WOMEN AND GLACIERS: CHANGING DYNAMICS IN SPORT, SCIENCE, & CLIMATE CHANGE

by

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Mountaineering became a popular, male-dominated, sport in the early 1800's, which both reflected and propagated Victorian gentlemanly ideals of exploration, manly vigor, and scientific discovery. Alpine exploration yielded the study of alpine glaciers, thus the history and heroic rhetoric that came from mountaineering shaped much of the culture of glaciology. Historically women have been discouraged from pursuing mountaineering and glaciology because of pervasive and problematic gender ideologies that held women as domestic, fragile, and non-scientific, on the one hand, and men as adventurous, tough, intelligent, and brave on the other hand. These ideas about women's and men's capabilities are still present and problematic in mountaineering and glaciology today. Despite the deeply engrained gender discrimination in these fields, women have consistently resisted the prejudiced gender dynamics and have successfully reached great heights both in altitude and in their fields even as women often continue to be a minority in some sports and in science. Today there is much debate about the minority of women in sport and science. Given their gendered and interrelated histories, further exploration of mountaineering and glaciology may help inform the current debates about gender in other areas of sport and science.

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I. Introduction

Though seemingly disparate subjects, particular understandings of gender and glaciers are at the center of sport, science, and climate change issues. Women have faced gender discrimination in glaciology and mountaineering since these became popular pursuits in the late 1700's (Hevly, 1996; Hulbe, Wang, & Ommanney, 2010; Mazel, 1994; N. Morin, 1968; Reichwein & Fox, 2001; Rosner, 2009). The extreme nature of high alpine and polar environments made the rhetoric of mountaineering and glaciology heroic and masculine, which made both pursuits the embodiment of gentlemanly activity—exclusively for men (Hevly, 1996). The masculine foundation of mountaineering fed by contemporary gender ideologies created a climate of gender discrimination and exclusion for female mountaineers and glaciologists alike (Chisholm, 2008; Hevly, 1996; Hulbe et al., 2010; Schrepfer, 2005). Due to historical discrimination and exclusion, there still are relatively few female mountaineers and glaciologists (Hulbe et al., 2010).

Although women generally were discouraged from exploring polar and alpine glaciers, some women have consistently resisted patriarchal gender ideologies and exclusion by alpine and academic institutions in order to pursue their passions and connect to alpine environments. Women have had to earn their acceptance in the historically masculine high alpine realms through physical experience on glaciers or high mountains (Blum, 1980; Schrepfer, 2005). For example, Fanny Bullock Workman, an accomplished mountaineer at the turn of the century, believed that "her alpine successes proved sexual equality" (Schrepfer, 2005, p. 73). Unfortunately, in order to have access to glaciers and high altitude climbing women tended to come from

privilege, and they often needed male support from either their family or someone in their field. Fanny Bullock Workman, for example, came from a wealthy family and was encouraged to climb and study glaciers by her husband (Miller, 1984).

The great alpine and glacial accomplishments of women like Fanny Bullock Workman, though enabled by men like her husband, blazed the trail for future women interested in mountaineering and glaciology. The successes of women like Bullock Workman, and other women studied here, affirm that alpine and glacial spaces are appreciated by both men and women through climbing and field study (Blum, 1980; Chisholm, 2008). Furthermore women's alpine and glacial experiences, no matter how extreme, may increase self-assurance and confidence of women's capabilities within individual women (Blum, 1980). This is important, because some women in a patriarchal society and misogynistic sport and science circles also saw themselves fitting into the gender ideologies imposed by men (Blum, 1980). Even women like the celebrated climber Arlene Blum had lurking doubts that women were equally as capable as men at high altitudes and on glacial ice (Blum, 1980).

Physical experience climbing and studying glaciers often quell these doubts about female capabilities in mountain and glacial environments. Mountains and glaciers are special places, because they provide the opportunity to overcome many different physical and symbolic challenges. Regardless of sex, climbing mountains and living on or studying glaciers tests both physical and emotional strength because of extreme environmental conditions like high altitude, sub-freezing temperatures, precipices, and high winds. Women in mountaineering and glaciology have to overcome this physically difficult environment, as well institutional gender ideologies

that tell women that they are not capable of withstanding such conditions (Hevly, 1996). Physically and emotionally transcending both literal mountains and figurative social mountains present women with a unique experience in high alpine spaces. Women like Isabella Bird and Rose Kingsley, climbing the Rockies in the 1870's, and Arlene Blum, climbing in the 1970's to present day, show that some women have felt deep empowerment from their mountaineering experience (Blum, 1980; K. M. Morin, 1999). Blum and Karen Morin, author of "Peak Practices: Englishwomen's 'Heroic' Adventures in the Nineteenth- Century American West," recognize that experience climbing and studying high alpine spaces allowed Blum, Bird, and Kingsley to realize that women were indeed capable of such exertions, and made them question the opposite gender ideologies.

Though gender ideologies are becoming more clear as ideologies and not as biologic truths, the prominence of these ideologies are still affecting women's ability to flourish in mountaineering and glaciology, as well as other areas of sport and science (Blum, 1980; Chisholm, 2008; Hulbe et al., 2010; Kodate, Kodate, & Kodate, 2010; O'Rand, 2004; Smeding, 2012; Zanish-Belcher, 1998). Today, a wide range of literature from sociology, education, women and gender studies, and science focus on gender dynamics in many significant fields such as science, technology, engineering, and mathematics (or STEM fields), athletics, and environmental studies. These gender dynamics concern a variety of actors from academics, to professionals in the field, to people hoping to enter these fields, to policy makers, because there is a marked minority of women in these fields. Not only are academics attempting to understand why many STEM fields and athletics are so male-dominated, but also it is important to think about

the consequences of male-biased STEM areas in the face of climate change. Studying the gender dynamics in mountaineering and glaciology where there has been pronounced male-domination and gender exclusion, as well as pronounced environmental deterioration (like glacier retreat) from climate change, can answer some of these questions and inform investigations of gender inequality in broader categories of sport, science, and climate change.

This thesis is my initial investigation of women's experiences with glaciers in mountaineering and glaciology from the mid 19th century to the late 20th century. I chose this period, because mountaineering rose to popularity as heroic, gentlemanly sport in the mid 19th century and is still popular today. Glaciology is a relatively new science and much of its culture grew out of the founding heroic narratives of mountaineering. In my research, I found very little secondary literature on the relationship between women and glaciers, which I think is largely because of the male-dominated narratives at the origin of mountaineering and glaciology. Thus I chose to investigate the outstanding female perspectives rather then the more prevalent masculine conquest narratives of mountaineering and glaciology. It is essential to understand gender dynamics in these fields and ensuing female relationships for many reasons. One, the relationships between alpine glaciers, early glacier physicists, and mountaineers were so politically charged and had such pronounced gender divides from the outset. Two, the race to understand glaciers and to summit mountains has had international physical and symbolic importance since the 19th century. Three, early interdisciplinary mountaineer and glacier physicist study of alpine glaciers precedes the separated subjects of modern STEM fields, and may inform our knowledge of gender

dynamics within STEM fields today. Four, in the face of glacier loss and deterioration of high alpine environments from climate change, it is important to understand the social and environmental dynamics surrounding these spaces so that we may protect them and fully grasp the idea of their loss.

