This thesis explores the role of Quaker women in science in an attempt to arrive at some understanding of what motivated Quaker women in nineteenth century America to go into the sciences. George Fox founded the Society of Friends in the mid-seventeenth century in England and the Quaker theology centered on the concept of the Inner Light, which is the idea that everyone has the capacity to perceive, recognize, and respond to God. Following their Inner Light to find God, Quakers also referred to themselves as “seekers of truth.” Additionally, Quakers have believed since their inception in the equality between men and women. Given the Quaker desire to pursue truth and their belief that women have the same capacity to do so as men, it is not surprising that there were a number of Quaker women in science. Through an examination of three Quaker women in science, I discuss the Quaker influences in their lives and works with the larger goal of demonstrating the inherent connections that exist between Quaker theology and the pursuit of science in the nineteenth century. One such connection lies within the tradition of natural theology, which was prevalent in the larger scientific
community in the eighteenth and nineteenth centuries. The connection that is unique to Quakers, though, relates to their idea of the search for truth, which led many Quakers to employ scientific methods. The three Quaker women examined in this study, astronomer Maria Mitchell, naturalist Graceanna Lewis, and medical doctor Ann Preston, were all truth-seekers in some sense who wanted to find evidence of God’s work within nature.
The Light Within Us: Quaker Women in Science

by

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Leslie N. McCabe, Author
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The Light Within Us: Quaker Women in Science

Introduction

The subject of this thesis is Quaker women in science and the aim of this thesis is to demonstrate that there is something inherent in Quakerism that led many Quakers—both men and women—into science. But of particular interest here is the work of Quaker women in science and the connections that can be seen between Quakerism and science within the work of three specific women: astronomer Maria Mitchell, naturalist Graceanna Lewis, and medical doctor Ann Preston. Although quite a bit has been written about both Quakers in science and Quaker women, there is no body of literature that discusses the role of Quaker women in science. If one searches the names of women in science, the names of a number of Quaker women appear, including astronomers Maria Mitchell, Annie Jump Cannon, Charlotte Sitterly, Jocelyn Bell Burnell, naturalists Graceanna Lewis, Mary Walcott, Dorothy Cadbury, and Priscilla Wakefield, and physicians Ann Preston, Annie Elizabeth Clark, Sarah Adamson Dolley, and Emily Jennings Stowe, just to name a few. Even within some of the works on either Quaker scientists or Quaker women, authors do mention the role of Quaker women in science, but no one focuses specifically on this topic.
Why Study Quaker Women in Science?

One might inquire why it is interesting to study specifically Quaker women in science as opposed to the scientific work of women in another denomination. While a comparative study of Quaker women and women of another denomination would be very interesting, it is difficult to find similar literature on other denominations. If one examines the Quaker literature carefully, one will find that most of it has been written by Quakers for Quakers; the study of Quaker scientists has not, until quite recently, been a study pursued by anyone outside of the Society of Friends. Nor have scholars writing about women’s history found it necessary to discuss the role of Quaker women’s history; rather, this literature comes from authors within the Society of Friends interested in discussing the important role that Quaker women have played historically in the Society. Thus, the Society of Friends is no more interesting than any other sect, but Quakers have produced a large amount of literature regarding the role that Quaker women and Quaker scientists have played historically in the movement.

Even so, it does appear that Quaker women are more visible in science than women of other denominations. If one examines the various biographical dictionaries on women in science, it seems that the religious affiliation of scientists is rarely noted unless the religion played a significant part in their lives or somehow influenced their scientific work.¹ Of course, one religion that is

¹ Benjamin and Barbara Shearer, eds. Notable Women in the Physical Sciences: A Biographical Dictionary (Westport, Connecticut: Greenwood Press, 1997);
frequently mentioned is that of Judaism, but it is almost entirely in reference to women such as Ines Mandl and Gertrude Scarff Goldhaber who had to flee Nazi Germany before World War II. Also, Cecilia Payne-Gaposchkin is noted as having taught Sunday school in the Unitarian church and Sarah Frances Whiting was known as a devout Congregationalist.² It is entirely possible that other women scientists did have particular religious affiliations that are just not cited by those who chose to write about their lives and work.

