Cisplatin has also shown to be due to increased removal of Cisplatin-affected DNA base pairs. The primary DNA repair mechanism for removal of platinum-DNA adducts is nucleotide-excision repair (31). This repair mechanism involves specific proteins that cut out defective bases, which are

then replaced by properly functioning base pairs (32). Cells that showed increased sensitivity to Cisplatin had downregulated excision-repair mechanisms, implicating that resistant cells likely have upregulated excision-repair mechanisms (13). Put simply, when cells have DNA repair mechanisms working in overdrive, more of the DNA crosslinks caused by Cisplatin get repaired, reducing the amount of DNA damage (and by extension, the number of cells that get destroyed). Linking this to the tumor suppressor gene *p53*, the downregulated DNA repair mechanisms (either due to mutant *p53* or other genes) is important for cancers with mutant tumor-suppressor genes, since they increase the amount of time that these repair mechanisms take to fix cancerous cells (29).

Drug Design and Overcoming Resistance

Understanding the cellular mechanisms leading to Cisplatin resistance is crucial in order to design effective chemotherapeutics. Drug characteristics that medicinal chemists use in designing chemotherapy drugs include: the incorporation of *unnatural elements* (e.g. fluorine), *3-/4-membered rings* and *transition metals* (33–35).

Unnatural elements in drug design

Unnatural elements, those that aren't naturally found in the human body, are useful for mitigating mutation-related resistance because the body has difficulties imitating their structure to gain resistance. An example is fluorine, which has only been found in twelve organic compounds (this number reduces to five when we account for the eight fluorinated fatty acids that are all from the same plant) (34). In addition to its relative scarcity in nature, the specific properties of fluorine, like its strong hydrogen bonding and low steric hindrance, have proven useful in drug design(34). These characteristics, along with strong binding affinity and lipophilicity make it a powerful tool for medicinal chemists to incorporate into drugs (36). Fluorouracil, a frequently used chemotherapy drug, is essentially a fluorine atom attached to a uracil base (used by RNA polymerase to transcribe RNA from DNA templates) (37,38). This effectively inhibits RNA processing and inhibits cell growth (38).

3- and 4-membered rings in drug design

In addition to individual elements, 3- and 4-membered rings are also useful tools for medicinal chemists to create drugs that have stable metabolites and are less susceptible to resistance by mutation (**Figure 4**). For example, the four-carbon rings present in both Carboplatin and Iobaplatin increase stability and reduce cellular resistance, because four carbon rings are rare in the body due to their high energetic cost, which is mainly associated to the angular strain present in smaller rings (32,33). This ring strain reduces their thermodynamic favourability, and as such they are rare in biological species (32).

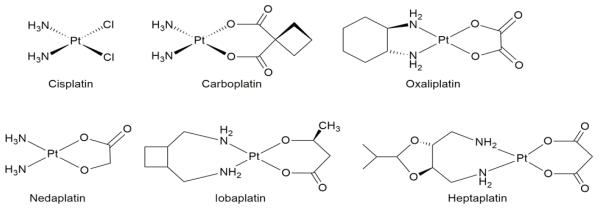

Figure 4. Chemical structure of platinum-based anti-cancer drugs. The top three drugs are approved for use globally, whereas the bottom three drugs are only approved in Japan, China and Korea(7). Single lines indicate single bonds, double lines indicate double bonds. Note: there are still carbon atoms in the corners where no atom is shown.

Interestingly, 5- and 6-membered rings are prevalent throughout biological systems since they have less angular strain, resulting in increased stability (many of them also undergo hydrogen bonding with other molecules, one of the most stable forms of covalent bonding) (33). Although challenging to synthesize due to energy barriers, 3- and 4- membered rings are useful in drug design as they are unlikely to be replicated (or mimicked) in the body, reducing the likelihood of resistance and increasing the stability of metabolites (2).

Transition metals

Transition metals are also frequently

used in drug design due to their ability to undergo reduction-oxidation (redox) reactions and because they are present at enzyme active sites. Metal compounds are used throughout biological systems for electron exchange, catalysis and structural integrity and are valuable as they provide a framework with which medicinal chemists can fine tune their reactivity to target a desired enzyme or molecule in the body (3,17,35). Specific features of metal-based compounds include charge variation, structure and bonding features, redox activity, Lewis acid features as well as a partially filled d-orbital shell, which all influence drug-body interactions and toxicity (35). Cisplatin is a good example of the specific reactivity of metal-based compounds since it is unreactive in high chloride concentrations (in the blood) but becomes activated through hydrolysis once these chloride concentrations drop (in cells) (2). Although Cisplatin distributes well (as a result of chloride concentration dependency), it is limited in its dosage amounts since the body has trouble excreting the drug. This renders it severely neuro-, hepato- and nephrotoxic (damaging to kidneys) (19,39,40). This has led to a search for other metal-based anticancer drugs that build off the targeted cytotoxicity of Cisplatin but reduce the overall toxicity to the body.

Carboplatin (**Figure 4**), was designed in the 1980s to mitigate the toxic effects of Cisplatin mentioned above (2,41). Although less cytotoxic than Cisplatin in the context of some cancers, it showed a reduced neurotoxicity due to the bidentate cyclobutanedicarboxylate leaving group (7,42) (**Figure 4**). This leaving group is much more stable than the reactive chloride ions, which results in a slower reaction and reduced toxicity (although this specific analogue has not made much headway simply because it has a similar drug-body interaction as Cisplatin) (2,41). Currently, Carboplatin is used in clinics in higher doses than Cisplatin and in combination with other chemotherapeutic drugs (such as Paclitaxel) since it has lower overall toxicity (41,43).