I drew from a variety of primary sources ranging from memoirs, to videos, to photographs, to advertisements, and secondary literature to try to understand the relationship between women and glaciers in the context of mountaineering and glaciology. This is in part because there was little secondary literature on these relationships, however I pull heavily from the few secondary sources I did find such as Bruce Hevly's "The Heroic Science of Glacier Motion" and Christina Hulbe et al.'s "Women in glaciology, a historical perspective." I build on these works by introducing the female experience to Hevly's article, and by providing historical narratives to Hulbe's. Together the male-dominated, heroic narrative that Hevly mentions, coupled with Hulbe's format of women's experience case studies provide a more complete picture of the gender dynamics in mountaineering and glaciology, and thus the framework surrounding women's relationships with glaciers in these contexts. First I investigated the secondary literature to understand the current academic discourse surrounding this subject. After realizing that the secondary literature was missing the essential piece of women's experiences, I then proceeded to find primary sources or literature on women's experiences with glaciers via mountaineering and glaciology. Looking at papers, journals, videos, biographies, and memoirs allowed me to see these experiences and gender dynamics through women's perspectives.

The paucity of secondary literature on this subject is significant, and I hope that those who are studying gender dynamics in STEM fields and athletics, and those who study human-environment relationships, will take this initial research as a springboard for further investigation of these relationships and their environmental and societal significance.

The thesis is divided into two chapters, where I examine various aspects of these relationships ranging from gender ideologies, to gender discrimination, to outstanding women, to individual's experiences in each field. Both glaciers and gender dynamics run through each chapter, and I will conclude with the general relationship trends shared by mountaineering and glaciology. Finally I will bring these historical trends to the present day by discussing climate change and intentional integration of young women into mountaineering and glaciology.

In no way do I wish to discredit men's experiences with glaciers, mountaineering, or glaciology in this thesis. Both men and women connect to glaciers and other aspects of alpine environments. I am investigating women's perspectives exclusively, because environmental literature, excepting Hevly and Hulbe, has barely explored them. This honors thesis will add to the existing environmental history literature by examining how glacier and gender dynamics wind their way through broader spheres of sport and science, and how climate change complicates the historical relationships between women, glaciers, and alpine environments.

II. Sport: Mountaineering

a) Mountaineering: an exclusive sport

Since it's rise to popularity in the late 19th century, mountaineering has historically been associated with men. Mountaineering, or alpinism, was the gateway to early glaciology. Until recently, women were discouraged from participating in field research and were only grudgingly acknowledged for their accomplishments by key alpinist groups like The Royal Geographical Society and the British Alpine Club (Bell & McEwan, 1996; Blum, 1980; Hulbe et al., 2010; Miller, 1984). The first woman was inducted into the Royal Geographical Society in 1913 and the British Alpine Club included only men until 1955 when Claude Kogan, a female, French mountaineer, spoke there (Bell & McEwan, 1996; Blum, 1980; Hulbe et al.). Since World War II, women have made more significant climbs of the Andes and Himalaya. Despite more recent success in science and mountaineering, women still experience gender discrimination (Blum, 1980).

The contemporary rhetoric and romanticism of mountaineering shaped it as a sport for men. It was seen as an inherently heroic, masculine "part of culture that celebrated sport as one of the distinguishing marks of a gentleman and a route to a disciplined perception of the world" (Hevly, 1996, p. 66). Alpinism allowed men "to have properly perceived and understood nature in part because of the effort they had undertaken—the 'muscular exertion'…Heroism, with its elements of direct action, lonely commitment, and manly risk" (Hevly, 1996, p. 66). Mountaineering's combination of formative athletics and adventure fit in perfectly with exploration of the 19th century. At that time exploration of rugged, uncharted territory, such as high alpine

glaciers, was popular and many countries had international rivalries in discovering and mapping new places. The rhetoric of the early 1800's framed mountaineering as not only essentially masculine, but also too physically strenuous, and too intellectually challenging for women (Hevly, 1996; Schrepfer, 2005). The gendered foundation of mountaineering, and thus glaciology, as I'll demonstrate later in the thesis, has had far-reaching repercussions that are still felt today.

In the mid 1800's, shortly after mountaineering became popular among men, more women challenged the male dominance in the sport. Many Englishwomen pursued mountaineering adventures in the American West, such as Isabella Bird and Rose Kingsley. These women wrote about their experiences, which reveal "a complex array of gendered subjectivities" and personal growth (K. M. Morin, 1999, p. 489). Karen Morin says, "Women climbers claiming places as their 'own,' in the context of the American West, demonstrate not triumph or domination over place, but a particular kind of triumph over self and emotive attachment to place" (K. M. Morin, 1999, p. 490). Women like Bird and Kingsley, helped to develop the idea of the "New Woman" which empowered female climbers, and pushed the restraints of the ideal Victorian woman (K. M. Morin, 1999; Schrepfer, 2005). This "New Woman" discovered her emotional and physical strength, which Victorian ideologies said didn't exist, through activities like mountaineering. Some women like Bird and Kingsley were greatly empowered by mountaineering, because they not only overcame the physical and emotional trials inherent to mountaineering, but also they overcame the imposed limits of Victorian gender ideologies. Through empowering mountaineering experiences, the

some individuals began to reject the gender ideologies and pursued activities that were previously exclusively male.

Though male dominated alpinist societies were often resistant to accept female accomplishments, it is clear that not all men were opposed to women on the slopes. Schrepfer says, "male companions voiced pleasure that the ladies brought to camp their instincts for cleanliness and order" (Schrepfer, 2005, p. 74). Schrepfer maintains that though many men were happy to have their wives and nieces along on expeditions, the women filled very domestic roles even in the wild. The resulting gendered expectations shaped women's roles in the field as domestic. These gender ideologies are problematic because the resulting gendered expectations, which shaped women's roles in the field: limited to domesticity while men reaped the benefits of exertion and discovery.

Challenges to gender ideologies also appear in women's climbing dress code. Because women were relatively new to climbing in 1901, The Mazamas, the first mountaineering organization in the Pacific Northwest, published an article devoted to women's climbing apparel. The brief article says,

> **Women Climbers:** 'Avoid wearing too much clothing, as it occasions fatigue. Dress with light, warm underclothing, woolen bloomers, good sweater, heavy hose, leggings, and very strong shoes, provided with loggers' calks/ The soles of such shoes should be half an inch in thickness. Every effort will be put forth to asssit [*sic*] the ladies, but they should do all they can before starting to provide for their own comfort and convenience' (Mazamas, 1901, pp. 14-15).

As seen in Figure 1, women's mountaineering apparel in the late 1800's to early 1900's was relatively gender neutral. Women wore knee-length, loose fitting pants accompanied by knee-high gaiters. This outfit was shocking, and revolutionary in a society where women were expected to wear long skirts. This cover art is particularly

interesting because of its gender neutrality, which suggests total climbing equality. Though it is true that gender equality in mountaineering was increasing in the early 1900's, there are still traces of gender ideologies that undermine women's equality in mountaineering today.

