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Perspectives of Women in Science: past and present

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ABSTRACT

Women were once pushed out from science. However, they pushed back, entering science in any way they could. Although these past women pioneered the way for modern women to choose science, there are still barriers that hinder a woman’s advance. Feminism was a social movement that evolved into academia. Feminist values have been used to critique science and look for solutions that will break down barriers for women. Is feminism still needed today to help women reach their full potential in science?

I have used case studies to compare five women in science today with women in the same field from the past, focusing on New Zealand, and Western society. I personally interviewed the women, either in person or by Skype, in order to ask follow up questions so I could dig deeper into the topic. The topics that I focused on were infrastructure, motivation, career and life balance, women directing science, and Māori women in science.

I have concluded that women in science still face many barriers, both implicit and explicit. While explicit discrimination has become less socially accepted, subtle biases still prevail, making it difficult for women to progress in their career. Support networks are a very important tool women use to work past these challenges. Feminism is still needed today to combat subtle bias and to help women establish greater support networks.
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CHAPTER ONE: INTRODUCTION

1. Feminism In My Life

It was only a generation back in my family that societal expectations hindered a woman's advance. My mother was the oldest, and went through school with A's and high honors. She had dreams of going away to university to become a psychiatrist. Her parents told her she could not become a doctor, she could only become a nurse. She could not go away to university, they had to save their money to send her brothers away. She could not follow her dreams, she had to get married and let a man take care of her (Laura Kaltz: personal communication, 4 Jun 2012).

Times have changed, but change is slow.

My mother did get married and raised five daughters. I grew up in a household with six women. I went to an all girls' high school, graduating in 2005. There was no room for male chauvinism in my young life. At that time, in my world, feminism was a thing of the past that was not needed anymore. That view changed when I experienced more of the world. I started to notice the underlying accounts of sexism that are subtle, but pervasive.

I went to a punk musical festival in Florida with friends in 2010. One member of the band, Paint It Black, made a speech at the end of their set saying how wonderful it was that there were two all female punk bands playing at the festival that year. At the end of what I thought was a very powerful speech, two male friends said that they thought that speech was stupid. I wondered why would it not be a good thing that more female musicians were breaking into a male dominated music
genre? Why would it not be a good thing that more females are entering any male dominated field? Why is there this stigma against feminism? And how can anybody in the 21st century think that an equal playing field is “stupid”?

I do not know if that is how the rest of the audience felt as well. If only I had passed out a survey then, catching people off guard. What did you think of that speech? What do you think of feminism? Would the majority of the audience think that it was started by crazy women who didn't have enough to do? Would they realize that feminism has taken on many different definitions? Would the audience hear the word and think empowerment, or would they think evil? Would they have thought it a thing of the past, or would they think it is still needed in today's society? These questions continue to race through my mind. Women should be given the opportunity to reach their full potential wherever their interests lead them.

1.2 The Full Potential of Women in Science

Everyone has their own perspectives about life, their self, of others, and of science. It seems some women have been privileged with family support, both financially and emotionally. Others have not had those privileges, but have still found the motivation to succeed. And still other women felt the burden of the struggle, were deterred because of someone's comment, let their dreams fade, and took their lives in another direction. Looking at statistical data from New Zealand, females are over-represented in Bachelor of Science programs at tertiary institutions. However, they are concentrated in the areas of health and biology. Furthermore, Māori females constitute only seven percent of these enrolments.
Once in the workforce, numbers drop off. Overall, there are less women in science related careers, and research careers (Bray & Timewell 2011, p. 9-14). This is a continuing trend whose reasons will be explored throughout this thesis.

1.3 Ellen Blackwell

Ellen Blackwell may have been a woman who was deterred from science. Ellen left England for New Zealand in 1903. On her way she met Robert Laing, a respected schoolteacher and amateur botanist. Ellen also had an interest in botany and together, in 1906, they published a book, *Plants of New Zealand*, under joint authorship. This book has been praised as an important tool for botany researchers and enthusiasts (Dell 2010). Controversy looms over this book, however, questioning who contributed more. The controversy did not come from the authors, but from outside parties. It started with a reviewer stating that it was "an open secret" that Laing contributed more to the book. Then there was a rebuttal from Reverend Robertson, in defense of Blackwell, published in the *Herald* newspaper. Blackwell's response was "I believe that he (Reverend Robertson) thought he was doing me a kindness and does not seem to understand the wrongful and unpleasant position in which he has placed me" (Godley 2009).

The reason for this controversy is not clear. If Robert and Ellen both agreed to have their name on the book, then the outside community should have accepted that each gave equal contribution. Ellen's biographer, R. K. Dell, points out that "local botanists, all male, appear to have held strong views on the place of women." This war of words could have been a way to keep women out of the scientific world. Ellen
returned to England, and made no further contributions to science. Had this controversy never happened, would her life have been different? Would she have stayed and prospered in the area of botany? This was a public controversy that could have discouraged prospective women who wanted to enter this world.

Fortunately, more women began to enter the sciences in New Zealand. We can only imagine their thoughts and feelings as they entered this world. Did their minority status hold them back or push them to succeed? Would a woman nowadays in science want to study back then in those conditions? Some may call them radical or pioneers. Did they think of themselves this way? We can look to history to give some insight on the reasons for these choices, and see how these women left stepping stones for the women of the modern world to build a road for the women of following generations.

1.4 Connection to my film, *Once a Pod of Whales*

As seen with Ellen Blackwell, science is not exclusive of politics. No area is safe from politics. This is something I have experienced while creating my thesis film, *Once a Pod of Whales*. The film, which can be found in the back jacket, highlights three groups that are involved in whale strandings. During the stranding that my film partner, Vanessa Marshall and I filmed, there was one woman in particular assuming authority. She was a scientist and at times aggressive, to the point of deterring volunteers. She yelled and pushed the people who gave up their time to help. Later, someone asked the question, “How would people’s attitudes toward her
change if she were a man?” I am still unsure if I would have reacted differently to her if she were male. But I do know now I am not immune to gender stereotypes.

The topic of gender has interested me for some time. Because of this, I chose my academic thesis topic before choosing the subject for my film. These two topics, women in science and whale strandings, may not have a distinct correlation. Even so, it was not hard to find metaphorical connections. Throughout the first chapter, I will connect the academic and creative topics by using metaphors of perspective and ocean/currents.

Both my thesis and film value unique perspectives. The film explores the different standpoints of a whale stranding from members of the Department of Conservation, Project Jonah, and the local Iwi. My thesis investigates the various viewpoints of women who are doing science or have had a career in science. I dove into both topics somewhat naïvely. Although I have not become an expert in either, the experiences I have had with both has made me grow with new, clearer insights on life. It has also made me contemplate how to be an effective communicator of science.

During the making of the film, the process of interviewing the Iwi intrigued me. While only two men were shown in the film, there were five Iwi present during the interview. When I asked a question, the answer was discussed amongst each member. The final response was a compilation of the various comments. This is how I imagine feminism can work, especially within science. Feminism can make every view heard, which will lead to a greater understanding of what women in science
need to reach their full potential. This thesis is a compilation of the responses of each woman I interviewed.

1.5 The Study

I have used case studies to compare women in science today with women in the same field from the past, all from New Zealand. The women from the past were chosen first based on their area of study, contribution in their field, and available historical information on them. To find the women of today to interview, I conducted online searches and received recommendations from my supervisor. I then contacted each one by email to see if they would be interested in my project. Once they confirmed their interest, I personally interviewed the women, either in person or by Skype.

I chose to use case studies so I could ask follow up questions which allowed me to uncover different sides of each woman’s story. Throughout my initial research, reoccurring issues that I chose to focus on were:

- Does the infrastructure of science need to change to accommodate women?
- What keeps a woman motivated to have a career in science?
- How difficult is it to balance a career with family life?
- Should women be calling the shots, deciding what research to fund?
- What does it mean to be Māori and a scientist?

Each chapter is divided into subheadings, which concentrate on each of these issues. I chose this type of format as a way to breakdown the information to aid the
digestion of the big picture. By exploring the different components of each woman’s story, I came closer to understanding how women can achieve their full potential in the world of science, and that feminism is still needed today to help women succeed. But before understanding how feminism can help women in science, first there needs to be an understanding of the feminist movement.

1.6 Perspectives of Feminism

In my opinion, the way ideas pass from person to person is like the way currents pass from ocean to ocean, gaining momentum, then trickling off, only to feed into another current. This is how feminism moves. Depending on where in the water you step in, you will get a different feel of the movement. Some feel the soft current, not even realizing it is there among them. They agree with ideas of feminism, but do not realize that is what they are. Others may feel the force of the strong current that gains strength as it pulls men under. They are feminists with picket signs and chants that rhyme. To understand feminism, you have to understand where it came from, and all the different perspectives.

The different perspectives of feminism have created a word with many meanings. An American feminist writer, bell hooks, describes feminism as "a movement to end sexism, sexist exploitation and oppression" (hooks 2000, p. viii). According to June Hannam, "feminism is a cultural as well as a political movement. It changes the way women think and feel and affects how women and men live their lives and interpret the world" (2012, p. 3). It is important to add to this definition the idea that feminism changes the views of women and men in different ways.
Today, there are feminist philosophers that analyze this variety in feminist thought, and the timing that these thoughts became more mainstream (Cudd & Andreasen 2005). They have grouped these changing currents in six main perspectives: Conservatism, Liberal, Radical, Socialist, Cultural, and Women of Color (Henley et al. 1998, p. 318).

Just as there is more than one perspective within feminism, people who do not associate themselves with feminism have more than one attitude towards it. Many studies have been conducted to understand these attitudes, focusing on trying to comprehend why there is an opposition to the word. One study by Paige W. Toller, Elizabeth A. Suter, and Todd C. Trautman, gave questionnaires to undergraduate students to discover how gender role identity reflected on how they felt about feminism. The results concluded that men with more masculine traits and women with more feminine traits were more opposed to being associated with feminism (2004). In another study, Jessica Jenen, Jennifer Winquist, Daniel L. Arkkelin, and Kristopher Schuster, looked at the implicit attitudes towards feminism. They showed that both men and women linked feminism with more negative and masculine words. They then associated persons with traditional roles with more positive and feminine words (2009). The beliefs of feminism are not being disputed, it is only the word, and the radical implications this word has. When people have more knowledge about feminism, they were more likely to affiliate themselves with the term (Liss, Hoffner & Crawford 2000).