Conclusion and Future Directions

The pivotal work done by Rosenberg and colleagues in the 1960s created a foundation for platinum-based chemotherapy drugs. This understanding of how metal-based drugs interact in our body has led to the creation of a number of drug candidates for cancer therapy (2). Through inclusion of unnatural elements, 3- and 4- membered carbon rings as well as transition metals, medicinal chemists can synthesize drugs to activate or inhibit specific processes throughout the body. Not only has this created a platform of knowledge with which to synthesize drugs applicable to all domains of medicine (rings have been useful in a plethora of drugs, including the diuretic Bendroflumethiazide), it has furthered research in the field of platinum-based anticancer drugs, resulting in effective drugs with limited toxicity (44). Although the mutation rates associated with cancer can result in resistance to medications, platinum-based compounds prove to be a strong avenue with which to pursue for sophisticated cancer therapeutics.

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Vanlife: How Outdoor Tourism Perpetuates Squamish's Housing Crisis

Tara Warkentin

On July 23, 2019, Squamish's municipal government passed Bylaw No. 2679, criminalizing camping on Crown land (6). Under this bylaw, the District of Squamish can fine people camping in tents or vehicles up to $10,000 (6). The municipal government states that the bylaw was a necessary response to exponential growth in Squamish's tourism industry (6). Squamish's tourism industry took off following the 2010 Whistler Olympics, when the Squamish municipality capitalized on B.C.'s new status as an outdoor tourism destination, branding the town as "hardwired for adventure"(5).

Yet, Squamish's transition from what Timothy Luke terms an "extractive industry," where activities such as logging and fishing dominated the economy, to an "attractive industry," where the resources that were once extracted become valued by the tourist gaze, presents a problem for city planners and municipalities: the tourism industry's growth threatens the image of environmental purity and wilderness that tourism itself depends on (11). Squamish's municipality identified the solution to the unsustainability of the tourist industry is increased regulation. The municipality's website reads, "the bylaw aims to preserve the joy of camping without the impact to the environment, by restricting camping within identified sensitive areas within the municipal boundary to designated campsites" (5). In addition to regulation, the city counsel's strategy is to expand the tourist industry, and open it to a global market. City council states that it will "continue to advocate with the Province of B.C. to expand existing campgrounds or establish new ones to match the interest in our community and our world class recreational amenities" (5).

However, this solution fails to address a less attractive aspect of Squamish's growth; namely, the housing affordability crisis where real estate and rental costs are greater than local incomes (18). Marginalized populations, such as single mothers, disabled folks, Indigenous people, people of colour, and immigrants, are identified as most vulnerable to homelessness in Squamish. The drive to develop Squamish as an adventure destination does not simply produce economic capital for corporations and thrill for adventure seekers—it also produces marginalized bodies, by the same logic of elimination that has expropriated Indigenous peoples from these lands (27). The Squamish municipality's authority over Crown Land relies on historical processes of violence and dispossession that are iterated today as neocolonialism (17). The camping bylaw's rhetoric of economic growth obscures the municipality's underlying neocolonialist agenda: to profit from attractive development. A particular image of Squamish is produced through the geophysical boarders of zoning regulations and the ideological tool of marketing, that delineate who can live in Squamish. Systemic inequalities rooted in colonization mean that adventure seekers can camp as a lifestyle or aesthetic choice, but marginalized people often have no choice but to live in vehicles or tents. The bylaw is structured to perpetuate economic growth through zoning

and marketing, while marginalizing vulnerable populations.

The bylaw's zoning policies are a neocolonial iteration of state dispossession of Indigenous lands. The state has inscribed lines on the land for centuries, to grant government, companies, and settlers the authority to use laws, policing and violence to remove Indigenous people from the land (22). Maps and laws are taken as truth, but act as constructed knowledges that make the violence of land dispossession invisible to settler-Canadians. Since 1860, settler capitalists and the colonial government have recognized the economic value of Squamish's land and resources. The colonial government created Indian Reserves, small parcels of land that were given to Squamish peoples in order to *take* vast swaths of ancestral territory (22). Squamish peoples' were only allowed fish, timber and land within reserves, which were too small and resource-poor to sustain healthy society. Meanwhile, both the state and settler-capitalists made booming profits by exploiting natural resources (22).

The Canadian state's continued "logic of elimination", or the state's desire to destroy Indigenous sovereignty, land, and lives, in order to replace them with colonial society, results in "structural genocide" of Indigenous peoples (27). Wolfe's term "structural genocide" refers to land dispossession, as well the assimilation of Indigenous peoples into settler society (27). Structural genocide forces Indigenous people into a double bind: without land, they cannot live outside the capitalist system; neither can they become prosperous within it, since the premise of capitalism is land ownership (12). The Canadian state thus marginalizes Indigenous people as labourers. Accordingly, Indigenous peoples throughout Canada, and the Sḵwx̱wú7mesh peoples who live on the land the town of Squamish sits on, are subject to high rates of poverty, a necessary condition for the capitalist economy (1). This historical pattern of marginalization is reiterated today, because the tourist industry's growth requires a growing workforce, and thus depends on the low-cost labour of other marginalized people: women, disabled people, immigrants, and people of colour. Furthermore, the municipality's support of the tourism industry perpetuates the housing crisis and ensures that marginalized people will not be able to become landowners.

The topography of tourism depends upon highway improvements that were made in preparation for the 2010 Winter Olympics and the ensuing influx of tourists (1, 11). Shortly after, someone installed a sign on the side of the highway reading, "Squamish: the Adventure Capital of Canada" (1). The municipality embraced the new brand (5). Simon Springer writes that the Olympics were an attractive "pretext" for "waging war on the poor, an opportunity to celebrate the segregation of humanity rather than our unity, and a politics of forgetting' (24). This war against the poor includes "criminalization of the homeless, the destruction of low-income housing, and the revanchist gentrification" (24). In Squamish, these acts continue long after the closing ceremony, because they sustain the continued growth of the tourist economy.