Figure 1. Cover of "Mazama: A Record of Mountaineering in the Pacific Northwest" *Mazama*.

Along with the great thrust of the first feminist movement in the early 1900's, women climbers reached new levels of acceptance. Eyla Louene Walker's "The Three Sisters with the Mazamas August 1916" confirms that more ordinary women shared in

mountain climbing experiences alongside men. The photos she includes in her memoir show men and women clambering across Sisters' glaciers together in relatively equal numbers, Figure 2 below. Walker's memoir presents summer mountain sojourns as a treasured vacationing option for families in the early 1900's. Walker and her parents stayed at Camp Riley at the base of the Three Sisters with many other families during August of 1916. Though "there were many different ascents of the three mountains made during the two weeks, by parties varying in number from two to fifty" and many women participated, only a party of experienced alpinist men were able to summit North Sister (Walker, 1916).[1] This suggests that though women were climbing higher peaks and subsequently higher levels of social equality, they still did not have access to the most difficult peaks.

[1] Walker did not include page numbers in her memoir, so I have not included any page numbers in my citations of her work.

Figure 2. Women and men on a glacier on South Sister.

Walker, Eyla Louene. "The Three Sisters with the Mazamas August 1916." Coll 403 Mazama Records. Accession 90.16. University of Oregon Special Collections.

Though alpinist societies eventually encouraged more women to accompany men on mountain expeditions, they were often objectified and pigeonholed into ideological gender roles. These gender ideologies, even in exceptional places like high mountain environments, still persist to this day. Members of gentlemen-founded alpinist societies often reacted to great female achievements with indignance (Bell & McEwan, 1996; Miller, 1984). In addition to gender, privilege was also a general constraint in the pursuit of glaciology and alpinism—both men and women with little money couldn't afford these activities, so privilege helped women break gender barriers. Only women who came from wealthy and supportive fathers or husbands were able to fulfill their dreams as scientists and climbers. Even with the support from her husband, Fanny Bullock-Workman is a perfect example of the "unremitting struggle" to

gain acceptance in the masculine field of mountaineering (Miller, 1984). Miller cites J.P. Farrar who wrote "In Memoriam: Mrs. Fanny Bullock-Workman" after her death. He describes her as a,

> very doughtry fighter…She herself felt that she suffered from 'sex antagonism' and it is possible that some unconscious feeling, let us say of the novelty of a woman's intrusion into the domain of exploration so long reserved to man, may in some quarters have existed (Miller, 1984, p. 127).

Millers says, "Perhaps her greatest victory was breaching that masculine province of the ultimate recognition, the Royal Geographical Society in 1905, she was the second woman to do so since its founding in 1830 (Miller, 1984, p. 127). It was extremely difficult for women like Fanny Bullock-Workman to be accepted as equally capable in a masculine field, even though they achieved both athletic and intellectual greatness. Bearing in mind the gender bias that rejected women's alpine achievements, the women who were successful mountaineers were very much empowered by their experiences on the glacial ice.

Arlene Blum, a renowned name in both biophysical chemistry and in women's mountaineering, was told by one of her climbing guides that "'there are no good women climbers. Women climbers either aren't good climbers, or they are real women'" (Blum, 1980, p. 1). Blum also mentions that she

> Received an advertisement for a commercial climb of Mount McKinley, on which 'women are invited to join the party at base and advanced base to assist in the cooking chores. Special rates are available. They will not be admitted on climbs, however.'… women are a liability in the high mountains: they are not strong enough to carry their share of the loads and lack the emotional stability to withstand the psychological stresses of a high-altitude climb (Blum, 1980, p. 1).

This commercial from the 1960's manifests the same gender expectations of women mountaineers as in the mid 1800's. They were appreciated for their domestic value, but not for their value as athletes. These gender expectations are problematic, especially because they reproduce gendered ideologies that encourage women to only appreciate their domestic side and to doubt their muscular and emotional capabilities.

Sometimes, men approached female alpine accomplishments and audacity with more threatening remarks than pigeonholing women into domesticity. Irene Miller, a friend and fellow climber of Blum, was told, "if you want to climb with the expedition, you ought to be willing to sleep with all the men on the expedition" by a man who opposed her presence on an expedition in 1961 (Blum, 1980, p. 2). This example goes even farther than problematic gender ideologies; it objectifies women as only worthwhile sexually and borders on sexual violence and harassment. It was certainly a threatening statement that was meant to make Miller doubt her modesty and to discourage her from joining the party via intimidation.

b) Exceptional female mountaineers

Though the prevailing paradigm held that women were not as capable of mountaineering and glaciology as men, early female explorers such as Nina Mazuchelli and Fanny Bullock-Workman physically climbed to transcend misogynistic limits. Nina Mazuchelli was one of the very first female alpinists interested in glacier exploration in the 1870's and 1880's. Mazuchelli proclaimed herself the first women to explore the eastern Himalaya, and said, "'the perpetually snow-clad mountains of the Kanchenjunga group…it is therefore our intention to cross the range of intervening Alps till we reach their base, and explore the glaciers'" (Miller, 1984, p. 27). She was carried

up mountains in dandies and basket chairs, and kept to smaller, less dangerous, peaks, which illustrates how weak women were considered (Miller, 1984). They could not walk up high elevation peaks by themselves—they had to be carried. However, by 1898, roughly 30 years later, Fanny Bullock-Workman was climbing mountains and exploring glaciers with her own two feet—evidence of greater appreciation of women's physical and emotional stamina.

Fanny Bullock Workman was an extremely successful early mountaineer, who climbed higher than any previous woman. Bullock Workman shared her climbing career with her husband Dr. William Workman. She was enticed by unmapped glaciers, and in 1908, she and her husband succeeded in traversing the Hispar and Biafo glaciers, totaling seventy-five miles of ice travels (Miller, 1984). This feat was yet another record for her, on top of the record she set the previous year: "'the only woman who has made the first ascent of one of the great Himalayan glaciers or any other of equal size'" (Miller, 1984, p. 123). Together she and Dr. Workman wrote eight books "chronicling their adventures in Europe, North Africa, India and the ice-wilds of the great Karakoram and Himalayan mountain ranges" (Miller, 1984, p. 101). So, unlike previous women mountaineers, she had the full support of her husband, which facilitated her great achievements.

In addition to climbing vast glaciated peaks, Bullock Workman contributed to the field of glaciology. She and her husband explored and mapped glaciers in Baltisan in 1911, they employed topographers to make detailed glacial surveys of Hispar, and over the years they organized and helped conduct scientific studies of the ice (Mazel, 1994; Miller, 1984). Luree Miller says, "The Workmans continued to make their

scientific studies with complete confidence…They studied the structure, movement, and particular phenomena of ice and glaciers, and the nature and development of ice pinnacles" (Miller, 1984, p. 124). On her 1912 expedition to Siachen Glacier, Bullock Workman writes, "Dr. Hunter Workman accompanied me…this time, in charge with me of commissariate and as photographer and glacialist, but I was the responsible leader of this expedition" (Miller, 1984, p. 125). Not only was Fanny Bullock Workman a leader for aspiring women alpinists, but also she was a distinguised expedition leader, and a pioneer in glacier field research. In addition to her leadership, Bullock Workman was climbing over 17,000 feet—an incredible feat of athleticism. Fanny Bullock-Workman climbed the highest physical and metaphoric mountains in the world. Her incredible athleticism and leadership, in addition to the challenge of being a woman in a man's sport, helped to empower future women in the sport and science.