The word feminism has been traced back to the 19th century. Feminismé was a French medical term to describe a male with feminine traits, or a female with
masculine traits (Chesters & Welsh 2011, p. 75). Past writers that are described in today's terms as feminists, explored the inequality of women throughout Europe as early as the twelfth century. These writings continued through to the fourteenth century and the Enlightenment of the eighteenth century (Hannam 2012, p. 4). Questioning the inequalities of women carried on, thus transforming a word into a social movement. It became a movement when women had enough, and they started calling out for equal rights. They were women who gained freedom during war, then had it taken away after the war (Chesters & Welsh 2011, p. 77). They were women who thirsted for higher education, but were told no (Herd 2005, p. 31). The currents of feminism flowed from country to country, taking on different ideas for change (Chesters & Welsh 2011, p. 75). There were reformists who wanted to draw attention to gender equality. They were revolutionaries who wanted to reconstruct the system, bringing an end to patriarchy and sexism (hooks 2000, p.4).

Feminism became a global movement that has been described as occurring in waves. These waves refer to the organized movement of women that have set out to achieve social change. Although the waves occur at different points in time, and emphasize different aspects of the movement, they are not unique to each other (Cudd & Andreasen 2005, p. 7). The current of feminism still flows through time, never dissipating. It is only that during each wave, the prominence of feminism grew, the current strengthening.

The issues of the first wave emphasized political and economic rights. This included property rights, reproductive freedoms, and greater access to education and the professional world (Cudd & Andreasen 2005, p. 7).
It could have been these ideals that provoked a woman to write a letter to Theodore Roosevelt expressing her concerns. She was a housewife and a mother of nine. Caught up in her role with no time to keep up with worldly affairs, her children dismissed her. However, they revered their father who was a sophisticated man. Roosevelt wrote back to this mother showing his sympathy and gave her the book “Mother” by Kathleen Norris. She wrote again expressing her gratitude saying, “Just having you interested is as good as a tonic, and braces me up till I feel as though I shall refuse to be ‘laid on the shelf’” (Roosevelt 1913, p. 180-184).

The suffrage movement in the United States and the United Kingdom gave feminism a unified issue to fight for (Chester & Welsh 2011, p. 77). In New Zealand, the first women settlers arrived in 1806, and initially took on their former roles in Europe as domestic caregivers. However, they were now part of an expanding nation, and detected the aura of change. "Now that Australia and New Zealand were represented in their own right at the League of Nations women were aware that their citizenship status within the Empire had changed and they set out with a new sense of confidence to influence the shape of 'imperial feminism'" (Hannam 2012, p. 59). This sense of change led New Zealand to become the first country to grant women the right to vote in 1893.

More attention was given to the second wave that concentrated on full economic equality, with the currents going deeper into political and personal life (Cudd & Andreasen 2005, p. 7). The suffragists propelled the ideas, and it took a few generations to get used to women having different societal roles. Now the Second World War was over. Women were willing to accept different responsibilities during
the war, and wanted to continue to do so (Hannam 2012, p. 75). In the United States, the Civil Rights movement and Vietnam War protests made women question their own stance in society (Herd 2005, p. 1). The economic depression made women question gender equality in the workforce (hooks 2000, p. 4). This questioning must have motivated women to take action and change what they did not like.

In New Zealand, education was changing to encompass feminist values and create more opportunities for women. Starting with primary school books, these were rewritten to erase old stereotyped language. The hope was that by getting rid of gender biased language in early education, children would grow up without these social cues, thus being able to become anything they wanted to be (Blickenstaff 2005, p. 377; Herd 2005, pp. 77-78). These changes rippled further down with more women continuing their education to the university level. The ripple would not stop there. Once these women were educated, the freedom of knowledge motivated them to use their minds in the workforce. The government responded "by amending the tax law to enable married women to be assessed separately from their husbands, thus avoiding the higher rates of tax that applied to combined incomes" (Herd 2005, p. 31).

A career choice turned into a difficult decision once marriage and children came into the picture. Many women would only work until they married or had children, trading in their career for family life. Some made the choice to not have children so they could keep their career. This became an either/or decision. This decision would play on emotions. Some women felt bad that they wanted to be mothers, others felt bad that they didn't (Herd 2005, p. 33).
The third wave of feminism started in the late 1980’s and leads us to today. This is when feminism really started to incorporate women's diversity (Cudd & Andreasen 2005, p. 7). The paths between women of color, lesbians, and women from third world countries are recognized as common struggles. There is some debate over defining this period as a separate wave since these women have been fighting for their rights all along. In New Zealand’s case, Māori women’s rights are just as important as Pakeha women’s rights. Ripeka Evans does differentiate between the two struggles:

*There was a distinct difference between what we called white feminism and Māori feminism. The difference lay in the fact that Māori feminism was grounded in the identity and creation of this country, grounded in the rivers, lakes, mountains, seas and forests, grounded in the war and peace between tribes and families, grounded in the whakapapa of generations of families, tribes, waka, Gods and Goddesses, grounded in notions and concepts of time and space that required reclamation, and if the price was a re-fashioning of Māori society then so be it*” (1994, p. 53).

Māori women strived to gain recognition for their efforts for the whole Māori community in the fight for land rights (Mohanram 1996, p. 58).

1.7 Feminism in Science

It was not until the 17th century that science started to become the word that we know today. The Scientific Revolution focused on using experiments and calculations to understand the physical world. It was during this reconstruction that
women were pushed out from the “new” science (Sheffield 2004, p. 3). Furthermore, science was used against women to claim that differences between females and males were due to biology. Nature made men rational, objective and scientific. Women were emotional, sensual, lacking in innate reason and a barrier to social progress (Hannam 2012, p. 11).

Medical science seemed to take advantage of women for the sake of science research. Dr. Herbert Green conducted studies on his patients without their knowledge. He wanted to test his theory that carcinoma in situ of the cervix was a harmless disease that would not progress to cancer. So if his patient had CIS, he would not tell them. The study should have been stopped by the 1970s, but went on, forcing the situation to go to court. The proposal for this study was initially approved in 1966. The judge ruled that by 1967, the dangers of this experiment should have been evident. The court demanded that Dr. Green contacted women who were treated from 1958-1986, letting them know what happened. His defense was "because that was the way things were done at the time" (Manning 2009, pp. 27-35).

For reasons like the previous example, feminism moved from a political and social movement, to academic theory (Schiebinger 2004, p. 234), and eventually entered the domain of science. Its goal is to evaluate the role of gender and sexism, in order to improve conditions for women (Richardson 2010, p. 337). For instance, in the United States, feminist theory pushed ideas and priorities of biomedical research. Now, federal law protects women, giving them the right to inclusion in basic medical research. Presently, feminist science is seen as a way to bring
creativity to science (Schiebinger 2004, p. 234), and can help steer research from biased judgment (Hoquet 2010, p. 113). The role of female choice in sexual selection was initially not given as much attention as male competition. Feminist values questioned this, eventually showing that female choice is subtle, but important (Keller 2004, p. 11). Biology is still used to explain that differences in behavior between females and males are a result of evolution. Feminist science, however, reveals issues in society that can cause these differences (Eagly & Wood 2011, p. 759). Biology and feminist science do not have to work against each other, but rather, each one can learn from the other (Hoquert 2010, p. 117).
CHAPTER TWO: MARINE SCIENCE

2. Introduction

This chapter aims to compare and contrast the lives of Elizabeth Batham and Abby Smith who both worked in marine science. Betty Batham initially studied botany and zoology, while Abby Smith initially studied geology. The course of their careers brought them to the marine science field. Marine research in New Zealand was not prominent until the 1950s (Probert, Jillett, & Carson 2005, p. 13). Betty Batham worked for the University of Otago and was director of the Portobello biological research station. Abby Smith currently works for the University of Otago in the Marine Science Department.

2.1 Elizabeth Joan Batham (1917-1974)

Elizabeth Batham, also known as Betty, was a very talented individual in both the arts and the sciences (Women Into Science Education [WISE] 1989, p. 2). She was born in Dunedin and studied at the University of Otago. In 1940, she received first-class honors for her Master’s in botany. She continued her education and received a Master’s in zoology the following year. Her interests soon expanded to include marine biology (Jillett 2010, para. 2). After World War II, Betty then left for England to study the neurophysiology and behavior of sea anemones at Cambridge and Plymouth (Southern 2005, p. 43).

Back in Dunedin, Betty was appointed by the University of Otago to transform the old marine science institution at Portobello into a biological research
station (Southern 2005, p. 42). She became Director of the station and worked hard to improve the conditions at Portobello. This included making sure that an aquarium was added to the station. She continued her own research and published *Ecology of southern New Zealand exposed rocky shore at Little Papanui, Otago Peninsula* (Batham 1958). Betty understood the importance of education, so taught an annual course on marine ecology and physiology. In 1962, she was made a Fellow of the Royal Society of New Zealand, along with only four other women at the time (WISE 1989, p. 4). She became a scuba diver at the age of 50 in order to progress her research. After ill health, she reluctantly stepped down in 1974 (Southern, 2005 p. 43). Her work led her to become a world expert on sea anemones (Batson 2003, p. 95), and is still cited in marine science textbooks (WISE, 1989, p. 3).

### 2.2 Abby Smith

Abby Smith was born in the United States and grew up in the 1960s, when Betty Batham was advancing in her marine science career. Abby's higher education started at Colby College in Maine where she was majoring in English. She was enticed by the challenge of science, so decided to switch majors and switch schools. Abby chose to study geology at the Massachusetts Institute of Technology. Later she made the move to New Zealand to do her PhD at the University of Waikato in the 1990s. Now Abby works at the University of Otago as an Associate Professor in the Marine Science Department (Smith, personal interview, 29 Aug 2010).
Abby Smith does consider herself a feminist. She acknowledges that feminism is about treating people properly, no matter what their gender is (Smith, personal interview, 29 Aug 2010).