Caught up by expanding the tourist industry, the municipality has conveniently forgotten marginalized populations. Just as the highway provides infrastructure for wealthy visitors and professional commuters, the municipality has centered recourses on services, infrastructure and entertainment for transient visitors, rather than addressing the town's widening social inequalities (1). Additionally, few tourist-industry jobs pay enough to meet housing costs. The standard wage for servers, baristas, and hospitality staff is $13.85 per hour. Average rent for a one bedroom apartment in Squamish is about $1500 per month, which means that a full time worker in the tourist industry spends nearly seventy percent of their income on housing (18). Squamish's tourism industry magnifies systemic inequality by leaving already vulnerable people homeless, or forced into exploitative conditions, such as sex-work (1).

Living in vehicles is a last resort of

many houseless people, but the camping bylaw criminalizes this means of survival. Furthermore, the people who are most vulnerable to policing and laws are people who already face discrimination at the hands of the colonial state. Media and public discourse associates single mothers, disabled folks, Indigenous people, people of colour, and immigrants with crime; policing follows suit by "profiling" marginalized people as criminals; thus, in practice, race and class determines the bodies prosecuted for breaking the camping law (1, 8, 19).

The bylaw allows camping on "exempt areas" but this benevolent accommodation is underwritten by the intent to marginalize impoverished people further. The District has set two exempt areas on roads that require 4x4 vehicles, more than 11 km outside of town (6). For people who live in vehicles as a result of poverty and Squamish's Housing Affordability Crisis, the 4x4 vehicle and gas needed to access these areas may be unaffordable. Ironically, the municipality states that the bylaw aims to restrict the number of tourists who campers and tourists, yet the exempt areas are accessible only to wealthy vehicle-dwellers. The exempt areas keep Squamish's homeless people out of sight, out of mind, literally pushing them to the margins of the municipality (**see image 1**).

Marketing also obscures their lives from view, so as not to dirty the pristine image of wilderness upheld by marketing and urban middle-class fantasy. Resultingly, Squamish culture is a "whitewashed" space (4). Coleman defines whitewashing as the process where images of white bodies and culture come to dominate media (4). Attractive models of development rely on aggressive marketing campaigns that whitewash rural places and brand them as playgrounds and wild refuges for the urban middle-class (11). Whitewashed images evoke iconographic outdoor culture (4). (Coleman 614; Luke 103). As a young white settler and a member of Squamish's outdoor sport community, my social media streams are populated by images of young, fit, white people who live in their vans. These posts are tagged #vanlife, a term that signifies "a renewed interest in the American road trip, a culture of hippie-inflected outdoorsiness, and a life free from the tyranny of a nine-to-five office job", according to a recent article published by The New Yorker (14). When vanlife is considered "an authentic… a mentality… and a movement" it appears to be a choice (14). Yet, for people pushed out of the housing market, vehicle living is a means of survival (26).

This essay demonstrates that the camping bylaw is the municipality's effort to sustain tourism's growth, while failing to address how tourism's growth perpetuates the housing crisis in Squamish. Future research must attend to who is living in vans, and how Squamish can not only be a place of labour, but also a place of life for long-term residents and marginalized populations.