A more recent exceptional group of women is Arlene Blum's ten-woman team—the first all-American, all-woman team to climb Annapurna in Nepal in 1978. At 26,545 feet, Annapurna is the tenth tallest mountain in the world and also one of the deadliest (Blum, 1980). The expedition was a great success with two of the ten women reaching the summit. Though two women died and only two summitted, everyone in the group felt equally exhilarated and successful. The following quotation traces the reaction of seeing the summit team reach the top.

> At the lower camps, where there was a clear view of the summit, Christy and Joan hugged each other and danced around shrieking, 'Incredible, marvelous, fantastic!' The film crew at Camp I was also terribly excited…Dyanna broke into a sweat but continued to film…Dyanna stopped just long enough to hug Marie, scream, and jump up and down…[Christy] nodded her head yes, and I sat down in the track and cried. It was a mixture of triumph of having reached the summit, relief at having made it across the avalanche slope…most of all, joy in knowing

> that a woman's place was indeed on top—after all the years of planning and preparation, we had climbed Annapurna. (Blum, 1980, pp. 215-216).

In the preface to her book about the expedition, *Annapurna: a woman's place*, Blum clearly emphasizes, "We did not organize the Annapurna expedition to prove that women could climb high mountains. We knew that before we began. But the publicized success of the venture brought the message to people all over the world" (Blum, 1980, pp. xi-xii). Besides having an excellent climbing repertoire these women also all held high-powered academic professions. With the help of volunteers the team raised all the funds for the expedition from volunteer donations, benefit events, and t-shirt sales, and fought for expedition approval by the American Alpine Club (AAC).

Like Fanny Bullock Workman, Blum's expedition 63 years later faced gender discrimination. According to Blum,

> The AAC hesitated and hedged for several months…men's expeditions with less-experienced leaders and climbers were routinely approved. But the AAC had never previously approved an all-woman expedition and apparently was reluctant to do so. This lack of support in the mountaineering establishment for women's climbing is not a new story (Blum, 1980, p. 7).

Though the team was eventually approved, the AAC said that they had "'to be more careful approving a women's expedition...There would be a lot of bad publicity if things didn't go well" (Blum, 1980, p. 8). Even with greater experience, women were not trusted to succeed in extreme conditions. Hidden gender ideologies suggested that women were too delicate to face high altitude climbing, and were too cherished to be lost. Also alpine societies, which had playful international rivalries didn't want to lose their reputations on risky female expeditions.

d) Trends in emotional transcendence and self-actualization

Mountaineering is an intersection between emotional identity and reverence, and the physical act of climbing, exertion, and proximity to nature. Climber Lynn Hill describes climbing as "a way of embodying freedom that all (climbers, readers) can grasp, even women who have never dreamed of climbing and especially women who want to climb but are intimidated by the masculine domination of the sporting world" (Chisholm, 2008). This intersection of physical and emotional transcendence, especially in the presence of gender discrimination, can be deeply empowering for women. Thus by climbing, women physically and emotionally transcended sexist limits. Fanny Bullock Workman, affirms this by claiming, "her alpine successes proved sexual equality" (Schrepfer, 2005, p. 73). Later in 1975, after seven Chinese women climbed over 8,000 meters on Mount Everest and one of them reached the summit, the Chairman Mao Tse-Tung stated, "Times have changed, and today men and women are equal. Whatever men comrades can accomplish, women comrades can too" (Blum, 1980). So, though mountaineering was an extremely gendered field, the women who participated in it were empowered by prevailing over both the physical stress and the societal stress of climbing.

Each mountain expedition is an opportunity for personal self-actualization, and for broader significance for gender equality. Arlene Blum emphasizes the greater meaning behind women's alpine achievements with,

> We all experienced the exhilaration, the joy, and the warm camaraderie of the heights…But as women, we faced a challenge even greater than the mountain. We had to believe in ourselves enough to make the attempt in spite of social convention and hundred years of climbing history in which women were usually relegated to the sidelines (Blum, 1980, p. 9).

Here Blum acknowledges both the personal and the gender equality gains that mountaineering provides. The act of climbing a mountain is a positive feedback system: women who achieve greatness through mountaineering feel personally empowered, which in turn gives them confidence to continue achieve personal greatness. Exceptional women earn more equal recognition, and therefore contribute to gender equality. Annie Peck, an early climber and rival of Fanny Bullock Workman, reiterates this point by describing herself as, "a firm believer in the equality of the sexes…any great achievement in any line of endeavor would be an advantage to my sex" (Blum, 1980; Peck, 1912, p. 4).

Eyla Louene Walker isn't as exceptional as Blum's Annapurna team, Fanny Bullock Workman, or her rival Annie Peck, nevertheless her moment at the summit of South Sister also has personal significance and far-reaching significance for women in general. Once at the top and over her initial exhilaration of self-actualization she shares,

> The last stretch of red lava, which often takes one backwards a few steps, seemed almost endless, but at last it was conquered and we came over the rim of the extinct volcanic crater. For the South Sister contains in its summit a perfect crater with a rim of rock around its edge. The crater is probably filled to a depth of several hundred feet of ice, and the snowfield covers many acres. To the west side were two small depressions or lakes, of the most marvelous blue. Such exquisite bits of color, there in the very top of the world in the vast field of pure white snow! (Walker, 1916)

On a micro scale, Eyla Louene Walker becomes aware and appreciative of her inner strength and her outer surroundings: the Three Sisters wilderness. Her physical connection the "red lava", "the marvelous blue", and "the vast field of pure white snow" fosters a deep emotional connection to herself and her environment (Walker, 1916). A

connection so deep that she wrote a memoir in commemoration of her time spent with the Mazamas. On a macro scale, her experience is similar to many women climbers, and to the struggle for gender equality as well. "The last stretch of red lava, which often takes one backwards a few steps, seemed almost endless, but at last it was conquered and we came over the rim of the extinct volcanic crater" (Walker, 1916). The red lava which takes hikers a half-step back for every step forward is reminiscent of the women climbers seeking equality on the slopes, and women in general seeking gender equality through feminist movements.

Often women find the pinnacle moments of self-actualization and recognition in reaching mountain summits. Arlene Blum was inspired to assemble an all-woman team to climb Annapurna by an all-woman trip up Mount McKinley.

> I had taken part in a previous all-woman expedition—an ascent of Mount McKinley in 1970—and it had been my most satisfying climb so far. Before the trip we had been told that woman [*sic*] were not physically strong enough to carry heavy loads, that we didn't have the leadership experience and emotional stability necessary to climb the highest mountains. But the McKinley climb turned out to be a wonderfully lighthearted adventure. We felt as though we were climbing our mountain 'without the grownups,' and we successfully handled some difficult problems. When the six of us stood on that Arctic summit on July 6, 1970, my belief that women could climb the highest mountains was confirmed (Blum, 1980, p. 9).