2.3 Infrastructure

Abby Smith views women in science as people who change in order to fit their environment (Smith, personal interview, 29 Aug 2010). The scientific mind has been regarded as masculine (Keller 1995, p. 29), creating an infrastructure which women feel they need to conform to. To be one in few, or even the only woman, in a male dominated field can be discouraging. Since men are in the majority, they become the “norm,” and women are deviations from that norm (Fox 1998, p. 202). Women feel that in order to make it in science, they need to be “asexual,” or even take on male behaviors (Hall 2010, p. 19-20). Abby acknowledges her change when entering science. “That’s what girls used to do: adapt or give up. And I adapted. I have a highly masculine point of view about things...I am a product of a time when girls who wanted to do geology were few and far between, and you had to fit in” (Smith, personal interview, 29 Aug 2010).

What can be done about how someone feels in the infrastructure of science? Abby believes there needs to be a community response to an individual. She expresses the importance in sitting down with students to find out what their individual needs may be. For example, she is an advocate to keep the University of Otago’s course approval system. Currently, during course approval, students must visit each department that they will take classes in. This is a chance for students to
express concerns and receive feedback. If the University moves to an electronic system then students will lose this opportunity (Smith, personal interview, 29 Aug 2010). The lack of ‘home’ and ‘community’ within science is one component that can deter women from this field (Fox 1998, 211). So it is important to create an environment that nurtures and promotes community.

2.4 Motivation

Elizabeth Batham and Abby Smith both transformed their interests into a career. Betty’s interest in science began at an early age. It then was heightened when a biologist encouraged her use a microscope to inspect details of sea animals (WISE 1989, p. 2). Abby explored other subjects such as English and comparative religions before settling on science. Geology became her passion because it was challenging, and that challenge motivated her. She also found it to be straightforward and practical. “It’s about the basic thing that make the world. And you can scrape off the surface, but what you end up with are the rocks” (Smith, personal interview, 29 Aug 2010).

A peer-reviewed study by Thomas Dick and Rallis Sharon in 1991, showed that women were more likely than men to consider a genuine interest in a subject to be an important element in a career choice (p. 286). It is that genuine interest that put Betty and Abby on the path of a scientific career, but what happens when an obstacle is in the road? Family support aided both women to keep moving forward. Betty and Abby each came from educated families who encouraged their children’s interests. Betty was close to her father (WISE 1989, p. 2), who was an electrical
engineer. Both of her parents encouraged her scientific endeavors (Jillett 2010, para. 1). Abby’s father was also an engineer and her mother a linguist and a mathematician. Her home environment was one that would support anything that she wanted to do (Smith, personal interview, 29 Aug 2010).

A strong support network was invaluable when Abby was completing her Master’s and PhD. When Abby attended Colby, a liberal arts college, she saw plenty of women doing science. The environment at MIT, however, she found to be a “very difficult place to be a female scientist...the only reason women are there is to provide potential wives, and some entertainment, and to be pretty.” Even though she was in a very different atmosphere, her sister was undergraduate there, and her father was Dean of the faculty. Abby and her sister shared with their father exactly how the environment was for women. “He did a lot of things to make a difference, and it was interesting to have that kind of capacity for change” (Smith, personal interview, 29 Aug 2010).

Abby would experience further discrimination when working on her PhD at the University of Waikato. It has been suggested that more serious, mostly unconscious gender discrimination enters at later stages of a scientific career (Etzkowitz, Kemelgor & Uzzi 2001). In Abby’s case, she experienced explicit aggression toward postgraduate and undergraduate women:

At one stage we had a seminar speaker who had graduated from the University of Waikato...And one of the women had asked a question, and he said I don’t have to answer that you’re just a girl. And I said loud and clear, in that case I
don’t think any of us need to stay. And I stood up and walked out, and a bunch of women did too (Smith, personal interview, 29 Aug 2010).

To combat this open intolerance, Abby changed to become hard and stern (Smith, personal interview, 29 Aug 2010). What this example shows is the lack of community in science that Abby talked about. How can one grow as a scientist if she cannot ask a question, or make a statement, or be heard in any way? Abby does mention that she has always had a supportive husband and her PhD supervisor also provided support (Smith, personal interview, 29 Aug 2010). They became her community.

2.5 Science and Life Balance

While it may seem that Betty and Abby led similar lives, that would be further than the reality. Abby currently spreads her availability across a variety of passions. She works full-time for the university. She is also a wife and a mother to two boys. And from here, the list keeps growing. She organizes the Northeast Valley Junior Cricket Club, she is treasurer of the International Bryozoan Association, chair of the Otago Conservation Board, runs a youth group, sings in a choir, and still finds time to make jam. And this is where the big difference lies. Betty never married or had children. She dedicated all of her time to transforming the station (Jillet, 2010, para. 6).

Abby explains that when she finished her PhD, she had high ambitions for her career. Starting out only part-time, then having children changed those ambitions. She admits that at first it was hard to give up on some of her goals, especially since
her husband’s career started to flourish, but now she is happy (Smith, personal interview, 29 Aug 2010). She had asked herself a question that many other women and men at some point in their scientific careers probably ask themselves: Will I be a well-rounded person, or a fulltime scientist? Abby chose the former, while Betty chose the latter.

Whether or not to have children seems to be a big decision, and could affect a person’s choice to continue with science as a career. A survey was conducted in the United States across 30 universities, and including 2,500 scientists. It was found that 45.4 percent of women and 24.5 percent of men indicated that they had fewer children than they had wanted because of their science career. The survey also showed that 29 percent of women graduate students worry that if they choose a career in science, they will not be able to have a family life (“Rice University,” 2010, para. 5). The challenge with balancing a career with family is a major reason why women leave science (“Women in science” 2011, para. 2). It could be Abby’s community that enabled her to tackle this challenge.

2.6 Women Directing Science

In 2011, it was reported that there were 50% of females on Senior Management Teams, but fewer than 25% on individual boards in the Ministry of Science and Innovation. Particularly, the innovation board and the science board, which are responsible for making important funding decisions, can affect the government’s investment into certain programs (Bray & Timewell, p. 21). The question is: how important is it to have more women influencing these decisions?
There may be more women in higher positions within science now. However, times were different when Betty was Director. She found the administration side of her job to be difficult (Jillett 2010, para. 7). As the station at Portobello grew, more scientists were working under Betty, which led to more office politics. Male colleagues would hassle her for being a woman in her position (WISE 1989, p. 5). They may have seen her as a competitor or an intruder in what they saw as a man’s world (Yentsch & Sindermann 1992, p. 213). It does not really matter what their reasoning was, the fact remains, women in management roles often suffer from discrimination.

2.8 Summary

Abby Smith found her way to the University of Otago in Dunedin where Elizabeth Batham carried out much of her career. Betty dedicated her life to her research, but still had to deal with harassment from the men that worked for her. In Abby’s experience, science is very hierarchical, and she had to change to fit in. When Abby became a mother, she did find her colleagues to be very supportive, and the university’s daycare to be exceptional. That kind of network let Abby continue her career. A sense of community in science is starting to emerge, but still needs to develop further so that more women feel they can be a part of it. In February of 2013, Abby will become the Head of Department of Marine Science at Otago, stepping into the shoes of Betty Batham.
CHAPTER THREE: BOTANY

3. Introduction

This chapter highlights the field of botany. Rosa Olga Sansom contributed to science and the communication of science in the 1900s. When she was Director of the Southland Museum, Olga collected many specimens for botany. Susan Walker is employed at Landcare Research in Dunedin, after receiving her PhD in Botany. She works in conservation, an area that Olga advocated for.

3.1 Rosa Olga Sansom (1900-1989)

Olga Sansom (maiden name Jensen) was born at Halfmoon Bay, Stewart Island (Gilchrist 2010). She had four siblings, three brothers and one sister (Sansom 1970, p. 13). Olga first worked as a teacher until she married when she was 21. She resumed teaching in 1923, after her husband’s death. In 1924, she married again. At first, Olga was only helping out at the Southland Museum. However, in 1953 she became Director. She did much work for the museum, creating displays, teaching school classes, and collecting botanical specimens. She was a natural science communicator when her work went beyond the museum to include tramping trips with Southland Girls’ High School, and she was also a radio broadcaster on natural science topics (Gilchrist 2010).

Olga had many connections to whales. During her childhood, whaling ships were built on Stewart Island. Her brother, Julius, worked on the whaling ship *Sir James Clarke Ross* (Sansom 1970, p. 227). Later in life, she was a guest, several times,
on the ferry *Wairua I*. During these trips, Olga did whale counts for Southland Museum's records. She noted that on October 1959, there were 29 humpbacks in the seas off of Stewart Island, many with calves. Yet, by the springs of 1968 and 1969, not one whale was recorded in that same area. (Sansom 1970, p. 229-230) Even in her time, she saw the changes in the sea.

Olga was familiar with many types of whales, including the pilot whale, the same animals that strand in *Once a Pod of Whales*. In her elegant writing, she describes her experience with pilot whales and what could have been a mass stranding:

> Under one of those smoky-red winter skies in 1969, and towards late afternoon, the sea below my window was a congested mass of small whales, more than a hundred of them, blackfish as we call them, or pilot whales...The school of pilot whales in my bay moved in among the fishing boats at their moorings and were very close to being grounded on the beach, when a boat rounded them up and diverted them out from the bay. Fears that these whales would be stranded are well-founded; in past years this has happened at Whale Corner and Ringa Ringa Beach, where ninety-six of them went ashore (Sansom 1970, p. 230-231).

### 3.2 Susan Walker

Susan Walker is currently working as a researcher for Landcare Research in biodiversity and conservation. She came to the University of Otago for her MSc and PhD in Botany in 1997. Before Otago, Susan first received her Bachelor's degree in
agriculture, graduating with honors from the University of Natal South Africa in 1988. She took a break so she could travel. During this time, she also finished a Postgrad Diploma in Publishing at the West Herts College in the United Kingdom in 1991.

Susan does consider herself a feminist and imagines that she would have joined the suffragist movement. “Today, people are free riding on the sacrifices other activists have made” (Walker, personal interview, 26 July 2012). Activists sought change in the system to enable women to have similar opportunities as men, and to give them the chance to make similar contributions in multiple fields of science. The system of science needs to ask the question: does there need to be activists trying to change science in the modern world?