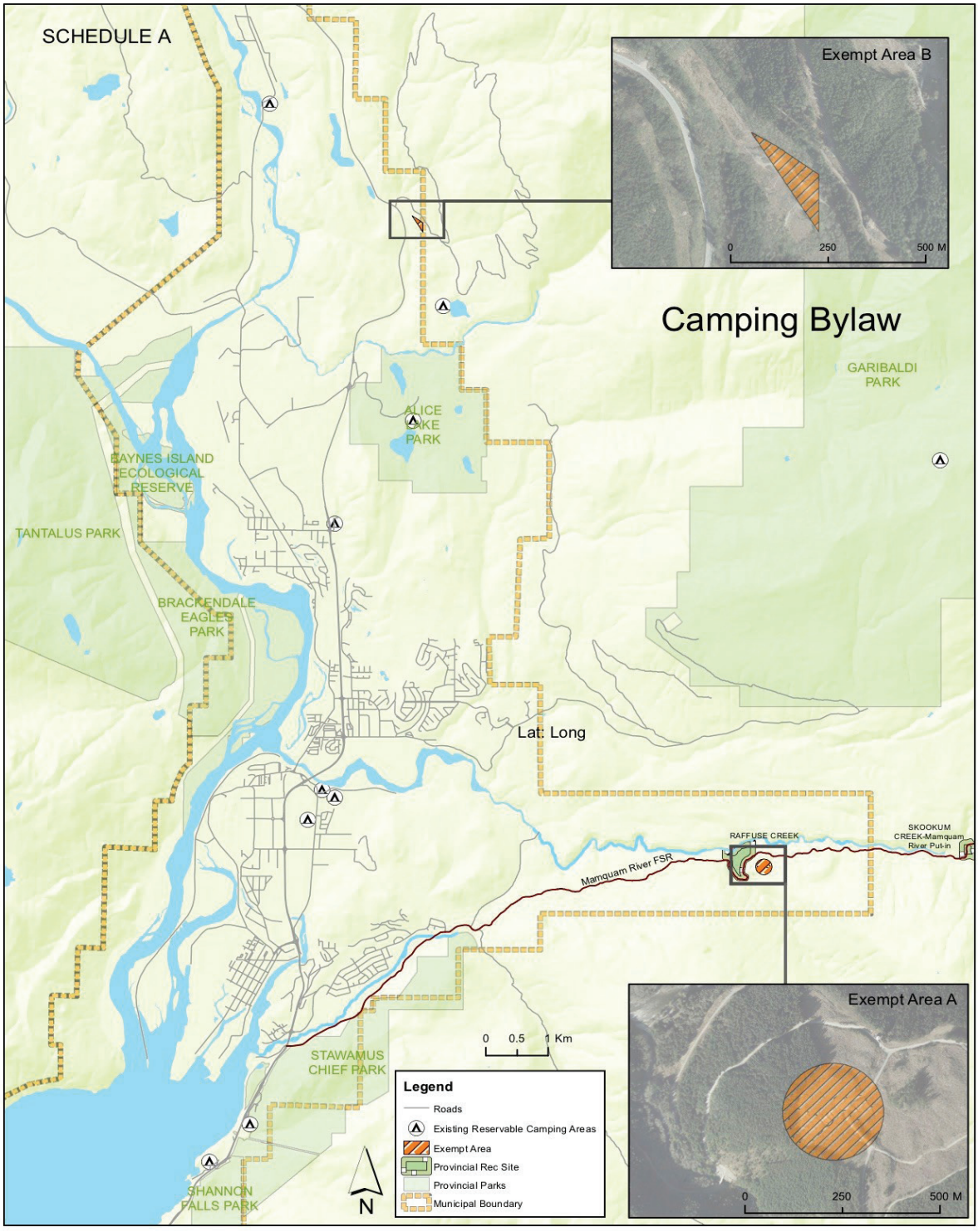

Image 1: The two areas exempt from the bylaw are more than eleven miles outside the town center. Image from Gartner, Hannah. "No Parking: How Squamish Regulations May Reshape #Vanlife." Climbing Magazine. Accessed December 11, 2019. https://www.climbing.com/news/no-parking-how-squamish-regulations-may-reshape-vanlife/.

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The Importance of Biocultural Diversity: Mycorrhizal Parallels in Adaptation and Resilience Admist Climate Change

Katie Hargus

Abstract

Global change is not a new phenomenon; it has characterized earth's systems since time immemorial and has enabled mass adaptation, evolution, and diversification of biological and cultural systems. However, global change as result of anthropogenic and colonial impacts to the land, seas, and climate are occurring at historically unprecedented rates, restricting these systems' capacities to adapt, respond, and form resilience to such rapid change. The concept of 'biocultural diversity' has emerged in recent years as a transdisciplinary lens through which to explore how these systems (operating in tandem) are affected by regimes of global change. It has most widely been utilized to explore cultural and biological interactions within Indigenous communities; these bodies of research emphasize points of contingency between biological and cultural change, adaptation, and resilience in order to argue for the necessity of maintaining diversity across the globe, including in the contexts of Indigenous communities. However, few have yet explored parallels between the components of biological and cultural systems. I argue that examining these parallels through the lens of biological symbiosis can serve to elucidate and to model the processes and mechanisms underpinning biocultural diversity. In particular, I explore how a certain type of symbiotic mutualism, mycorrhizal fungal-plant nutrient exchanges, can help highlight why trans-systemic interconnection is crucial in promoting adaptive and resilient systems amidst climate change.

1. Background

1a. Biocultural Diversity: Interconnection between Culture and Biodiversity

Cumulative and compounding components of climate impacts are widely considered to be the leading causes of mass declines in biodiversity worldwide, as they affect all temporal and spatial scales of ecosystem and species composition, structure, and function. These effects include global temperature rise, changes in global rainfall distribution, ecosystem fragmentation, population declines and species extinctions, and biotic invasions (Bellgard & Williams, 2011; Cairney, 2000; Simard & Durrell, 2004). Past research into these impacts has tended to isolate the relationship between biodiversity and climate change from other systems, excluding such crucial topics as (a) the impacts of climate change on culture and cultural diversity, particularly of Indigenous communities, and (b) the interconnectedness of cultural and biological diversity in regards to climate impacts. However, it can no longer be ignored that threats to biodiversity are interwoven with threats to cultural diversity, and that we must cultivate strategies for protecting both in tandem if we are to maintain any semblance of global and local resilience (ISE, 1988; IUCN, 2011; IUCN, n.d.; Persic & Marin, 2008).

Specifically, the interwoven threats aforementioned have arisen from past and present impacts to lands, ways of knowing, lifeways, and peoples through processes of colonization,

globalization and the proliferation of extractive economies, and climate change (Elands et al., 2018; ISE, 1998; IUCN, 2011; IUCN, n.d.; Persic & Marrin, 2008). It is vital to address that these threats disproportionately affect Indigenous communities due to (a) continuing and ongoing colonization and destruction of Indigenous lands, resources, peoples, and ways of knowing, and (2) an approximated 80% of the world's biodiversity being held in traditional Indigenous territories (McIvor, Fincke, & Oviedo, 2008; Sobrevila, 2008; Tuhiwai-Smith, 2012).

1b. Origins and Concepts of Biocultural Diversity

A recognition of the interconnectedness of biological and cultural diversity, as well as of the disproportionate negative affects of anthropogenic and climate change-induced biodiversity loss on Indigenous Peoples, was catalyzed by the 1988 Declaration of Belem. The Declaration advocated for the necessity of establishing programs to "guarantee the preservation of vital biological and cultural diversity" (ISE, 1988,1) by identifying several linkages between the disappearance of 'fragile ecosystems'; species extinction; destruction of Indigenous culture; economic and agricultural health; and Indigenous Peoples' major stewardship of the world's biodiversity. It concluded that there exists "an inextricable link between cultural and biological diversity" (2), and since its release a number of international organizations and conventions, including UNEP, UNESCO, IUCN, and the UN Convention on Biological Diversity, have recognized these interwoven facets of culture and biodiversity (UNCBD 1993; Hong et al., 2014).