Interestingly, Blum shows that she also fell under the common ideology that women were not as able to climb high peaks as men. Like the men in alpine societies, she needed the proof of the summit in order to confirm her belief that women indeed belonged on the highest peaks. This quotation shows how instrumental the self-actualization achieved at summits can be for women. In this case it gave Blum the trust

in herself and her fellow female climbers to make history and take on one of the most difficult and deadly expeditions—Annapurna.

In her memoir, Eyla Louene Walker shares her empowering moments from climbing South Sister. Reflecting on her experience at the summit she says,

> This was the first peak I had ever climbed and when I finally ascended the last rim of rock, caught my breath, and looked into the distance, I realized at once why I had spent those hours of hard labor in order to reach that spot. The other members of the party had all seen such sights many times before, so I simply held my breath again and marveled at the wonderful distances stretched out before me: to the north were five snow-capped peaks; to the south six others; to the west the wooded valley of the McKenzie and tier upon tier of green foothills; to the east, the yellow grain fields of Eastern Oregon. What a marvelous earth this is that we live on! (Walker, 1916)

As Walker reaches the pinnacle of South Sister, she also reaches the pinnacle of self-actualization. Literally, she overcomes the immense physical and emotional struggle of climbing the mountain and revels in the surrounding scenery from the summit.

Mountain summits aren't the only alpine inspiration for emotional transcendence; glaciers along the climb are often sources of such natural reverence as well. Walker's memoir is filled with photographs of glaciers from her many hikes during her stay at Camp Riley. Walker demonstrates such amazement with, "Our party kept to the rocks and so missed seeing some beautiful glacial crevasses. Looking down in to the depths of these great cracks and caverns the blue of the ice becomes more and intense until it turns to black" (Walker, 1916). Though her party avoided the largest glaciers they "traversed Collier glacier, and took a peak into some of the smaller cracks" (Walker, 1916). Walker's description of the ice's intensity illustrates her interest in them, and portrays their mysterious and captivating qualities.

It is easy to see why glaciers were a major source of inspiration for early mountaineers: they were both numerous and vast. Walker's photographs of the Three Sisters are much more snow covered, even in August, than they are today. With so much perennial ice around, glaciers were ready sources of awe-inspiring nature. Today, with climate change melting away glacial ice, these sources of emotional transcendence are disappearing. This begs the question, what effect will glacier recession have on women who have historically been touched and empowered by them? Will glaciers touch women in different ways as the ice becomes more and more scarce?

e) From mountaineering to glaciology

As mountaineers climbed into the high alpine peaks, they began to explore the awe-inspiring glacial ice in those environments. Thus it is likely that the male-dominated culture of mountaineering influenced the culture of alpine glaciology (Hevly, 1996). In this chapter I explored the history of gender dynamics, specifically women's experiences, in the sport of mountaineering. This culture has historically been exclusive—only tolerant of educated men of privilege, and intolerant of women because of the contemporary gender ideologies. Glaciology, a scientific extension of alpinist exploration, shares many of the same gender dynamics and ideologies. As the next chapter will argue that women in glaciology have faced similar discrimination and exclusion from academia as women faced in mountaineering. Such discrimination and exclusion results in women representing a minority of both alpinists and glaciologists today (Hulbe et al., 2010).

III. Science: Glaciology

a) Background on women in science

There is extensive literature on women's participation and acceptance in academia and science. Although the reasons for the problem are subject to debate, it is clear that women are underrepresented in the scientific community (Taasoobshirazi & Carr, 2008). The major issues being discussed by scholars in sociology, science, and women and gender studies, are the minority of women in math-intensive fields, the influences of gender stereotypes, and "the leaky pipeline" phenomenon.

Culturally constructed gender stereotypes are a potentially explain the absence of women in science and math departments. Studies, such as that of Jocelyn Steinke et al, have shown that "mass media perpetrate traditional views of women that may influence children's perceptions of women in science, engineering, and technology" (Steinke et al., 2007, p. 36). These stereotypes can not only deter women from entering science fields, but also can be very detrimental to academic performance. Based on studies in Germany and North America, "gender-STEM stereotypes have the potential to undermine girls' and women's self-perceptions of ability, performance and interests in pursuing a career in counter-stereotypic (masculine) disciplines" (Smeding, 2012, p. 617). Gender stereotypes cause low self-confidence in math and science, and therefore foster a more dominant male presence in such fields. Such trends create a self-perpetuating cycle and indeed render science and engineering as masculine domains.

An underrepresentation of female perspectives should concern people because half of the world's population does not have a voice in influential math, science, and technological fields, which often study and determine the health of the planet. This is a

problem with both scientific and social repercussions. Science loses 50% of the world's intelligence and input. Socially, these fields have a lot of political influence and maintaining male-domination in these areas upholds persistent, institutional gender inequality. The lack of women entering the math-intensive fields, and the trend of women quitting these fields during their careers concerns many academics and professionals. The leaky pipeline is the phenomenon that women are more likely than men to fall out of the science pipeline (or quit their careers) before obtaining tenure at a college or university, especially in fields like physics and engineering (Goulden, Mason, & Frasch, 2011). Scholars in STEM fields, sociology, and women and gender studies wonder: why are women more likely than men to drop out of hard science careers, is it because of discrimination, media, and/or family influences? Academics are examining policy and education as potential sources of the leaky pipeline. A current debate in the education field is whether the dearth of women in science and math-intensive fields is due to individual or institutional problems. Such institutional problems include the difficulty of being a mother and maintaining an ambitious career such as science or mathematic academia. It is generally agreed upon by education scholars and professionals within STEM fields that the issue is institutional, and must be addressed by changing current educational and institutional policies to be more female friendly. Some women who do stay in STEM fields through tenure have faced gender discrimination by their colleagues and by journals.

Though women are still a minority in many STEM fields, there have been phases of growth associated with movements, such as in the 1940's with post-World War II 'big science' and in the 1960's with the women's movement. Despite such

phases of growth women have still had to make their own publication forum (Zanish-Belcher, 1998). Tanya Zanish-Belcher, the curator of the Archives of Women in Science and Engineering at Iowa State University says, "although society is more tolerant of women in science and their numbers in science professions have risen, that fact is not reflected in the traditional mainstream journals, with the exception of *ISIS*" (Zanish-Belcher, 1998, p. 212).

The literature indicates that other STEM fields and glaciology have similar gender dynamics. Like other STEM fields, the majority of modern glaciologists are men, and some women in the field terminate their careers before reaching tenure. The history of gender dynamics in mountaineering and glaciology, which I will discuss more in the next section, institutionally excluded women from the outset. The result of this exclusion along with the gender ideologies in the early 19th century may still linger in glaciology today. Therefore the history of gender dynamics in mountaineering and glaciology could reveal the cause of the male domination in the field, and, perhaps, could shed light on the gender dynamics in other STEM fields. Such information is important for glaciologists, for educators, for those who study women in science, and for future women who wish to enter the field.

b) Women in glaciology

In addition to mountaineering, women experience glaciers and glacial retreat through academia and science.[2] Though the field of glaciology is still male-dominated, women's presence has grown substantially since the 20th century, and it wasn't until the

[2] Glacier retreat is a state of imbalance, where glaciers lose ice mass more rapidly than they offset the melt with snow accumulation. This results a net loss of ice, or glacier shrinkage.