3.3 Infrastructure

Olga Sansom contributed to science in many ways, both in the field and as Director of Southland Museum (Gilchrist 2010). She has shown that the infrastructure of science can involve either laboratory work or field work. Different ways to do science should be promoted as this could attract students who do not realize what science entails (Walker, personal interview 26 July 2012). At Londonderry School in Pennsylvania, the seventh and eighth graders practice field work as part of the curriculum. It is not just an occasional field trip, but a weekly affair (Brosius 1998). By adding regular classes for field work as part of the course, instead of occasional trips, which compliments their laboratory work, students can develop a greater understanding of what a science career can lead to. Also,
understanding what type of science would fit their lifestyle can encourage students to consider science an option at an earlier age.

Olga Sansom went on tramping trips with Southland Girls’ High School. She shared with them her knowledge of biology and conservation (Gilchrist 2010, para. 4). In my experience, field trips included the teacher, students, and occasionally parents to act as supervisors. It should become the norm for field trips to include guests like Olga. Someone who can share their knowledge, enthusiasm, and reasons they chose a science career. Perhaps they can even talk about their hardships, so perspective students can enter the field, knowing what they need to be an activist for.

3.4 Motivation

It is Olga’s family that appeared to be her motivation, at least when she was young. When Olga first left Stewart Island for Invercargill, her new environment was daunting. To help Olga in this time, her father sent books that he had read to her and her siblings. This support alleviated Olga’s homesickness (Sansom 1970, pp. 233-234).

When Susan came to New Zealand, she decided to return to complete a degree in science because it matched her skills and interests. What makes somebody want to do science is different to what keeps them doing science. In Susan’s case, her motivation to continue working in science is sometimes tested, giving her the feeling of wanting to give up. She experiences struggles inside and outside science. Inside science there can be the arrogance of colleagues and lack of recognition from them.
as well. Outside science there is apathy from the public. What would make someone want to continue in this field? For Susan, it is to be there for others who still have hope that these struggles will change (Walker, personal interview, 26 July 2012).

Other women have also experienced challenges inside science. A study found interesting biases in primatology, where females are the majority. Twenty-one annual meetings of the American Association of Physical Anthropologist were evaluated. It was found that woman presented more poster presentations than talks. The opposite was true for men. This is worrisome because people who present posters are seen as less dedicated or less serious. Organizers of these events select who gives poster presentations and who gives oral presentations. These gender biases are only seen when the organizer is male (Isbell, Young & Harcourt 2012).

Awards and prizes have seen biases as well. Although women are receiving more awards for their work than a decade ago, they receive less prestigious awards. In the United States, men filled 94 percent of the prize committee chairs. Additionally, 120 of the prize committees were comprised of only men (Lincoln et al. 2012). Similar results can be found in New Zealand. For example, the Leonard Cockayne Memorial Lecture award, which recognizes work in botany, has only given one award to a female, 15 to male recipients (Bray & Timewell 2011, p. 24-25). Judging by the last study, it would be interesting to find out how many women and men win awards when women fill the prize committees’ chairs. Would the biases be diminished, resulting in an even distribution?

In Susan’s experience, it is not necessarily gender biases that lead to challenges inside science. These challenges reflect back to the infrastructure. Susan
sees a career in science as competitive and individualistic, creating an atmosphere where both males and females work for themselves (Walker, email, 15 Dec 2012).

Outside struggles with conservation ideals are expressed in a paper that Susan collaborated on, *a unified approach to conservation prioritisation, reporting and information gathering in New Zealand*. “Many of the ideas we present have received little attention in the New Zealand ecological literature and outside government agency work teams” (Walker, Stephens & Overton 2012, p. 1). It would be hard to work in an environment where challenges seem to come in every direction. While it may be a big step to change a society’s apathy, science at least can make the move to create an unpretentious atmosphere. There needs to be activists to fight challenges outside and inside science.

3.5 Science and Life Balance

Susan is not a mother herself, but sees juggling a family life with a science career is still a major barrier for women. She describes mothers in her workplace as “superhuman.” She goes on to explain that a science career is not a nine to five job and can interfere with family life (Walker, personal interview, 26 July 2012). Susan is not the only one that feels that way. Shirley Tilghman is a molecular biologist and the first woman to be president of Princeton University. She also illuminates that science is not, and never will be a 9 to 5 job. Nevertheless, she advocates that it is the quality of science that needs to be emphasized, not the quantity (Tilghman 1993).
The demands of science can even influence decisions to have a family. A study conducted in the United States found that 29 percent of women graduate students are concerned that a career in science will prevent them from having a family. This can be compared with seven percent of male graduate students who also see family life as a concern (“Rice University” 2010). Is this a legitimate worry? Women in the U.S. who get pregnant and have children encounter lower expectations at work, as well as fewer opportunities, and lower pay than those women who do not have children (Sevo & Chubin 2010, p. 31-32). According to the 1996 New Zealand census, differences between the incomes of women with children and women without were recorded. Those women, who had dependent children and a male partner, had the lowest personal median incomes of $8,900. In contrast, women in a relationship and without children had the highest median of $14,200 (Ministry of Women’s Affairs 1999).

In order to counter this phenomenon, women may have to work harder than their male colleagues, as Susan has observed (Walker, personal interview, 26 July 2012). When surveying women who already have a career in science, 45.4 percent of them, as well as 24.5 percent of men, stated that they had fewer children than they wanted as a consequence of their science career (“Rice University” 2010).

Recently Susan was at a Lincoln research-planning meeting for LCR’s top biodiversity researchers. At a dinner, she and a friend counted around the table of around 20 researchers, which was about evenly split male and female, and found that only one woman scientist had children, and about 80% of the men (Walker, email, 27 Sep 2012).
I chose Olga to highlight as a pioneer for women in science because she was married and had children. Among 20 New Zealand pioneer women scientists I studied, there were only two other women who were married. One was Kathleen Maisey Curtis, also known as Lady Rigg. She was a mycologist and the first woman in New Zealand to receive a DSc. After many achievements Kathleen retired in 1952. She did not marry until 1966 at the age of 74 (Rhodes 2010). The other was Beatrice Tinsley who I will talk about further in Chapter Five.

Another reason Olga was chosen was that she did not have the university education that today would be needed to succeed in science. She still had the knowledge, and furthermore, the experience necessary to understand science. She was a foundation member of the Ornithological Society of New Zealand, an honorary secretary of the Southland branch of the Royal Society of New Zealand, and a foundation member of the Southland Art Society. She did these things later in life (Gilchrist 2010, para. 6.) During her time, she would still have been expected to care for the children and maintain the household, since New Zealand held on to traditional family roles for women (King 2003, p. 375).

3.6 Women Directing Science

Olga became the Director of Southland Museum at the age of 53 (Gilchrist 2010, para. 3). By then her children were grown up, so she had more time to dedicate to the museum. While Olga was able to attain a top position at a museum, few women reach top positions of science even today. According to Susan, it is not that women do not possess leadership skills, but that they are not self-promoting.
She again feels that this is another case that women need to be superhuman in order to reach this position (Walker, personal interview, 26 July 2012).

Should the attention be on who is directing science? Some believe it is more important to look at what and where research is being done (Churchhouse 1988, para. 1). Do women even want these positions? Susan sees a position in management as a trade-off, since you do less of your own research (Walker, personal interview, 26 July 2012). This was the case with Betty Batham in marine science, who saw that the administration side of her job took up most of her time (Southern 2005, p. 44). This trade-off may be a determent for some scientists, both female and male.

For some women the trade-off might be more than losing time for your own research. Olga seems to have reversed what women do today. She had her children young, then made contributions to science later in life. Today, women are leaving having children until later in life, after they have already started their career. Balancing raising a family with a career is one of the main reasons women leave science (“Women in science” 2011), instead of progressing in their profession.

3.7 Māori Women in Science

Susan believes that starting with the fundamentals is the key to attracting more Māori into science. This means building on early education, so that Māori women can consider the option to do science, once they reach university level.

Tertiary institutions were advised to increase their recruitment, retention, and completion rates for Māori. If they failed to improve these numbers, their
government funding would decrease. Even though the government stepped in to improve higher education for Māori, there were not enough reforms to develop basic living standards for rural Māori communities (Mutu 2003, para. 11). In 2007, it was reported that nearly 40 percent of Māori students left school before turning 17. This was 10 percent more than the national average. The report continues to show that 56 percent of Māori students left without a Level 2 NCEA qualification (Maori Education Report Card, 2009). There should be more effort to improve early education to raise numbers of Māori women and men in tertiary education, in addition, to increase their numbers in the sciences as well.

3.8 Summary

Susan Walker has seen the effects of women balancing today's expectations with traditional roles. They work hard as scientists, while fulfilling their role as wife and mother. To her, they are superhuman. Olga Sansom managed to satisfy a family life with a career in science, although it seems that most of her work was done after her children were grown up. It is not clear if Olga ever felt torn. This is a question I would have loved to ask her.

Olga's passion for science spilled into many areas: the museum, tramping trips with the Southland Girls' High School, and radio broadcasting. Olga showed there were many ways to make science part of your life. Students need to see the many opportunities, so they can make the choice of science as a career.

Susan made the point that, “Today, people are free riding on the sacrifices other activists have made” (personal interview, 26 July 2012). New Zealand
suffragettes fought for women’s rights. They succeeded when New Zealand became the first country to give women the right to vote in 1893. This brings up the importance of learning about the women from the past and what they had to go through to pave the way for women of today.

Olga wrote about the pioneers of Stewart Island. Science can learn from what she writes of their infrastructure. “Stewart Island’s pioneers worked like brothers together, not always agreeing, but agreeing to differ.” She also describes them “as a composite picture which you might like to hang on your wall.” (Sansom 1970, p. 235) Of course, I would add in sisters. Scientists need to start working together, not as a hierarchy, but as a composite picture.
CHAPTER FOUR: FORESTRY

4. Introduction

This chapter explores the field of forestry through the lives of Mary Sutherland and Julia Charity. Mary Sutherland was not only the first woman to graduate with a forestry degree in the UK, but also the first woman to work in the newly created field in New Zealand (Roche 2010). Julia Charity also worked in this area of science that was still male-dominated generations later. Currently, Julia has moved on from scientist to entrepreneur, giving her a different perspective of what her life was like inside the realm of science.