The denomination besides Judaism that is referred to frequently is Quakerism. There are a number of possible reasons that Quakerism has been more noted than other religious affiliations. First of all, the women who are specifically identified as being Quakers tended to be activists for social causes. Involvement in social reform movements was an important component of membership in the Society of Friends, so very often participation in these various movements was a significant part of Quakers' lives, even for those who were also scientists. For example, Kathleen Lonsdale was a prominent British scientist, but she was also very involved in various peace movements and she worked for prison reform as well. Her social activism was often regarded to be as important if not more important than her work in crystallography, and much of this activism related to her membership in the Society of Friends. At least for the first century or so of its existence, the Society of Friends was considered a dissenting sect. Quakers

² Shearer, 146, 252, 290, 417.
strived to actively maintain a separation from the norm, and this difference was often noted as a Quaker characteristic.

So, part of the answer to the question “why study Quaker women in science?” is that others have found the Quaker affiliation of these women to be significant. The question then becomes “why did these Quaker women decide to go into science?” It is the aim of this thesis to attempt to answer that question in a number of different ways.

The first of these relates to the concept of truth, which is central to Quaker doctrine. As I will explain later in more detail, Quakers consider themselves “searchers of truth.” I have speculated here on the connection between this Quaker concept of truth and the idea of truth that scientists pursue in their research. Also, what is the nature of the Quaker search for truth? Is it a spiritual truth? I inquire here about whether or not Quakers believed that one might seek spiritual truths in nature, as in the sense of natural theology. I examine the natural theology tradition of the eighteenth and nineteenth centuries in an effort to illuminate this issue.

The accomplishments of Quaker women in science might encourage the strong claim that Quaker women were bound to be more successful than women from other religious sects, or the weaker claim that they just had better opportunities. The Quaker belief in the equality between the sexes and the Quaker emphasis on education, particularly science education, could be used to support such claims. However, it is also possible that the three women studied in this
thesis were simply the products of their time. It was during the nineteenth century, the time period in which each of these women lived and worked, that women in America began to gain access to higher education. If one examines the literature on women in science during this time, such as the work of Margaret Rossiter, one will find that white women of the middle to upper classes were being educated and many were finding positions outside the home.³

The purpose of the case studies is to determine whether or not these three women were merely anomalous cases of Quaker women who happened to be raised in families or communities that emphasized science education for girls. These women came from different family situations, had different educational opportunities, and pursued scientific interests in different fields, but there are intriguing similarities between them that I argue were a product of their Quaker heritage.

The Literature

There are also questions relating to the nature of the literatures themselves that are interesting to examine. First of all, why has no one written about Quaker women in science? Part of the reason could relate to the hagiographic nature of

³ Although race is not something that is examined the literature on Quakerism, it should be noted that the Society of Friends, particularly in the nineteenth century, was composed largely of a white population. It could be speculated, though, that the opportunities available to the three women studied in this thesis would not have been readily available to them had they not been identifiable members of the white upper-class.
these literatures. As already noted, the literatures on Quaker scientists and on Quaker women have been written by Quakers and for Quakers. There is certainly an element of bias present there. Perhaps the examination of Quaker women in science has not been something of particular interest to anyone within the Society of Friends, although these women are discussed within the larger contexts of both literatures, and perhaps no one from outside the Society of Friends has thought to examine these women because the literature seems so insular.

As is the case with most of the literature regarding Quakerism, the works written about general Quaker history have been written by people who have some sort of association with the Society of Friends, although they have not all been members of the Society. Elbert Russell and Howard Brinton, authors of *The History of Quakerism* (1942) and *Friends for 300 Years* (1952) respectively, are undoubtedly members of the Society of Friends who have also served in academic roles at many of the Quaker colleges. This also seems to be the case for Hugh Barbour and J. William Frost, co-authors of *The Quakers* (1988). Brinton in particular is an important Quaker scholar who has written many books on various aspects of Quaker history, the most important one for this thesis being *Quaker Education in Theory and Practice* (1940). It does not seem that sociologist David E. W. Holden, author of *Friends Divided: Conflict and Division in the Society of Friends* (1988) is a Quaker himself, but he does note his wife's membership in the Society and he did serve at least one year as a scholar-in-residence at one of the Quaker colleges. It thus becomes apparent that the Society of Friends has
produced a number of scholars who are interested in examining the history and theology of their sect. There are some more recent books and articles on Quaker history, but the ones that cover the history more generally have not yet been surpassed, although Barbour and Frost’s history is relatively recent.