1980's that women were published notably in the *Journal* and *Annals of Glaciology*, however for a vast minority of publications. The proportion of publications by women in the International Glaciological Society has grown from 5% to still below 20% in 2010 (Hulbe et al., 2010). In the western world, as opposed to the east, women tended to experience more sexism and weren't accepted in the sciences and especially in field research in glaciology (Hulbe et al., 2010).[3] Men felt that women weren't able to withstand the physical demands of polar research, and that their minds weren't scientifically creative enough.

As discussed in the previous chapter, modern glaciology was born out of early mountaineering and geographical expeditions of glaciers. Mountaineering became very popular in the 1800's, especially among British gentlemen. The dominant paradigm of mountaineering was that of manly vigor and sportsmanship. John Tyndall's, an early glaciologist in the second half of the 19th century, "account of his first ascent of Mt. Blanc demonstrated the qualities of manly vigor that made mountaineering a proper Victorian sport, which made the scientist a sportsman" (Hevly, 1996, p. 79). This view was shared by other famous glaciologists of the time such as James David Forbes, John Tyndall, and Leslie Stephen, all three of whom emphasized the importance of first hand experience with the glaciers. In either 1839 or 1840 Forbes wrote an unpublished article, which stated that the benefits of mountain experiences were,

> 'most emphatically available to men' although women could appreciate the beauties to be found in the mountains…educated men were more in need of both the uplift and relaxation provided by travel, and also better able to grapple with the rigors of these explorations…Forbes saw manly

[3] I realize I draw heavily from Hulbe et al. in this section, because I found no other articles on women in glaciology. This is highly significant, because though gender dynamics in glaciology are rather extreme, the subject draw relatively little academic attention.

> travel as a refining influence, sharpening the faculties of observation and strengthening the character. These general attributes of manliness…were essential in all aspects of a scientific observer's experience (Hevly, 1996, p. 82).

Women were believed to enjoy alpine vistas, but were not encouraged to exert themselves strenuously or put themselves in danger, both of which were associated with high glaciers. Forbes, Tyndall, and Stephen were widely published alpinists and glaciologists who believed that valid glacial research was done in the field on glaciers. Since women were discouraged from climbing high peaks and traversing glaciers, this made valid glaciology socially inaccessible for them. Bruce Hevly articulates that

> Field sciences such as glacier physics were 'gendered' not only by the exclusion of women, but by incorporating ideas about appropriate manly characteristics within male-dominated scientific cultures…Excluding women from the ranks of mountaineers did more that physically exclude them from participating in glacier research. It marked them as unable to participate in a distinctive act of perception
>
> (Hevly, 1996).

This discourse not only discriminated against women alpinists, but also set up a climate in the field of glaciology that held men as innately more capable glacier scientists than women. This gendered environment made glaciology a difficult field for women to participate in through the late 1980's—indeed, to this day women are underrepresented in glaciology and other physical sciences.

The earliest women polar and glacial researchers were the wives of scientists and ship captains. Abby Jane (Wood) Morrell's journal was the first woman's own account of the sub-Antarctic. She was the wife of Captain Benjamin Morrell aboard the *Antarctic* (Hulbe et al., 2010). Hulbe et. al. cite her journal, where she illustrates the contemporary paradigm of women in science.

> The great difficulty we women feel in collecting information, is the want of order and classification of our thoughts…I doubt whether a scientific observer would have had more thoughts than passed through my teeming brain; but he would have known how to arrange them, and have drawn conclusions tending to establish known truths, or elicit new ones…the unstudied and unpracticed mind, however, observes many things that might escape the notice of the best educated.
>
> (Hulbe et al., 2010, p. 947).

This entry reveals the gendered nature of science during the 1800's because "he would have known," "the scientific observer" is unquestionably male. Also, it is clear from this passage that even she, as a woman, believes that she is less capable to come to accurate scientific conclusions than a male scientific observer. However, she challenges the ideology that men are innately better observers than women, by "doubt[ing] whether a scientific observer would have had more thoughts than passed through [her] teeming mind." Through her experience observing glaciers, she had the confidence to give herself credit for her astute, and involved observations and scientific musings that might indeed surpass a man's with "the unstudied and unpracticed mind, however, observes many things that might escape the notice of the best educated."

c) Outstanding women in glaciology

Edith M. Ronne, or 'Jackie' Ronne, and Jennie Darlington also accompanied their husbands to Antarctica for the winter. They both followed the gender order of the era, though "Jackie Ronne was an active participant in the work of the expedition, filing news reports of the team's progress, learning to operate the expedition's seismic observation equipment, and making tide height observations" (Hulbe et al., 2010, p. 947). They were not only the first western women to winter in Antarctica, but Jackie

Ronne was an active participant in scientific proceedings. However, Jackie Ronne was not conducting her own research, but was taking direction from the men in her party.

In more recent history, professional women glaciologists were often dismissed from their first research applications, and had to seek out acceptance into research programs internationally. Christina Hulbe et al. detail the professional careers of several female glaciologists like Kathleen Lonsdale, Almut Iken, Elizabeth Morris, and Kumiko Goto-Azuma in attempt to understand the current climate of gender equality in the field.

Though there were surges of women in the polar science and glaciology domain, the gender ideologies of women as homemakers endured (Hulbe et al., 2010). For example, many women found it easier to integrate themselves into male-dominated polar academia and research during World War II (Hulbe et al., 2010). However many glaciologists encountered a climate that discouraged women from continuing in field research after the war, when women were encouraged to return to the domestic sphere and raise families.

The "leaky pipeline" is the notion that many women in science fall out of their careers before reaching graduate degrees or tenure (Goulden et al., 2011). Hulbe et al's case studies make obvious the source of "the leaky pipeline" in glaciology. All the women studied had to fight for acceptance in the field. As seen in Dr. Kumiko Goto-Azuma's case, examined below, it is quite an achievement to be "one of the 11 women out of every 100 scientists in the Japanese workforce" (Hulbe et al., 2010, p. 958). This fact clearly illustrates the idea of "the leaky pipeline": the majority of women who enter

the field do not gain tenure, nor engrain themselves as a permanent part of the workforce.

As in the fields of math and science in general, family formation is a source of leakage in the glaciology pipeline. Hulbe et al's case studies examining successful women glaciologists spanning from the beginning to the end of the 20th century expose commonalities between the women. Like Fanny Bullock Workman, they all came from affluent, educated families, who supported their pursuit of higher education. Not all of the women studied were married or had families. All the women who did marry were supported by their husbands, who were usually also in the field (Hulbe et al., 2010). Importantly, they all agreed that family impedes research. This is seen in Kathleen Lonsdale's application for a research grant for the 1851 Exhibition Fellowship from the British Crown. Her application was denied because "they would be breaking the spirit of the regulations in awarding an exhibition to a married woman" (Hulbe et al., 2010, p. 950). It is clear that when Lonsdale applied for this award in the mid 20th century, the British Crown expected a married woman to be fulfilling her familial duties rather than researching. More recent testimonies from female glaciologists and other STEM specialists suggest that professional women still are expected to prioritize domesticity over professional development. In other words, they are more obliged to prioritize their families over their work.