The term 'biocultural diversity' arose as result of the conclusions made in the Declaration of Belem, and refers to "the diversity of life in all its manifestations: biological, cultural, and linguistic, which are interrelated (and possibly coevolved) within a complex socio-ecological adaptive system" (Maffi, 2007, 269). The concept has gained traction as a transdisciplinary means through which to research the effects of the permeation of climate change through various systems, including those pertaining to connections between language, land, culture, agriculture, human and ecological health, economics, and resource extraction (Hong et al., 2014; IUCN, 2011; IUCN, n.d.; Persic & Martin, 2008; Rozzi et al., 2006). It also "nurtures respect for the multitude of ways that different cultures manage and protect their local environments, and promotes support for traditional cultures in their efforts to conserve their local landscapes and the biodiversity living within them" (McIver, Fincke, & Oviedo, 2008, 4). Indigenous Peoples therefore are integral within many of these biocultural systems, as are the vastly diverse ways of knowing and living (in regard to biodiversity) that each distinct Indigenous community harbours (McIver, Fincke, & Oviedo, 2008; Sobrevila, 2008; Tuhiwai-Smith 2012). Although each of the previously articulated biocultural systems and the infinite interconnections within and between them could easily comprise entire books, for the purposes of this exploration I will recognize their importance but not delve into their complexities.

2. Biocultural-Mycorrhizal Processes, Components, and Parallels

2a. Introduction

According to the IUCN's Regional Director for South America, João Stacishin de Queiroz, "society's ability to adapt, like that of a species, hinges on the biological and cultural diversity that it encompasses. It is from this diversity that viable systems will emerge. Diversity, both cultural and biological is the raw material for evolution; without them society will be unable to adapt to ever-changing conditions" (IUCN, 2011, 1). It is this premise of adaption from which I hope to build, and elucidate the complexity and importance of, biocultural diversity. One way in which to accomplish this is through comparison and connection with other adaptive systems, including those networks between mycorrhizal fungi, plants, and soil. This particular connection is premised on two main ideas. First, that interdependence

between components of both biocultural diversity (culture/biodiversity) and mycorrhizal networks (plants/fungus/soil) run parallel and unite both systems. Accompanying the main tenet of biocultural diversity – that impacts to biodiversity affect culture (and vice versa) – is a similar consensus emerging in biological disciplines that "any changes occurring aboveground (in the atmosphere or land) undoubtedly will affect plant, animal and belowground microbial biodiversity; these are intimately linked" (Covacevich, Escheverra, & Pagano, 2012, 3). Second, that the interconnections forged in mycorrhizal networks and in bioculturally diverse systems can offer opportunities for adaption and resilience amidst climate change. Before diving further into these connections it is necessary to identify what mycorrhizal networks are and how they function, from which I will move to discussing the intricacies of their parallels.

2b. Mycorrhizal Networks: Interconnection between Fungi, Plants, and Soil

Mycorrhizal networks are symbiotic associations between soil fungi, plants, and soil; these networks serve to connect plant communities with belowground microbes and with other plants and are responsible for linking an enormous number of biological and geochemical processes and components, including nutrient cycling and uptake, decomposition, seedling establishment, plant growth and succession, microbial composition, and ecosystem functioning and resiliency (Bellgard & Williams, 2011; Cairney, 2000; Horton, 2015; Simard & Durrel, 2004). Structurally, symbiosis occurs through the fungal mycelium colonization of the root tissues of the host plant. This association "provides a physical bridge—involved in the absorption and delivery of nutrients from the soil matrix—to the plant-host via the mycelial network" (Bellgard & Williams, 2011). It is important to note that soil, as the broader medium through which transfer occurs, is integral to these associations (Covacevich, Escheverra, & Pagano, 2012). From this symbiosis, fungi are benefitted by having direct access to root stores of glucose and fructose that they require (Simard & Durall, 2004). In return, because most fungal mycelium are much smaller than root hairs and have more efficient nutrient uptake mechanisms, they are able to access and make available many nutrient sources that plants are not capable of obtaining, including nitrogen and phosphorous (Covacevich, Escheverra, & Pagano, 2012).

These fungi also provide other benefits to their host plants, including soil stabilization and increasing tolerance to salinity, drought, acidity, pathogens, and toxins, as well as improving overall fitness and resilience to ecosystem fragmentation, and biotic invasion (Bellgard & Williams, 2011; Cairney 2000; Hewitt et al., 2013). The benefits of mycorrhizal networks, however, are not limited to host plants – entire plant communities can be supported by connected mycorrhizal networks in the soil (Wang et al., 2017). This enables 'plant-fungal-plant' communication, facilitated through biochemical signaling and resource transfers (Gorzelak et al., 2015). Such connection is key in sustaining plant populations under the affects of climate change – these plants (and the mycorrhizae that facilitate their connection) supply surrounding soil microbes with nutrients that other plants can also utilize, therefore supporting an enormous array of diversity within these networks (Bellgard & Williams, 2011; Simard & Durall, 2004). In addition, the majority of mycorrhizal fungi evolve parallel with their host plants and have incredibly complex levels of specificity associated with those hosts, also helping promote diversity (Covacevich, Escheverra, & Pagano, 2012; Simard & Durall, 2004). Diversity is the raw material for evolution, and increases the capacity of these networks to adapt to unfavorable conditions, including those that characterize climate changes (Bellgard & Williams, 2011; Cairney, 2000; IUCN, 2011). This diversity is therefore crucial in maintaining plant and ecosystem adaptation for, and resilience amidst, such change.

2c. Biocultural Diversity Processes and Components

As previously articulated, biocultural diversity lays at the intersection of a wealth of both biological and cultural processes and conditions, including language, land, agriculture, human and ecological health, economics, resource extraction, etc (Hong et al., 2014; IUCN, 2011; IUCN, n.d.; Persic & Martin, 2008; Rozzi et al., 2006). One way the links between culture and biodiversity can be understood is through an analysis of the interdependence of the ethnosphere, or the sum total of all thoughts, beliefs, myths, and institutions made manifest today by the myriad cultures of the world; and the biosphere, or the region of the earth's crust occupied by living organisms (Davis, 2001). According to Garibaldi & Turner, the ethnosphere "is born out of the biosphere within which it is situated, but it has its own particular features, history, and development. In its turn, the ethnosphere modifies, manages, and therefore influences the biosphere" (Garibaldi & Turner 2004, 1).