Quakers in Science Literature

Many works have been published on the topic of Quakers in science, probably the earliest account being Arthur Raistrick’s *Quakers in Science and Industry: Being an Account of the Quaker Contributions to Science and Industry During the 17th and 18th Centuries* (1950). In his conclusion, Raistrick states that the purpose of this work was to ask the questions: “Is there anything in all this which is peculiarly Quaker?” and “Have the Quakers made a contribution to science or industry which, in its description, merits the inclusion of the term ‘Quaker’?” His response to these questions is:

> We have no hesitation in giving an affirmative answer to these questions, although in essence the answer rests on ‘the sense of the meeting,’ the sensing all through their work, their journals, and their letters, that these men lived in an ever-present certainty of the unity of life and all its multifarious activities.4

It hardly seems surprising that a Quaker writing about the history of Quaker successes would come to this conclusion. And indeed, one would certainly put Raistrick’s book in the same category with much of the other literature that

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4 Arthur Raistrick, *Quakers in Science and Industry; Being an Account of the Quaker Contributions to Science and Industry During the 17th and 18th Centuries* (New York: Philosophical Library, 1950), 335.
currently exists about Quaker history, Quakers in science, and Quaker women—all of which are very hagiographic.

Geoffrey Cantor, a more recent scholar on Quakers in science, and perhaps the only non-Quaker writing about Quaker scientists, takes Raistrick to task in his essay “How Successful Were Quakers at Science?” Cantor later arrives at the conclusion that this question is invalid—and thus so is Raistrick’s entire argument. Cantor says that trying to determine if Quakers were successful at science or not is not the issue on which historians should focus.

Not only is it difficult—perhaps impossible—to determine the relative success of Quakers in earlier periods, but by focusing on the problem of determining whether Quakers were more or less successful at science than non-Quakers may be ignoring many historically important issues concerning the Quaker engagement with science.5

He proceeds to pose a number of more focused questions that he has answered in other papers.6

Quaker Women Literature

Much of the current literature on Quaker women relates to early Quaker women’s writings. Rosemary Foxton has compiled an annotated bibliography of

6 For example, “How did Quakers respond to Darwin’s theory of evolution?” which he addresses in his article “Quaker Responses to Darwin,” Osiris 16 (2001), 321-342. Also, “Why were a number of Quakers drawn to careers in horticulture, botanical illustration and botanical publishing?” which he answers in his essay “Aesthetics in Science, as Practised by Quakers in the Eighteenth and Nineteenth Centuries,” Quaker Studies 4 (1999), 1-20.
Quaker women's writings from 1650-1700 that contains more than four hundred references to works published by Quaker women during this period. Foxton says that while women writers were not uncommon during this time, "among the newly visible women authors emerging during this period by far the largest single group is made up of the writers of Quaker tracts, testimonies and spiritual biographies."\(^7\) The abundance of this literature is one way of demonstrating how important women were in the founding of Quakerism and how Quaker women were allowed—and oftentimes encouraged—to play an active public role. Indeed, in her foreword to an edited volume of Quaker women's writings from 1650-1700, feminist theologian Rosemary Radford Ruether claims that the first movement of feminist theology occurred in seventeenth century England primarily with the writings of Quaker women who were reinterpreting texts and theological arguments in order "to claim women's rights to larger cultural roles in society and in the church."\(^8\)

One of the things that is most visible in the literature on Quaker women is the Quaker ideal of social activism. Margaret Hope Bacon in particular focuses on work done by women in various social reform movements. As a Quaker, Bacon is not detached from her subjects; in her book *As The Way Opens: The Story of Quaker Women in America*, she explains how she came to this work: "I hoped my

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lists [of notable Quaker women] and the talks I gave from them, would serve as a point of departure for modern Quaker women to think about the kinds of things Quaker women had done in the past in order to open our minds and hearts to what might be required of us today. She admits that the purpose of her work is to help inform and inspire other Quaker women, and while this goal seems hagiographic, her scholarly research reaches beyond the Society of Friends.