Like in many science fields in the 1940-60, many women were rejected from participating in glaciological field research and denied grants on the grounds that they were female. This exclusion had two primary reasons for existence, one, that male-dominated fields were prejudiced against the academic capabilities of women, and two,

that women were deemed physically incapable of field work in harsh glacial environments. Elizabeth Morris, a British glaciologist in the 1970's and 80's, also experienced sex discrimination early in career because of her gender. Hulbe et. al, say that Morris' application for posts with Scott Polar Research Institute (SPRI) rejected her because she was a woman, and the related work in the poles was considered unsuitable for women.

Though women glaciologists faced varying levels of sexism from their male colleagues, they all shared a deep-rooted passion for their work, and with diligence and patience overcame discrimination and went on to have extremely successful careers in glaciology. Though Almut Iken faced some gender discrimination early in her career, she went on to be extremely successful and influential in the field of glaciology. Hulbe et. al. believe that her work on glacier flow and her discovery of a temperate layer of ice in Greenland "fundamentally changed the understanding of Arctic glaciers" (Hulbe et al., 2010, p. 956). Similarly, with persistence Morris became the first woman to join a BAS field team, and in 2003 was awarded the Polar Medal for her contributions (Hulbe et al., 2010). Hulbe et. al. include a personal communication with Morris where she says, "there were an awful lot of women around who were trying to do the same I was trying to do. You could be shot down at any time but, by chance, I wasn't. I wasn't shot down as I rushed out of the trenches" (Hulbe et al., 2010, p. 957). So, though Iken and Morris faced prejudice early, they were undeterred and eventually were recognized for their insights and contributions.

Dr. Kumiko Goto-Azuma also embodies the tenacity that women need in order to stay in the gendered field of glaciology. Like the women mentioned above, "despite

an institutional culture that did not readily accept female scientists," Goto-Azuma " set aside the harassment and lack of respect that greeted her intrusion into what was a male domain, and was willing to wait out the long cycle of postdoctoral and temporary positions common for female scientists in Japan" to complete her PhD on lattice defects in 1986, to be appointed Associate Professor at the Japanese National Institute of Polar Research (Hulbe et al., 2010, p. 958). It was only because of her patience that she was able to battle sexism and attain her place in the field. Thus, successful glaciological field research is empowering because not only must women achieve academic greatness, but they must also persist through gender bias.

Dr. Ruth Hopson Keen is a local example of an outstanding glaciologist whose work is still relevant today. Keen wrote her dissertation on the retreat of Collier glacier. Collier glacier was once the largest glacier in Oregon and resides on the saddle between Middle and North Sisters in central Oregon. Keen took a dynamic approach to her investigations of Collier glacier. She performed field observations of the glacial lake, stream, and moraines, as well as photographing the glacier from the same points over the course of several years. These observations allowed her to determine the melt patterns of the glacier and are still important to glaciological research of Collier today (Broadcast, 2012). She also corresponded with Carey R. Martin, who participated in an expedition to Collier glacier in 1882 with the University of Oregon's geology department (Keen). Martin provided her with historical experience of the glacier and how substantially it had retreated since his first visit. Keen's in-depth and multi disciplinary approach and subsequent expertise of Oregon glaciers earned her national recognition in glaciological circles and publications (Keen).

Hulbe et al.'s case studies demonstrate social and professional pressures that perpetuate women's hesitance to enter and/or to continue pursuing the field of glaciology. For example, Kumiko Goto-Azuma was told "'there was no way that woman can be a professional scientist'" by her high school counselor (Hulbe et al., 2010, p. 957). Experiences such as Goto-Azuma's are evidence for the notion that cultural gender ideologies discourage women from entering science fields such as glaciology.

d) Activism and global trends

Gender discrimination in glaciology hasn't gone unnoticed, and some glaciologists, both male and female, have taken on activist roles. A few have spoken out against sexism in the field such as Kathleen Lonsdale, who contributed to a Royal Society report in 1957 that recognized the prejudice against women in science education. Hulbe et al. say, "The report was suppressed by the President of the Royal Society" (Hulbe et al., 2010, p. 950). Other women, such as a group of Russians, have taken on additional leadership roles by helping to establish high-altitude glacier stations in the Tajikistan Pamir Mountains, on Elbrus Mountain in Caucasus, and in the Polar Ural Mountains (Hulbe et al., 2010). Women are not the only advocates for gender equality in glaciology. Men like Professor Colin Bull helped women, such as Almut Iken, find a place in field research. It is professionals such as Dr. Bull, and the dedicated husbands of female glaciologists who help to make the great female achievements possible, which in and of itself demonstrates how male-dominated the field truly is.

Gender discrimination in glaciology, though widespread, is not a global phenomenon. Russia, for example, is known for accepting and promoting women in science and glaciology since the late 1850's. The Russian Nihilist movement fostered women in science at Russian universities, however they could only audit classes at first. After 1861, when Tsar Alexander II put down student demonstrations, Russian women flocked to Western Europe, chiefly Switzerland, to attend university without an entrance exam (Hulbe et al., 2010). During the International Geophysical Year (1957-58) and the following decade, many new opportunities arose in Soviet snow and ice research, and women were active in planning, operations, and data analysis. Women were well represented in the field, in national committees, and in project leadership, though as was typical of the time, women did not go ashore in Antarctica (Hulbe et al., 2010). According to Hulbe et. al. "Russian women continue to be well represented in glaciology, although they rarely rise to the highest levels of leadership. Paleoglaciologist Olga Solomin, Corresponding Member of the Russian Academy of Sciences, is a notable exception in that regard" (Hulbe et al., 2010, p. 958).

The experience in China also shows more gender equality because it supported women in glaciology and other physical sciences. In the 1950's and 60's China produced a group of successful female glaciologists and hydrologists who found employment in the years subsequent to the Cultural Revolution. In China, the government and the Cultural Revolution were very influential on women's accessibility to the field. The government assigned jobs that placed women in water management and glacier monitoring (Hulbe et al., 2010). Unfortunately, many of these successful glaciologists have not been replaced (Hulbe et al., 2010). More pronounced acceptance,

even encouragement, in Russia and China prove that women are equally capable glaciologists as men. It also indicates that the minority of female glaciologists in the western world is due to lack of societal support—western cultural conceptions of gender limit women's ability to pursue glaciology.

The examples of more vibrant, and equal gender dynamics in Russia and China are important, because they indicate that female minority in glaciology could stem from institutional discrimination. In countries such as Russia and China, that encouraged and supported women in glaciology, there was more equal gender representation in the field than in countries, like Western Europe and the USA, who historically were not supportive. This is significant for those who wish to understand cause of female minority in STEM fields, and especially for those who believe that current male-dominated gender dynamics in STEM fields is cause by institutional discrimination.

e) Recent reflections on gender ideologies and climate change in glaciology

Much has changed since the late 20th century, however there is still a scarcity of women in glaciology. Hulbe et al. say, "Glaciology today embraces a highly specialized set of disciplines. To understand women's participation in glaciology, we must understand women's access to the fields of study leading toward those specializations, primarily math and the physical sciences" (Hulbe et al., 2010, p. 959). Hulbe et al. makes it clear that women's access and confidence in math and science is vital for their pursuit of glaciology. Therefore, the general literature of gender equality in science plays a great role in equality in glaciology. The same institutional problems found in society, in education, and in academia result in a paucity of women pursuing glaciology, and result in "the leaky pipeline" phenomenon.