4.1 Mary Sutherland (1893-1955)

Mary Sutherland was born and raised in London. She was the first woman in the United Kingdom to complete a BSc in forestry in 1916, so her sights were set high (Roche 2010, para. 1, 2). In the UK, Mary served in the Women’s Land army during the First World War and had also gained experience working in her field as a forester on two Scottish estates (Lynch 1991, p. 40).

Mary came to New Zealand in 1924 to make her mark in the newly established area of forestry. Once in New Zealand, Mary started working as a forestry assistant for the State Forest Service, her job becoming permanent in 1925 (Maplesden & Langer 1993, p. 28). She was paid less than her male colleagues, and was seldom sent on fieldwork (Roche 2010, para. 4). Due to the Depression, cutbacks were made to the State Forest Service, and Mary lost her job as a forester.

Fortunately, she did not let this rough beginning in her career deter her. In 1946, she began work in the Department of Agriculture as a farm forestry officer. This was an important position and her work "helped reshape attitudes towards land use and break down barriers between farmers and foresters." During her time at the Department, Mary wrote many journal articles and contributed to a chapter for *Farming in New Zealand*. Mary worked until a kidney condition prevented her from continuing in 1954, and passed away a year later (Roche 2010, para. 8-10).

4.2 Julia Charity

Julia Charity lives in Rotorua, New Zealand and is working as an entrepreneur in hospitality. This is after a successful 15-year career in science, primarily working for the company Scion, a New Zealand Crown Research Institute, formerly the New Zealand Forest Research Institute Limited. She received her PhD in plant biotechnology from Australia National University in 1996. A large part of her research was to develop new techniques to genetically engineer pine trees and other conifers. Julia published 12 papers such as *Insect-resistant transgenic Pinus radiate*, and contributed to three book chapters. She co-developed the group Te Arotūruki, a pan-iwi National Advisory Group, which helps scientists engage with Māori. She also took on leadership and management roles, which gave her the skills to transfer to her new area of work (Charity, Skype interview, 31 July 2012).
Julia does not consider herself a feminist, but she is an advocate for strong personal conviction that is not defined by gender. Julia is a strong role model for her daughter and a compassionate team leader because of who she is as a person, not because she is female (Charity, Skype interview, 31 July 2012).

4.3 Infrastructure

Julia reasons that infrastructure, how New Zealand runs their science system, is there for a purpose. There needs to be a system in order to deliver science. However, she goes on to explain that when there is too much focus on the system that reports science, becoming too ridged, it can lead to a loss in creativity around the actual scientific experiments (Charity, Skype interview, 31 July 2012). Fostering creativity is becoming more important for big, innovative companies (Meyer 2000, para. 11). This can increase productivity and wellbeing in the workplace (Ario 2004, p. 16). Science needs innovation as well, and can learn from how these companies run their businesses. Julia believes a way to achieve this is by allocating 10% of a scientist’s time to a project of their choice (Charity, Skype interview, 31 July 2012). Not only could this improve employees’ attitudes toward their job, but it could also set up a more productive environment.

When Mary Sutherland started working permanently for the State Forest Service in 1925 (Maplesden & Langer 1993, p. 28), the new department was confined to a ridged structure. Because of this, they were not well equipped to handle a female employee, particularly in terms of accommodation. Since Mary was the only female among a group of males, she could not share a tent with her
colleagues. The Forest Service had to pay for alternative accommodation (Roche 2010, para. 4). Financially, this was a discouragement for the Service (Lynch 1991, p. 40). So instead, Mary was mostly employed on technical calculations and microscopic work (Roche 2010). This was considered “women’s work” and has been seen in other areas of science as an acceptable way women could enter their chosen field. Women were given office jobs, while the men performed the more physical side of research work (Sheffield 2004, pp. 129-130).

Even though Mary mostly worked in the office, and was paid less than her male colleagues, it was, nevertheless, a starting point for her career. Other women found this to be the way to enter science. For example, Amy Castle, who eventually was known as an entomologist, started working for the Dominion Museum in 1907, first as a photographic assistant. The main reason she was picked for the job was because she was female. The museum was attempting to save money so employed Amy, who they could pay less for the same type of work. She eventually moved to the entomology department and became the first woman to hold a scientific position in the New Zealand public service (O’Donnell 2011, para. 2-3).

4.4 Motivation

Two things helped get Julia motivated at a young age to do science: her fascination with plants, and her Year 12 biology teacher. Her biology teacher was the one to convince her to go to university, when she was only considering a certificate in science. At university, Julia heard about genetic engineering and
decided that was the direction she wanted to head (Charity, Skype interview, 31 July 2012).

Challenges to following her passion would present themselves in a number of ways. One was gaining support from the people around her. While Mary pioneered the way for women to go into forestry, many years later Julia pioneered the way for her working class family to enter science. Julia was the first in her family to attend university, and the first scientist her family interacted with. There initially was doubt that she could make science a viable career. Eventually, they understood her desire and then offered their support (Charity, Skype interview, 31 July 2012).

Julia may have gained support from her family, but she still faced trying to win support from coworkers. At the age of 27, Julia held a position leading a team of mostly older males. Some thought she was not up to the job, and made their views known. This would affect her self-confidence. “My perception was that you needed to be a real brainbox to do science and to succeed. And I didn’t consider myself in that elite” (Charity, Skype interview, 31 July 2012). Research has shown that cultural stereotypes can influence an individual’s self-confidence and ultimately choices (Charles 2011, p. 25). The academic culture in science fails to offer sufficient direction and mentoring for women. This can also affect self-esteem. (Etzkowitz, Kemelgor & Uzzi 2001, p. 355) While Julia faced self-doubt, she took action. Her mother told her to “fake it until she made it.” As long as she acted like she had confidence, it would eventually build until she actually did have that confidence. Julia additionally took leadership and motivation courses (Charity, Skype interview, 31 July 2012).
When Mary came to New Zealand in 1924 (Lynch 1991, p. 40), there were no women studying forestry at Auckland or Canterbury Universities, which held the original schools of forestry (Maplesden & Langer 1993, p. 28). When she started working for the New Zealand Forest Service, she experienced strong conservative attitudes and male prejudice (Lynch 1991, p. 40). Even today, forestry is still a male dominated field (Maplesden & Langer 1993, p. 28). What kept her motivated to pursue this field? Three of Mary’s four sisters chose to have careers, two in teaching, and one in medicine (Roche 2010, para. 1). Like Julia, it could have been family support that helped her through difficult times. Her biographer described her as having common sense, good character, intelligence, and a strong Scottish doggedness that helped her overcome challenges (Lynch 1991, p. 40). It could likewise have been Mary’s personal convictions, as with Julia, that kept them motivated through their work.

In 1952, Mary started traveling to Europe and North America for her job. She visited forests there and worked with farmers to help them understand the importance of forests (Roche 2010, para. 9). Julia Charity also travelled extensively when working in science, and considers this a benefit of a science career that is overlooked by young people. “Encouraging young people to see the potential for where science can go and grow for your own personal development is a good thing” (Charity, Skype interview, 31 July 2012). Opportunities to combine work and travel could be a motivator for many people.
4.5 Science and Life Balance

Mary Sutherland never married or had children. The structure of science during her time was one that did not accept marriage and a career. So Mary chose a career. She also worked for organizations supporting women: the Society for the Oversea Settlement of British Women, the New Zealand Federation of University Women, and the YWCA hostel at Woburn (Roche 2010, para. 7).

Before Julia had her daughter, she was working in management. In that position she felt overworked at periods and pulled in every direction. In time, she became sick with glandular fever for nine months. For this reason, when the time came to have her daughter, Julia stepped down from management feeling she could not juggle the demands of a managerial position with motherhood. She took maternity leave and afterwards came back part-time. Working part-time allowed her to balance motherhood with her career (Charity, Skype interview, 31 July 2012).

A survey conducted in Canada demonstrates that managers feel they have less flexibility in managing their work, they work long hours, and work comes before family (May 2003). Hence for Julia, following her personal conviction by stepping down from her managerial position and working part-time was the best choice for keeping her career while being a parent. As a result, she became very efficient in her work (Charity, Skype interview, 31 July 2012).

Part-time work is common for employed mothers in Western societies (Buehler, O’Brien & Walls 2011). This was not always the case. In New Zealand, the 1986 census revealed that women with dependent children were less likely to be employed at all (Ministry of Women’s Affairs 1999). Working part-time has been
seen as an adaptive strategy so women can balance work and family commitments. In contrast, others have seen it as a way to maintain gender inequalities in the workforce (Buehler, O’Brien & Walls 2011). According to the National Science Foundation, more women are employed part-time, listing family has the main reason (2011, p. 7).

4.6 Women Directing Science

The New Zealand Forest Research Institute Limited, now Scion, has always had low numbers of female scientists, and even fewer women in management (Maplesden & Langer 1993, pp. 29-30). Other Crown Research Institutes have similar numbers. In 2004, 36% of CRI staff was female, and filled less than 50% of senior positions (Bray & Timewell 2011, p. 20). Julia was one of these few, along with two other women at the time (Charity, Skype interview, 31 July 2012). It can be important to have women in these positions of power. It has been seen that some female scientists are more comfortable approaching female supervisors (Yentsch & Sindermann 1992, pp. 129-130). In order for other women to succeed in science, there needs to be women in higher positions who they are comfortable working for.

While moving up in a managerial position, Julia had a colleague say to her, “You will not last five minutes” (Charity, Skype interview, 31 July 2012). Some perceptions of women in her position are that they are not competent and do not have the managerial skills needed (Yentsch & Sindermann 1992, p. 126). Julia was labeled by her colleagues as someone who was trying to climb the corporate ladder, but managed to look past that to do her job. Julia had family support and leadership
training that gave her the confidence to do this (Charity, Skype interview, 31 July 2012).

4.7 Māori Women in Science

Julia has considerable experience working with the Māori community on scientific issues. She sees that Western science compartmentalizes a scientific experiment, while a Māori approach draws on a spiritual realm. For example, Julia worked with a Māori woman who was investigating the strength and property of fibers in fibrous plants to determine new product uses. The woman took a Māori worldview approach which considered the past traditional uses of the plants (Charity, Skype interview, 31 July 2012).