Integral to these ethno/biosphere systems and their interactions is land, which influences both the continuation and preservation of biodiversity, and the generation and transmission of diverse cultures and forms of knowing, particularly within and across Indigenous contexts (Berkes & Folke 1998; Johnson 2010; Simpson 2004; Tuhiwai-Smith 2012). This transmission takes place across multiple temporal and spatial scales, and influences specific practices, processes, and ways of knowing/living within and across each of those scales– including as they pertain to biodiversity (values, stories, interactions, management, etc. (Berkes & Folke 1998; McIvor, Fincke, & Oviedo, 2008; Tuhiwai-Smith 2012). These diverse cultures and ways of knowing and interacting with biodiversity provide room for continual diversification, so long as they continue to be transmitted (Persic & Martin, 2008). Climate change and anthropogenic environmental impacts directly threaten this ability (Elands, 2018; Tuhiwai-Smith 2012).

3. Integration of Concepts

From the broad contextualization of both biocultural diversity and mycorrhizal networks, there emerge many connections between components of each. These include links between culture and plants, biodiversity and soil, and mycorrhizal networks and biocultural diversity. For example, (1) culture thrives and is supported through close relationships with the land, as plants are supported by the nutrients they receive from the soil; and (2) biodiversity supports the generation and transmission of diverse cultures and ways knowing, as soil supports the nutrient transfer and uptake by plants. Both culture/plants and biodiversity/soil conditions are susceptible to environmental changes – particularly those that result from climate change – because of their interdependence on, and specificity within, certain conditions. However, mycorrhizal networks display how this specificity can lead to diversity, enabling adaptation for (and resilience amidst) changing conditions. According to Cairney (2000), "on-going parallel evolution of the partners (within mycorrhizal networks) in response to environmental change on both widespread and more local scales may most readily explain mycorrhizal diversity and specificity" (13).

This concept provides similar insight into how biocultural diversity functions, and why it is important. For example, cultures, particularly of Indigenous communities, are formed from close connection with the specific land and biodiversity they interact with (as plants interact with soil/fungi) (Berkes & Folke 1998; Johnson 2010; Simpson 2004; Tuhiwai-Smith 2012). This close connection enables a wide array of specific ways of knowing and living, practices, etc. to occur and to be transmitted (Berkes & Folke 1998; Simpson 2004; Tuhiwai-Smith 2012). As in mycorrhizal networks, where communication (e.g. plant-fungal-plant) promotes diversity, in biocultural systems, transmission (across spatial and temporal scales) does the same (IUCN, 2011). Both systems rely on continual connection/transmission in

order to sustain this diversity. However, the ability for these systems to connect and transmit is directly affected by climate change impacts (IUCN, 2011; IUCN, n.d.).

Here, the importance of biocultural diversity is elucidated: without mycorrhizal networks, and without biocultural diversity, each respective system would not be capable of adapting to such impacts (Bellgard & Williams, 2011; IUCN, 2011; IUCN, n.d). These systems therefore increase the resiliency of their components, allowing them to survive and diversify despite the impacts of climate change (Bellgard & Williams, 2011; Persic & Martin, 2008). Ultimately, mycorrhizal networks give insights into the complexity with which cultural transmission, diversity, and specificity in connection with biodiversity occur. In so doing, they hint at why diversity is important in promoting adaptive and resilient systems amidst climate change. Insights to be gleaned from the comparison of mycorrhizal networks and biocultural diversity are plentiful. I have only skimmed the surface and have not provided full integration of concepts and their significance. Regardless, it is clear that connections between these systems can be made, and require much more analysis in order to make valuable conclusions about their interconnection.

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Why Canadian Implementation of the 'United Nations Declaration on the Rights of Indigenous Peoples' is Not as Democratic as it Seems

Luzarno Sáqa7 Kage-Thevarge

The 2016 commitment to adopt and implement the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (1) within the Canadian Constitution seems to be perceived by the public to be a landmark moment for Indigenous-Settler relations (Fontaine 2016). However, under further examination of the text of UNDRIP and the surrounding national context it is being implemented in, it is clear UNDRIP does almost nothing in terms of justice and lacks a real sense of democracy by design. Ultimately, the promised implementation UNDRIP is nothing but lip service, a case of further red-washing of settler institutions and impositions on Indigenous peoples.

One definition of democracy is a system in which there is a correspondence between acts of governance and the desires with respect to those acts of the persons who are affected (2). In other words, democracy is a system where people have a say in how they are governed, where they have a sense of self-determination. However, the way that Indigenous peoples are administrated in Canada is done through the *Indian Act* (3), legislation imposed by Canada at a time when the goal was to assimilate Indigenous peoples into colonial society (4). For centuries Indigenous-settler relations have been characterized by what has been strategically defined as 'cultural genocide' instead of 'genocide' in efforts to "avoid legal debate over the applicability of the United Nations Convention on the Prevention and Punishment of the Crime of Genocide" (5). Although there have been amendments to the *Indian Act*, the spirit of assimilation contained within it is still the same as when it was created (4). As there was no consent to be governed by this act, there is an implicit lack of self-determination and therefore no democracy for Indigenous peoples in Canada.