Glaciology is another way that women experience and interact with glaciers. Such women struggled against sexism to fulfill their dreams of publishing, teaching, and researching glaciers. As glaciers rapidly retreat a female glaciologist's experience is two-fold. One, they have the opportunity to study the rapid melting process and contribute to climate change sciences, and two, the retreat of glaciers means the retreat of their source of inspiration, passion, and life's work.

IV. Conclusion

The relationships between women and glaciers are hardly ever recognized or explored, however these relationships and the ensuing histories of women in mountaineering and glaciology are pertinent. Today we are trying to understand important issues like gender inequality in sport and science, technology, engineering, and mathematics (STEM) professions, and climate change. The gender inequalities within mountaineering and glaciology inform us of gender dynamics in broader areas of sports and science.

The conditions of high alpine and polar environments—sub-freezing temperatures, high winds, high altitude, avalanches, precipices, and snow and ice—make mountaineering and glaciology extreme areas of sport and science with duly extreme gender narratives. Mountaineering and subsequently glaciology were founded on masculine rhetoric and ideals. As a result both the sport and the science have a history of exclusiveness, where women were barred from alpine societies and were discouraged from pursuing glacial relationships. The gender inequality in both mountaineering and glaciology still persist today through problematic gender ideologies, and as a result there are relatively few women who participate in extreme alpinism and glaciology.

Though there is a long history of sex discrimination in mountaineering and glaciology, women have consistently resisted the gender narratives. However it should be noted that many successful women in mountaineering and glaciology are privileged and supported by male figures in their lives. Nevertheless the stories of Fanny Bullock Workman, Arlene Blum, Kathleen Lonsdale, Elizabeth Morris, Almut Iken, Kumiko

Goto-Azuma, and Ruth Hopson Keen show that glaciers and high altitudes are indeed a woman's place too. It is essential that these stories be told because they empower other women to follow in their footsteps and break out of prescribed western gender ideologies—for if women perpetuate these ideologies, then they will continue to persist. These stories are also crucial in our current era of climate change.

As climate change progresses and threatens our world, and especially our vulnerable alpine and polar environments, we need gender equality in mountaineering and glaciology so that women may celebrate glaciers and contribute their knowledge to their study. More minds on climate change issues foster more creative solutions. Also women may bring a more holistic perspective to the table, such as the "emotive attachment to place" that Morin noticed in climbers like Bird and Kingsley in the American West. Or Eyla Louise Walker's deep connection not only to South Sister, but also the surrounding peaks, deserts, and valleys. The trend of deep attachment to place, exists in men as well as women, however it may have roots in historic subjugation of women on slopes. Since mountaineering's rise to popularity in the middle of the 19th century, women have had to overcome both the innate challenges in the climbing mountains and studying glaciers, and the social exclusion from these activities. Therefore women have a unique relationship with glacial and high alpine spaces, which provided them with the opportunity to break gender ideologies and prove gender equality both for themselves and for society. The resulting deep emotional connection to place often leads to far-reaching environmental stewardship, which is essential today as we face climate change.

Another way to engage more women in environmental study is to intentionally bring them into the field, and foster a love of science and climbing, as well as bonds with glacial spaces. Today some women in mountaineering and glaciology are doing just that by bringing future generations of women onto the slopes and giving them access to the fields through a program called Girls on Ice. In *The New York Times* article, "Young Women Get Serious in a Laboratory of Ice" Margaret Wertheim asserts, "while many existing organizations offer excellent programs to teach young people outdoor competence and other offer training in science, Dr. Pettit knew of none that combined both activities and especially not for girls" (Wertheim, 2005). The Girls on Ice program intentionally addresses the lack of women in glaciology by exposing young women in high school to glaciology. Roughly ten high school girls are selected from a pool of applicants to participate in a ten-day program, where they are lead and camp on glaciers. Female glaciologist Erin Pettit founded the program, and leads alongside several accomplished female glaciologists and mountaineers. The Girls on Ice website in participants reviews of the program. All the participants gave it scintillating reviews, and many of them said Girls on Ice was transformative for their self-confidence and inspired them to continue studying glaciology, mountain ecology, and/or environmental sciences (Pettit & Reid, 2014).

A variety of sources from *Current Science* to the *New York Times* have featured articles about Pettit's Girls on Ice Program. *The New York Times* article had several comments from participants like Lauren Carter who said, "I've always wanted to go to Antarctica and this was about the closest I could get…I had never known that ice could be so interesting" (Wertheim, 2005). Lauren Carter believes that "having a woman as

the course instructor was particularly important. 'It made you see that women could be scientists'" (Wertheim, 2005). *The New York Times* article also cites another participant, Kelsi Franzen with, "although Ms. Franzen had plenty of experience hiking, she had never before tackled mountains. 'Now I climb volcanoes…Girls on Ice was really the beginning of that'" (Wertheim, 2005). Testimonies such as these suggest that Girls on Ice can be a deeply empowering experience for young women. The program seems to successfully encourage participants to pursue fields like mountaineering and glaciology that were previously considered unavailable to women. Programs like Girls on Ice could be one way to intentionally bring more women into glaciology and mountaineering, and thus more young minds into the study of alpine environments through climate change.

The thesis process raised many questions for me, some answerable outside the scope of this project and others that may never be answered. Most of the speculative questions stemming from my thesis revolve around how climate change, science, and sport would be different or similar if women had been encouraged to participate in mountaineering and glaciology. Would climate change have progressed this far and have such dramatic effects on glaciers? Or with more people experiencing and growing attached to glaciers, would there be a greater push to reduce emissions and protect alpine environments?

I would love to investigate both women's and men's emotional connection to glaciers, and see what the similarities and differences are between the genders. Do glaciers play a role in personal identity for women and men, and if so what role do they play? Does glacier melting from global warming change these sentiments, and if so

how? What does glacier loss mean people and how does it complicate their identity? Interview, survey, or discussion groups could answer these questions. These kinds of questions are investigable, and would further shed light on human-glacier relationships.

Other questions are not as answerable, but are important food for thought. The number of women, some of which I mentioned in this thesis, have resisted gender narratives in mountaineering and glaciology and have been very successful. This suggests that without exclusive gender narratives there would be more women and thus more creative minds working on glaciers and climate change issues. What kind of input would such women contribute to the field? Would the buzz topics in glaciology be different than the ones that are so popular today? Finally, if women had been encouraged to participate in mountaineering and glaciology, would there be more gender equality in other areas of sport and science? The answers to these questions may be impossible to know, however they are valid questions to ponder as sports and science continue to be male dominated and as climate change continues to threaten the planet as we know it.

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