Te Arotūruki, the pan-iwi National Advisory Group that Julia took a part in building, assists dialogue between scientists and Māori. This framework helps each side become informed with each other’s views. “In order to move forward, scientists will need to overcome perceived cultural barriers and take the time to listen, learn and understand that the values and guiding principles that Māori live and view the world by are different to European New Zealanders” (Wilcox et al. 2008). It is important that science does not stay in a ridged structure, but instead opens itself up to understand other views.

4.8 Summary

With the help of a wonderful biology teacher, and the support of her family, Julia Charity pursued a career in science. She had struggles along the way with lack
of self-esteem and lack of the confidence of her peers, but still managed to work through those difficulties. Mary Sutherland faced similar discrimination from colleagues, but she too continued a career in science. Mary worked in science until her illness prevented her from continuing. Julia has left the field of science in exchange for hospitality, transferring the skills she learned from her science career.

Julia has stated that she is an advocate for personal conviction. Both Julia and Mary took strong stances that enabled them to work through the ridged structure of science. Julia’s main recommendation for science’s infrastructure is to embrace creativity and other worldviews. This will allow the system of science to change for the better.

[Mary Sutherland was]...“a true pioneer in her own right and well respected for her contributions in the early days of forestry in New Zealand. I admire her courage – firstly becoming the first woman graduate in Forestry, and then establishing her career in a very male dominated industry half way around the world in the early 1920s. I think of Mary often on my daily walks through Rotorua’s Redwood Forest – there is a plaque honouring her contributions next to a magnificent Redwood tree. How odd that our paths should cross in this manner. “

-Julia Charity
CHAPTER FIVE: ASTRONOMY

5. Introduction

This chapter gives attention to the world of astronomy. Astronomy has been an important contributor to the development of New Zealand. About a thousand years ago, early Polynesians followed the stars to Aotearoa to create a new settlement. Then in 1769, Captain James Cook traveled to the south Pacific to observe the transit of Venus (Hearnshaw 2006, pp. 63-64). Beatrice Tinsley continued her career in the United States, but started down the path of astronomy in New Zealand. Karen Pollard studied at, and now works for the University of Canterbury. Karen is also part of the Beatrice Tinsley Institute for New Zealand Astronomy and Astrophysics.

5.1 Beatrice Tinsley (1941-1981)

Beatrice Tinsley (maiden name Hall) was born in England. She was the middle child of three girls (Catley 2006, p. 19). Her family moved to New Zealand after the Second World War, first to Canterbury, then to Palmerston North. Beatrice attended New Plymouth Girls’ High School (“Beatrice Tinsley” 2011). School was when Beatrice started to explore thoughts about the origins of the universe and scientific theories (Catley 2006, p. 63). She was also interested in language, writing, and music (“Beatrice Tinsley” 2011).

After graduating high school at the age of 16, Beatrice enrolled at the University of Canterbury, where she studied mathematics, chemistry, and physics.
She would go on to finish her Master’s in physics in 1961 ("Beatrice Tinsley" 2011). Two years later, Beatrice left for Dallas, Texas with her husband, Brian Tinsley who was offered a position there. Unsatisfied with Dallas, Beatrice chose to work towards her PhD at the University of Texas in Austin, finishing in 1966 (Meduna & Priestley 2008, p. 100).

In 1974, Beatrice left Texas, and in that same year was awarded the Annie J Cannon Prize in Astronomy. Soon, she started working at Yale University, first as an assistant professor and then a professor of astronomy ("Beatrice Tinsley" 2011). Beatrice’s work revolved around measuring the Hubble constant to determine the age of the universe and how fast it expands. She noted the change of galaxies and how they evolve by using computer models (Meduna & Priestley 2008, p. 100).

In 1981, the same year Beatrice became a professor of astronomy, she was diagnosed with melanoma. Her priority was still her research until her death on the 23rd of March 1981 ("Beatrice Tinsley" 2011).

5.2 Karen Pollard

Karen Pollard studied at the University of Canterbury, where she received her PhD in astronomy. After working abroad, she returned to the University of Canterbury to work as a Senior Lecturer. She is also the Director of the University of Canterbury Mt John Observatory. Karen’s stance on issues around gender are that she believes everyone should have equal opportunities, and without barriers (Pollard, personal interview, 25 July 2012).
5.3 Infrastructure

Karen believes it is important to make science, especially physics and astronomy, a normal subject to study. Karen, like Abby Smith discussed in chapter two, also mentions the word ‘community.’ In Karen’s case, she talks about where women can see other women doing science. She points out that we are in an age now where many people have access to the Internet. “You can see women doing science and you can see woman scientists. And they’re held up as something you can aspire to.” She is familiar with the campaign, “Girls can do anything,” and thinks campaigns like this can help make science a normal choice for girls to select (Pollard, personal interview, 25 July 2012). Even when young, children’s views of scientists are influenced by outside sources such as cartoons, films, and books. This can affect their interest to further their science education (Steinke et al., 2011). Creating a community where young girls see women doing science could inspire them to pursue this as a career.

5.4 Motivation

Beatrice was a bright and highly motivated person. Yet, she still felt like she had to work hard to get anywhere. She chose science because she had a real interest in it. She was not close to her mother, but still felt that her parents had high expectations of her. Even when Beatrice left for the United States, she remained in contact with her parents through letters, which she wrote in a positive light (Catley 2006).
Karen was always interested in mathematics and science as a child. Her parents encouraged all of her interests. They gave her a telescope for Christmas when she was about 10 years old. From here on, she wanted to keep learning about astronomy. In high school she decided to take physics. She was one of four girls in a class of 30 students. Her friends would tell her to switch to biology instead. There were more girls in biology. Fortunately for Karen, being around boys didn’t bother her, since she grew up with two older brothers, both who also took physics and like it. Karen did state that there were some people who thought her choice was odd since girls did not typically do physics, although they did not discourage her (Pollard, personal interview, 25 July 2012). There must have been people who thought that Beatrice’s choice was odd as well since she was the only woman completing her Master’s in physics at the time, but she was not bothered by these biases either (Catley 2006, p. 127). Physics and astronomy were normal subjects to study for both Beatrice and Karen.

Physics was not always an odd subject for girls. In America during the 19th century, girls were actually overrepresented in physics, astronomy, chemistry, and natural science. It was thought that studying science would teach the necessary skills that women could apply to motherhood, social work, and teaching (Charles 2011, p. 27). After the First World War and the economic depression, however, a shift in numbers began. Women were seen as competitors for ‘men’s jobs.’ As a result, physics and chemistry progressively became ‘masculine’ subjects and were taught in the boys’ grammar schools (Watts 2007, p. 297).
Preconceptions of certain science subjects as masculine are still seen today, even in a university setting. A recent study tested gender biases amongst academic staff in biology, chemistry and physics. Both male and female science staff were given applications for a laboratory manager position that randomly had a male or female name. Male applicants were rated more competent, more hirable, given a higher starting salary, and offered more mentoring than females with the same application. Subtle bias against women was found to have a moderating role in these decisions. It was noted, however, that the female applicants were rated more likeable (Moss-Racusin et al. 2012). It is these subtle biases that hinder women’s progress in science. Normalizing science, particularly for females, is important at any level of study or work. As soon as it is seen as a natural subject to pursue, subtle biases can diminish.

5.5 Science and Life Balance

There is never a good time to have kids, according to Karen, because you’re always moving between temporary positions while trying to publish your work. She has seen first hand that having children can either slow or halt a woman’s career. She saw her friend give up studying for her degree after her first year of university so she could have her first child. She has seen PhD students take longer to finish their thesis after starting a family (Pollard, personal interview, 25 July 2012). There have been many women physicists who have admitted that one of major challenges they see when starting a family is the expectation that they take on the majority of familial duties (Blickenstaff 2005, p. 381).
Karen became pregnant with her first child when she and her husband were both postdocs in America. Feeling that they did not have a support network in America, they accepted a job share position back in Canterbury. There, they had family support to help raise their own family. Karen now has two children, ages eight and ten. She still works part-time so she has time for her children’s activities, while her husband moved back to full-time. Karen eventually would like to move to full-time once her children are grown up (Pollard, personal interview, 25 July 2012).

The time to have kids can be something to consider. Beatrice and her husband, Brian, made the decision not to have children when they were still in the early stages of their career. Ultimately, Beatrice found out that she was not able to get pregnant. At that time, adoption was a possibility she and Brian considered. Later, when a letter arrived for Brian, telling him about a family member who became pregnant out of wedlock, he wanted to adopt. Beatrice, who was now working on her PhD, did not want to adopt the child. But Brian pressed for the decision to start a family. In 1966, they became parents of a baby boy (Catley 2006).

Beatrice and Brian were still living overseas in Texas when they adopted their first child. They did not have the family support network that Karen returned to New Zealand to have. Beatrice soon found a nanny so she would have more time to finish her PhD, a case of the struggle in balancing motherhood and career. Two years after Beatrice and Brian adopted their son, they also adopted a daughter. While Beatrice tried to further her career, she always considered the children, planning ahead and finding them daycares (Catley 2006, pp. 162-164).
Working mothers can find it difficult to balance work life with home duties. In Germany, starting in Dec 2004, a fellowship program was developed to address these difficulties. It was realized that domestic chores and childcare generally fell to female scientists at home. So with funding from the Max Planck Society and private donations, fellowships were produced specially for these mothers (Opar 2006). This program acknowledges that there needs to be more done for women scientists with families. Women should feel like they have enough options within the system of science to accommodate family life as well.

Beatrice tried to find a job in Dallas, but it was not easy. In a letter to her father, Beatrice reveals, “The University of Texas in Dallas has kept me at the nearest possible level to nothing” (“Beatrice Tinsley” 2011). Brian, however, was happy with his position there. Many women, especially in Beatrice’s time, have placed their partner’s career first and forgone their own (Hall 2010, p. 21). However, Beatrice could not do that. Her longing for a fulfilling job in science, along with other factors, led her to want a divorce. Brian would not let her take the children, or at least, not their son. So instead of separating the children, Beatrice agreed to leave them with Brian (Catley 2006 pp. 225-226).