In 2016, Canada removed its objector status to UNDRIP – moving to accept UNDRIP rather than rejecting it within the United Nations General Assembly – which was held since UNDRIP was proposed in 2007 and has now committed to adopting and implementing it within the Canadian Constitution (6). Additionally, the province of British Columbia independently passed legislation to implement UNDRIP, generating overall positive coverage by the news media (7). After all, a United Nations Declaration on the Rights of Indigenous Peoples must be for the benefit of Indigenous peoples whose rights are now to be enshrined in law, must it not? What, otherwise, would be the point of such a declaration if not to uphold the ideals of justice and democracy as the United Nations purports itself to be doing?

Before addressing whether or not UNDRIP is beneficial or representative of just and democratic ideals for Indigenous peoples or Canadian society, we must understand exactly what UNDRIP is meant to be. To put it in few words, UNDRIP is supposed to ensure that Indigenous peoples have rights to practice their traditions, speak their language, hold the land they have often resided upon for millennia, be treated as equals, and most importantly: to give or withhold "free, prior, and informed consent"

(1) for use or development upon their land. This is what Indigenous activists, policy managers, lawyers, and reporters point to when contesting infringement of various actors, including the federal government, on Indigenous lands (8, 9). This acknowledgement and respect for the fact that Canada largely lies on pre-existing Indigenous land is the part UNDRIP that generates the most excitement.

However, there is one glaring problem with this new piece of legislation. That it, why draw the distinction between Indigenous peoples and humans in the first place? Are they not humans already? For if they were, then under the Universal Declaration on Human Rights (UDHR) (10) these rights would have already been protected. Religious freedom, the freedom to speak a language of your choosing, freedom from discrimination, freedom to property and freedom from arbitrary deprivation of this property, are all rights under this declaration. Furthermore, courts have repeatedly proven that Indigenous title preexisted colonization and was not extinguished (11, 12,13,14). If Indigenous title exists, and if UDHR includes all these rights than what, if anything, is UNDRIP doing that UDHR is not? The dominant interpretation in the news sources covering the adoption UNDRIP is that it is a huge step forwards in at least acknowledging there is a disparity in treatment between Indigenous and non-Indigenous peoples. In the eyes of the public, this is being seen as a commitment to changing that by engaging Indigenous peoples as equals in a just and democratic way. They have been led to believe that UNDRIP will bring us closer to reconciliation with its implementation being tipping point where Canada turns away from its unjust policies in the administration of Indigenous peoples.

Now that we have addressed the background information required to understand at least in part what UNDRIP is in comparison to UDHR and what the context of its implementation into Canadian law is, let us examine why none of this will meaningfully change the state of Indigenous-settler relations in Canada. In the creation of UNDRIP, Indigenous peoples were purposefully excluded from providing meaningful input, contrary to the very same rights laid out in the document (15). The document was carefully worded in such a way the prioritized UN member states' autonomy over true justice, with vague terminology giving states the power of interpretation around articles such as Article 46-1 which essentially nullifies the use of any of the other articles in the declaration for:

> "…authorizing… any action which would dismember or impair, totally or in part, the territorial integrity or political unity of sovereign and independent [United Nation member] states" (1).

Of course, the declaration goes on to state in Article 46-3 that:

> "…this Declaration shall be interpreted in accordance with the principles of justice, democracy, respect for human rights, equality, non-discrimination, good governance and good faith" (1).

Article 46-3 is an important addition to Article 46-1, however it still doesn't take away from the fact that limitations can be imposed on these rights by the settler state, if the state, according to its own criteria, decides it's interests are threatened by the enforcement of, or respect for, Indigenous rights. Therefore, because of Article 46-1, the states interests take priority over the rights of Indigenous peoples.

This interpretation is particularly problematic for the fate of Indigenous 'rights'. Recognition of Indigenous rights and serving of true justice involves recognizing the right to self-determination inherent in not only Indigenous rights, but human rights. As Corntassel & Holder said, "decolonization and restitution are necessary… to transform relations with Indigenous communities in the way justice requires… it must begin by acknowledging Indigenous peoples' inherent powers of self-determination" (16, p. 467). Under the current system of government, these rights cannot be acknowledged, as Canada is built entirely upon Indigenous land, and its own ability to engage

in a system of extractive meta-colonization in which individual groups of Indigenous peoples are subjected to the rule of the settler state; they are confined to tiny plots of land amounting to 0.2% of Canada's total land base, (17) of over which they have little real say, governed by a state imposed agency, while resources of their traditional territory are extracted for denser, settler, population centers.

If the state cannot exploit in this way, then it cannot exist in its current form. Thus, Canada does not have to, and will not voluntarily, acknowledge Indigenous rights within this declaration framework, because acknowledgement of Indigenous rights involves dismembering and/or impairing at least in part the territorial integrity and political unity of the state. However, human rights are inherent to democracy, and Article 30 of UDHR (10) makes abundantly clear the United Nations own position on this:

> "Nothing in this Declaration may be interpreted as implying for any state, group or person any right to engage in any activity or to perform any act aimed at the destruction of any of the rights and freedoms set forth herein."

How can United Nations Declaration on the Rights of Indigenous Peoples be perceived to be in any way just or democratic if built into its language and implementation is inequality between Indigenous peoples and humans? This is structural inequality by design and poses Indigenous peoples as second-class citizens within the framework that is supposed to grant them rights. This is purposeful and strategic, with UNDRIP upheld as the solution to the conflict present in Indigenous-settler relations, while doing nothing but further placing the fate of those relations within the hands of the very entity that committed the injustice in the first place, and generating a positive national image of and for Canada.