5.6 Women Directing Science

Karen considers that there should be changes within top management positions, and more effort is needed to get women in those positions to make a difference. She points out that the more diversity in management, the greater range of ideas there will be, which will benefit science. In Karen’s experience, meetings
were scheduled during times she would have to leave to pick up her kids because the men making the schedule did not hold those responsibilities (Pollard, personal interview, 25 July 2012).

Increasing the numbers of women may or may not make a difference. What will make a difference is making sure their voices are heard. A study was done to determine women’s participation and influence in deliberation. A number of conclusions were recognized. In situations where women are the minority, they participate less than their equal share. Conversely, they participate equally when in a large majority, and have more influence. In situations of unanimity, where every voice is heard, women were not at a disadvantage when they were in the minority. In these groups, women actually participated more when they were in the minority than when they were in the majority (Karpowitz, Mendelberg & Shaker 2012).

Attention needs to be given to how meetings are conducted and how decisions are made. If a woman is in a position of power, yet feels like she does not have any influence, why would she want to continue working in that position?

Another example Karen gave of a situation where more women would have been beneficial was when the University of Canterbury first introduced research grants for early researchers. The recipient had to be a full time researcher and there was a time limit put on the grants. So women who only worked part time due to family restraints were excluded from these grants. Karen brought this to the attention of the University. Now the research grants have been changed to take these women into account (Pollard, personal interview, 25 July 2012). In the United
States, women are still less likely to receive federal grants or contracts (National Science Foundation 2011, p. 8).

The Marsden Fund in New Zealand, distributes $60 million dollars per year for funding. There are 10 review panels of representatives for various subjects. The panel for physics fails to have any female representatives (Bray & Timewell 2011, p. 21). There needs to be a female’s perspective on funding decisions.

5.7 Māori Women in Science

Māori and Pacific women are underrepresented in science. Karen points out that the first thing that needs to be done is recognizing that there is a problem. She believes a way to combat this is to find mentors and highlight Māori achievements in the sciences. Just like making science a normal subject for women to study, it should be a normal subject for Māori to study as well (Pollard, personal interview, 25 July 2012).

Like Susan Walker from chapter three, Karen Pollard believes we need to start at the fundamentals. This requires giving teachers the right tools to teach science (Pollard, personal interview, 25 July 2012). Ruth Watts brings out the example of Jane Marcet’s book Conversations on Chemistry in which the Elements of that Science are familiarly explained and illustrated by Experiments, written in the 1800’s. Marcet wrote the book in a conversational style and offered examples of experiments to teach chemistry. The characters of the book were a female teacher and two teenage girls who she taught. Another example she gives is a book called Practical Education, written by a friend of Marcet’s, Maria Edgeworth. This book is
also aimed at girls, teaching them chemistry through learning confectionery (Watts 2007, pp. 287-289).

Even though these examples are from the 19\textsuperscript{th} century, the modern science can still be inspired by the past. While these books focus on teaching chemistry, and rather gender biased, it’s the principle that can be applied to any science subject. The issue is about getting Māori and other underrepresented groups interested in science. It is also about getting girls, as well as boys interested in science at a young age. This can be achieved by using a variety of tools and techniques to intrigue children.

5.8 Summary

It is important to create a community where everyone feels welcomed. Science is a normal subject to pursue for any gender or race. Teachers need to have the knowledge and enthusiasm to depict this to students when they are young. Also, teachers need to take advantage of today’s technology and use it to showcase achievements from women and Māori scientists.

Although this hopefully will intrigue more minority groups to enter science, their experience within science needs to be improved as well. Specifically, the lives of mothers who have the challenge of balancing their career and family. Overall, there should be more options for these women. More options for daycare, maternity leave, paternity leave, funding, and so on. Women should not feel like they have to make an either/or choice.
“Beatrice Tinsley seemed to be an amazing women – she was academically very bright and made some fundamental breakthroughs in galactic research in her short lifetime. That she achieved so much in a time when women were discriminated against means she must have had great determination. Students and colleagues she worked with said she was also a lovely person – very supportive and encouraging, and especially helpful to young women graduate students.”

– Karen Pollard
CHAPTER SIX: MĀORI IN SCIENCE

6. Introduction

This chapter reveals the lives of Māori who have chosen to pursue science. Makereti Papakura was a well-respected guide in tourism. She moved to England when she was 38. There, she started studying anthropology when she was 53, although it can be argued that she studied it through personal observations all her life. Ocean Mercier now works in the Department of Māori Studies at the Victoria University in Wellington, moving from the Department of Physics. Like Julia Charity, this gives her a unique perspective, now working in a different field, reflecting on what her life was like in physics.

6.1 Makereti Papakura (1873–1930)

Makereti Papakura was born at Matata, in the Bay of Plenty. Her mother was a hignborn Te Arawa Māori and her father was an Englishman. Relatives from her mother’s side in Parekarangi raised Makereti with Māori customs. When Makereti was 10 years old, her father started paying for her education. She soon attended Hukarere Native Girls’ School where she learned English (Northcroft-Grant 2010).

When Makereti was 18, she married Francis Dennan, with whom she had one son, William Dennan, that year. They eventually divorced in 1900. She had already returned to Whakarewarewa, where she started working as a guide (Northcroft-Grant 2010). “Guides provide evidence of a ‘living’ culture, linking traditions of the
past to the practices of the present, sharing their own stories and experiences which hold personal meaning” (Dwyer 2012).

In 1910, Makereti traveled to Sydney, Australia to take part in an exhibition. A year later, the exhibition moved to London, and Makereti moved with it. After the exhibition was over, Makereti returned to Whakarewarewa. She did not stay for long, and traveled back to England to marry Richard Charles Staples-Brown in 1912. In 1924, this marriage ended in divorce, but Makereti still remained in England (Northcroft-Grant 2010).

In 1926, Makereti started studying anthropology at the University of Oxford. She visited New Zealand to gain approval for this work from her elders (Northcroft-Grant 2010). She became part of the Oxford Home-Students society, instead of joining a college since women were not allowed to join the colleges at this time. Her son also studied anthropology at The Queen's College (Diamond 2007, p. 143).

Makereti died in 1930, two weeks before her thesis was due. A friend of hers, T.K. Penniman, published her thesis, *The old-time Maori*, eight years after her death. This work “gives an account and analysis of the customs of Te Arawa from the point of view of a woman. It covers many aspects of daily life, including child-rearing and family relationships, which were generally ignored or treated superficially by male writers on Maori society” (Northcroft-Grant 2010).

6.2 Ocean Mercier

Ocean Mercier has spent all her professional life at university. After she completed her PhD 10 years ago in condensed matter physics, Ocean started
working in the physics department on a contract research and teaching appointment. Her postdoctoral research was in superconducting tapes and Antarctic sea ice.

Ocean left physics and science, in 2004, to pursue Māori studies. She accepted a position as a lecturer. She now teaches Māori science, and Māori research and methodology. Ocean considers herself a feminist because she notices imbalances that are still in our culture. “We can't let down our guard and think everything's fine now because it's not” (Mercier, personal interview, 2 Aug 2012).

6.3 Infrastructure and Māori Women in Science

Ocean sees the parallels between Māori and women in the framework of science. She sees these groups being enticed to enter science, only to be beaten down by the system. Ocean believes that science needs to create an environment that rewards the heart and soul of the people working in it (Mercier, personal interview, 2 Aug 2012).

Programs to aid women in science were evaluated to determine their effectiveness. Some programs tend to view the conditions of women in science as an individual issue, instead of a structural concern. There have been other programs created to assess the “chilly climate” in science, aiming to urge diversity and lower competition. Solutions to improve this environment have been to create additional circles for women to go and share their experiences. This is a chance for women to discuss their concerns, but still fails to effectively change the chilly climate (Fox 1998). Making sure women have a place to go and be heard I feel is important, yet
the phrase “preaching to the choir” comes to mind. There should be programs for those women who are experiencing a chilly climate, for those who are contributing to the chilly climate, and for those who do not realize what is even going on.

Working as a lecturer who is young, female and Māori, Ocean felt like she was breaking a taboo teaching physics (Mercier, personal interview, 2 Aug 2012). Studies were conducted in the United Stated using the Draw-a-Scientist Test (DAST) to test children’s perceptions of science and scientists. The results indicated that children mostly perceive science and scientists as masculine. The studies were conducted across a range of grades from kindergarten through twelfth grade. No matter at what age, the participants usually drew pictures of male scientists, and 74 percent of the pictures were Caucasian. Related studies were done in various countries, Ireland, Turkey, and Korea, all having similar results (Steinke et al. 2011). These perceptions could be creating the indescribable environment that Ocean experienced while teaching physics.

Ocean also believes that the infrastructure of science can improve if it is open to other knowledge systems. She explains, “Science sets itself up to be objective and value free and all these things, but needs to learn the lesson that it’s just another system, another knowledge system created by human beings in a social context” (Mercier, personal interview, 2 Aug 2012). Knowledge systems reflect the society and culture of a geographical area. Māori knowledge system, in particular, reflect their relationship with the natural environment (Ulluwishewa, Roskruge, Harmsworth & Antaran 2008, pp. 271-272).
Throughout history, different types of knowledge have been held above others (Watts 2007, p. 283). And in science, knowledge based on Eurocentric or Western views, are held above the rest (McKinley 2003, p. 6). Tourism now uses Māori culture to promote New Zealand, which has led to an awareness of Māori traditions (Dwyer 2012). Makereti Papakura, working as a tourist guide to a geothermal area, knew how to bring the Western world and the Māori world together. Science education can learn from Makereti’s work by combining the two knowledge systems.

Wānanga are iwi-based and iwi-initiated tertiary institutions that offer one way of combining the two knowledge systems. In 2003, there were 63,000 students enrolled. They accept persons from all ethnicities, but teach from a Māori perspective. One goal of these institutions is to provide higher learning to adults who did not flourish in primary and secondary education systems (The Report on the Aotearoa Institute Claim Concerning Te Wananga o Aotearoa 2006).

An example of this type of education is when Ocean taught a class at a Marae. There, she used Māori names for the stars. The children were already familiar with the Māori star names and the oral history associated with them. Ocean saw how the class switched on to the lesson (Mercier, personal interview, 2 Aug 2012). By incorporating different knowledge systems, more children can be reached. It would be interesting if all learning institutions considered this approach, at least for a select number of classes.

Resource management has considered a Māori approach for sustainability. Just as Julia Charity described in chapter four, Māori take a spiritual approach, while
considering every aspect of the ecosystem. Within their knowledge system, Māori offer a range of indicators to evaluate the environment for harvest of natural resources (Ulluwishewa et al. 2008). Their approach can be taught to resource management students as another method for creating sustainable practices.

6.4 Motivation

Ocean chose to study science because she enjoyed it. She attributes this to having good, enthusiastic teachers at Wellington’s Girl’s College, her secondary school. Comparable to Abby Smith, Ocean liked the challenge that physics presented and the concrete answers to questions of how the universe works that it gave (Mercier, personal interview, 2 Aug 2012).

Ocean felt that her education in secondary school offered a safe introduction to physics since it was an all girls’ school. Once at university, where the classes where mixed gender, there were new social dimensions. She recalls that there were guys who could not admit they made a mistake, or played games of who is smarter than who. “It’s just those little moments, but they kind of add up after awhile” (Mercier, personal interview, 2 Aug 2012). It is noted that “gender discrimination in the 1990s is subtle but pervasive, and stems largely from unconscious ways of thinking that have been socialized into all of us, men and women alike” (Etzkowitz, Kemelgor & Uzzi 2001, p. 356). Many women have stated that science has a “chilly climate” and this is a reason they chose not to continue with a science career (Blickenstaff 2005, p. 380).
One way to contest a chilly climate and encourage more Māori students to do science is to provide additional support. The Māori Research Centre in Auckland opened its doors to support to Māori students who are completing their PhD, and support for their communities. Since the Centre opened, the numbers of Māori working on PhD’s have increased. In 2002, there were only a few dozen students enrolled in PhD’s, and now in 2007 there are at least 500 (Bohannon 2007). Centres like these that focus on creating a supportive community can be beneficial to underrepresented groups in science.

Makereti’s motivation is not easily assessed. She received more schooling than most during her time. Because of the 1877 Education Act, primary education became free in New Zealand. Even so, school was not compulsory for Māori until 1894. Furthermore, it wasn’t until the 1930s that secondary education became more accessible (Diamond 2007, pp. 25-26). Makereti’s father paid for her and her sister’s education at the time. She became a very knowledgeable guide, and visitors sought after her (Northcroft-Grant 2010, para. 2-3).

6.5 Women Directing Science

Female scientists have the notion that they need to play the game in science culture (Hall 2010, p. 20). Ocean is aware of this and comments that at first women who entered science were prepared to play the game of becoming more like men, in order to survive the world of science. But she is also aware of a generation who is pushing back against the system in subtle ways, but ways that matter. She says that these subtle changes allow other women to come into science and not feel like it is
an alien environment. Feminist writer Evelyn Fox Keller also talks about how the mere presence of women in leadership positions changes the meaning of traditional gender roles (Keller 2004, p. 13).

Does the presence of women make a difference? A study was done across 353 Fortune 500 companies analyzing their revenues and gender ratios of their top management teams. It was found that companies with more women on their management teams had better financial performance. Companies within this study that were given the Catalyst Award outperformed 339 other companies that were sampled. This award recognizes efforts and the effectiveness of increasing women in management (Catalyst 2004). There may be other reasons for the connections between women in top management positions and overall financial performance than just the women themselves. These companies could have a better and more accommodating atmosphere for women and men alike. This study could go further accessing additional differences between these companies such as average working hours, holiday time, or maternity/paternity leave. Correlations with race and financial performance should also be investigated. The fact remains that the presence of women is linked to better performance in well-established companies.

There is a generation pushing back against the system, but maybe not so subtly. The group, Young Women Changing Aotearoa, or YWCA has set up a campaign to demand equal pay by passing the Pay Equality Bill. The group points out that women on average earn 10 percent less than men. They have acknowledged an experiment by Brosnan and Waal for backing (Young Women Changing Aotearoa 2012). The experiment showed that capuchin monkeys recognize when they were
rewarded unequally, and reacted negatively by refusing to complete requested tasks (Brosnan & Waal 2004).

6.6 Summary

Ocean recognizes that Māori knowledge is undervalued in science. Instead of seeing other knowledge systems as inferior, science education and research needs to understand and learn from these systems in order to progress. The infrastructure of science also needs to change into an organization that rewards the heart and soul of those working in its confines.

The importance of teachers has been reiterated in this section. Ocean had good teachers that motivated and inspired her to pursue physics. She might have still followed physics even if she had inept teachers, but they did supplement to her overall perception of the field.

Ocean believes there is currently a generation pushing back against the system that makes little, but effective changes. I believe more research needs to be done in this area, especially on the effects that the presence of women and women of color have on work atmospheres and performance.
CHAPTER SEVEN: CONCLUSION

After listening to the stories that the women I interviewed told, then comparing them to the women from the past, and after reading the literature written by various generations, I have concluded that although there have been steps taken to improve conditions for women in the sciences, there still needs to be larger strides. Laws were passed to aid women’s equal rights. In New Zealand, the Human Rights Act of 1977 prohibited discrimination against women, and the Bill of Rights Act of 1990 prohibited discrimination based on sex or marital status (Herd 2006, p. iv-vii). Yet, laws have only reached so far. Women still do not receive equal pay for the same work as their male colleagues (Bray & Timewell 2006, p. 13). The biggest challenge that seems to pervade is where laws fail to reach. Underlying biases found in our culture are reinforcing barriers for women. Feminism is still needed to contest this challenge.

Ever since I started researching for this thesis, I found myself noticing stereotypes and discrimination more. Whether I was out with friends, watching television, or listening to the radio, someone makes a sexist joke, everybody laughs. If you don’t, you are ridiculed for lacking a sense of humor. Is inequality too much to deal with anymore that it gets turned into a joke, and then forgotten? Surveys were given to adolescent girls who were studying science, math, computer technology, or athletics in the United States, asking if they have experienced sexism in an academic setting. The results show how laws have not reached far enough. Ninety percent testified that they have encountered sexual harassment at least once. Of these
women, 67 percent stated receiving unwanted romantic attention and 52 percent received unwanted physical contact. They have experienced teasing with 62 percent exposed to demeaning gender-related comments, 58 percent harassed because of their appearance, and 25 percent bullied or threatened with harm by a male. Specifically in the areas of science, math, and computer technology, 52 percent of girls reported receiving discouraging gender-based comments on their abilities, typically from male peers. In athletics, 76 percent of girls reported sexist comments on their abilities, mostly from male peers. It was more likely that girls who reported sexist behavior were knowledgeable about feminism (Leaper & Brown 2008). I do not find these numbers funny and would be horrified to see this turned into a joke on a sitcom.

A reminder of the definitions of feminism I provided in the Introduction, "a movement to end sexism, sexist exploitation and oppression" (hooks 2000, p. viii). Also, "feminism is a cultural as well as a political movement. It changes the way women think and feel and affects how women and men live their lives and interpret the world" (Hannam 2012, p. 3). It was feminism that challenged science, and improved conditions for women (Keller 2004, p. 7). Feminist values can continue to help women realize what they are experiencing compared with what an ideal world would entail. Women should be honest with themselves and with the situation. Women can once again unite and stand up against any form of discrimination towards any group of people.

I believe that the most important aspect of my research was talking to the women I interviewed. Each woman said she was interested in and enjoyed doing
science. That was motivation enough to make a career in it. All experienced challenges along the way, but either they have a support network, or are the support network. This allowed them to work past these challenges. It seems that support networks are instrumental in helping women achieve their goals. Other reports have also shown that mentorship and a supportive environment are essential for women scientists to feel satisfied in their job ("Women in science" 2011, para. 3).

A follow-up to this thesis topic would be to explore how feminism and media can be used to support women in science. Karen Pollard had expressed this when she talked about how today's technology can help promote women in science. Media can turn around to act as a support network when women feel that they do not have one. The more young girls see women doing science on the Internet, or through magazines, it becomes a more normal subject to pursue (Pollard, personal interview, 25 July 2012). Women actually engage with social media more often than men, and in a more personal manner. Plus, women share their own experiences and seek advice from other women through social media. Marketing relies on this to promote their brand (Nation 2012). Science communicators can use social media to promote science as a career choice for young women. This can be taken a step further in that women already working in science can use social media to find support when encountering challenges. Rayna Rapp used Ms Magazine to collect data for her study, asking women to write about their experiences with amniocentesis (Roberts & Mackenzie 2006, p. 161). My study can be transferred to media in a similar way so that other women in science can share their experiences and answers to the questions that I asked my interviewees.
This would be an important direction to venture, since media has been used against women. In 1970, page 3 was launched in the UK tabloid *The Sun*, which displays topless women. Four different feminist groups came together to set up a protest against this content by designing a birthday card. Half of the card had pasted on images of topless women from the tabloids, and the other half of men, who were clothed (Cochrane 2012). For 42 years this page was considered accepted content for these publishers. Media endorses the continuing use of stereotypes for the detriment of women.

It is not just the tabloids. Media can also misrepresent women in science. A study by Chimba and Kitzinger analyzed media representations in the United Kingdom’s national press, and found vast differences in the content of these articles. Overall, 84 percent of articles were written about male scientists verses the 16 percent about female scientists. Within the profiles written about women, half referred to their clothing, physique, and/or hairstyle (2010, p. 612). While this is not as explicit as bare breasts, there is still a discrepancy in how women and men are depicted. In terms of science communication, what are we communicating? Is the appearance and gender of the scientist more important than the science itself?

Feminism offers values that can connect women in the struggle to gain equality. At the end of each interview, I asked the women if they identified themselves with feminism. Not every interviewee wanted to be associated with the word, but all still held similar goals and values. Is our independent nature not allowing us to work together for the same cause? I believe more women need to
share their experiences and challenges so that the infrastructure of science can adjust to fix the issues.

Synchronous breathing occurs among pilot whales. The exact reason is unknown, but researchers theorize that it could be a mechanism for reinforcing social bonds (Senigaglia 2012, p. 218). Metaphorically, feminism creates a similar system. Breath in timing with a group, reinforce bonds and empathize with each other. Then move forward as a composite picture, as Olga Sansom would say.

I was only able to interview five women, but there are many women doing science, each with their own perspective.


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