For this document to be implemented in any just or democratic way, the fundamental structure of Canadian government would have to be changed, or rather, Canada as we know it would have to be dissolved. Democracy, in its root definition as the power of the people, necessitates fundamental respect for the humanity of others, and in respecting the humanity of others justice of some form must be realized, whether that is corrective, correcting a previous status, or distributive, distributing the power that is currently concentrated (18). Neither of these things can be brought about under the current system because, as has been argued so far, Indigenous rights and Canadian colonial practices cannot coexist. Reconciliation efforts, including the creation and implementation of UNDRIP, have been state dominated and state coordinated, perpetuating the power imbalances by controlling when and how reconciliation is brought about (15). This reconciliation often finds itself in the form of hollow and symbolic gestures, where the victims, Indigenous peoples, are forced to reconcile their losses, instead of the state making meaningful reparations (16). Land acknowledgements, to take a well-known example, are often low investment virtue signaling tactics in which few are serious about returning the traditional territories of Indigenous peoples. Users of this tactic ask for approval and legitimization by adhering verbally to protocol of the local peoples, presenting their acknowledgement that the land is in fact stolen, while doing nothing about it for fear of losing their own status as the thieves or beneficiaries of thievery (19).

If a state can override rights in its own interest, then are they really rights? If a democratic action threatens the state, then will the state bend democracy? If all actions towards reparations between the state and the peoples harmed by the state are dominated by the state, is justice ever within reach? With states such as Canada, with such a well-documented history and policy of, at least cultural, genocide (16; 20), it is imperative that we ask these kinds of questions and recall that this settler state stands largely to gain from the extermination, at least of the rights, of the peoples who occupy the land it has settled upon. If the state was willing to do this, is it willing to do something of a similar fashion again?

In light of Canada's numerous accounts past and present of continual, systemic, and systematic undermining of human rights, especially so in the case of Indigenous peoples (5, 21) how could there be any faith in Canada's ability to uphold these 'new' rights as opposed to the 'old' ones? It is within this understanding of UNDRIP and the context it will be implemented in, that it becomes abundantly clear that UNDRIP is not of any real substance, has been misconstrued to the general public, and does little to democratize, or uphold justice in, Indigenous-Settler relations.

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QUEST SCHOLARSHIP SYMPOSIUM

The Quest University Summer Fellows Program provides students the opportunity to do research on campus under the guidance of Quest faculty. Since its inception in 2012, this program has afforded many students the opportunity to explore big questions in the arts and sciences (social and life/physical) both on campus and in the field. This year's recipients of these competitive summer fellowships were Marika Dunham (faculty host: Emma Davy), Jesse Genereaux (faculty host: Jeff Warren), and Mason Pitchel (faculty host: Steve Quane). You will find the abstracts to their projects here. To see more of their projects, as well as past year's projects, please see the Beyond the Classroom section of the Quest University Webiste.

Yours in scholarship,
the Research and Scholarly Works Committee
(Kaija Belfry-Munroe, Emma Davy, Curtis Wasson, and Shiva Sundar)

Landslide Detection at the Mount Meager Volcanic Complex

Mason Pitchel

Abstract:
In 2010, rock slopes above Capricorn Creek at the Mount Meager Volcanic Complex (MMVC) failed in what became the largest landslide in Canadian history. The event caused roughly $10,000,000 in damage, and while no lives were lost, the communities of Pemberton and Pemberton Meadows are still in significant danger of a large runout landslide (Friele et al., 2008). Recent research has identified multiple slopes on the MMVC that are in danger of failing, but one is of particular concern. This slope is approximately 10 x the size of the source of the slide in 2010 and poses a significant danger to the communities of Pemberton Meadows and the Village of Pemberton (Roberti, 2019). Landslides are quite prevalent in the area, especially at loosely consolidated volcanic edifices like the MMVC. Just recently, a large landslide off of Joffre Peak made headlines (CBC, Global News). As we see increasingly warm weather and rapid snowmelt through the spring and summer, we will see an increase in large landslides (Petley, 2019). We will be implementing the first rendition of a seismic monitoring system at the MMVC, using an industry-standard geophone and infrasound system, coupled with a weather station and a camera. Data will be transmitted to Quest via satellite and to an Innergex power plant via radio frequency transmission. This project is collaborative. Our main partners are Weir-Jones Engineering (WJE) out of Vancouver. The geophysical group has offered equipment and a small honorarium. They will be using the system we helped design and install to create a landslide alarm system for an Innergex power plant at the base of the MMVC. The duration of the QSFP was spent organizing donors, securing helicopter time, designing the system, and planning the installation. Once we have installed (early September), we will be using the data to look for correlations between weather trends and landslides/rockfall.

Being Otherwise:
Generating Levinas's Ethical Subject

Jesse Genereaux

Abstract:
Emmanuel Levinas shifts the grounds of metaphysics radically. Instead of placing being and the question of being at the base of all understanding qua existence, Levinas places ethics, goodness and responsibility prior to all. Levinas places the source of the meaning of ethical responsibility in the pre-ontological structure of human subjectivity. In educational theory, according to Guoping Zhao and Claire Katz, Levinas's ideas have been incompletely interpreted. Both theorists suggest that Levinas's ideas provide renewed ground for subjectification as an end of education, something almost all 'Levinasian' educational theorists have overlooked in the past. This research project aims to investigate the problem of producing Emmanuel Levinas's primordial ethical subject. We introduce Levinas and the metaphysics of production, explicate Levinas's ideas and develop a practical way forward in the project of 'Levinasian' ethical subjectification. In short, we concern ourselves here with the generation a good person and the metaphysical-ethical puzzles which arise in such an endeavour within the continental European tradition of philosophy from the 20th century.

You Are What You Eat:
Narratives of the Food System

Marika Dunham

Abstract:
In an attempt to integrate academic theory with practical knowledge this summer fellow project was the creation of an interview style podcast; called Savory. It's about the people and processes behind food production and the politics that shape our understanding of the food system. While the podcast is rooted in critical academic theory, it works to recognize voices outside of academia as valuable contributors to our understanding of the food system. The goal of the podcast was to interview people who are involved in the food system in a variety of ways in order to gain a better understanding of how a person's lived experience shapes their understanding of the food system.

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