In the 1980s, Bacon published three different books on very similar subjects, but with viewpoints that seem to vary with the publisher. The Friends United Press published *As The Way Opens: The Story of Quaker Women in America* in 1980. In 1985 Bacon published *The Quiet Rebels: The Story of the Quakers in America* with New Society Publishers, which is related to Movement for a New Society that promotes social change through non-violent action. Although this book also examines Quakers and Quaker women in America, it focuses more on their work for social change in accordance with the stated principles of the publisher. The next year, she published *Mothers of Feminism: The Story of Quaker Women in America* with Harper and Row. This book was written for a more popular audience, but still relies on scholarly research. In the Introduction to this book, Bacon explains the importance of examining Quaker women because they worked within a larger socio-cultural context.

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The history of the Society of Friends in America can be seen, therefore, as a microcosm of the long struggle for gender equality in society at large. One can learn about the slow process of social change and the difficulties of reconciling creative new insights with the ways of the world by studying the Friends’ successes and failures in realizing the original version.10

In Bacon’s view, an historical examination of the Quaker belief in equality of the sexes and Quaker work in social activism can serve as a model not only for Quaker women, but for everyone regardless of their sex or religious affiliation.

The Focus of this Thesis

Having discussed the importance of scientific investigation for many Quakers and the purported equality between Quaker men and women, both in society as a whole and educational institutions more specifically, as well as the encouragement that Quaker women have historically received to be active, public figures, it seems likely that some Quaker women will have pursued scientific careers and inquiry. Thus, the goal of this thesis is to examine the work done by three Quaker women scientists and consider how Quaker influences are reflected in their lives. Chapter 1 will give an introduction to Quaker history and the relevant ideas embedded within Quaker theology. Chapter 2 will examine the connections that can be drawn between science and Quakerism specifically relating to scientific and religious truth and the tradition of natural theology. Chapter 3 will look at the lives of three Quaker women in science—astronomer

Maria Mitchell, naturalist Graceanna Lewis, and physician Ann Preston—all nineteenth century American women. This chapter will specifically address the Quaker influences in their lives and scientific works, and will attempt to determine the extent that Quakerism not only led these women into science, but also how it influenced their scientific work.
Chapter 1
Quaker History

In order to understand the role of Quaker women in science, one must first have a basic understanding of the history of the Society of Friends including their origins and beliefs, how they practiced their religion, and what sort of other institutions, such as schools, they established in support of the Society. While the focus of this thesis is Quakerism and women scientists in nineteenth century America, it is necessary to discuss the history of Quakerism more broadly from the seventeenth through the nineteenth centuries in both England and America in order to understand the origins of many of the ideas that are important in this context. I emphasize in particular the role of women within the Society of Friends in order to demonstrate the importance of sexual equality.

Historiography

Some historians have attempted to divide Quaker history into distinct periods. Although they do not agree on the number or length of these periods, they all acknowledge important changes in the Society of Friends. Elbert Russell divides the history of Quakerism into three periods, marked by the death of George Fox and the critical separation within American Quakerism. Thus, his periods are

I. The Rise of the Society (1647-1691), from George Fox’s great experience until his death.
II. Age of Quietism (1691-1827), from George Fox’s death until the separation of 1827 in America.
III. *The Revival and Reorganization of Quakerism* (1827-1941), from the separation of 1827 until the present time.\(^1\)

Howard Brinton’s divisions reflect the nature of Quaker doctrine and practice more than any specific events. His four divisions are:

1. The synthesis or balance of mysticism and evangelicalism, about 1650-1700.
2. The period of greater mystical inwardness, about 1700-1800.
3. The conflict of mysticism and evangelicalism, about 1800-1900.
4. The rise of a paramount interest in rationalism and the social gospel, about 1900—.\(^2\)

Together, these two methods of division provide an understanding of how Quaker theology has changed since the inception of the Society of Friends. Russell’s periods note the important role that George Fox played in the foundation of Quakerism and its theology, and how this theology changed when the Hicksite, Guernsite, and Wilburite separations occurred in America in the mid-nineteenth century. Brinton’s distinctions go a bit further in demonstrating the complex interactions between mysticism, evangelicalism, rationalism, and activism of the social gospel.

**George Fox: Founder of the Society of Friends**

The Society of Friends was founded by George Fox (1624-1691) in the mid-seventeenth century.\(^3\) Fox learned a considerable amount about the

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\(^2\) Howard Brinton, *Friends for 300 Years: The History and Beliefs of the Society of Friends Since George Fox Started the Quaker Movement* (Wallingford, Pennsylvania: Pendle Hill, 1974), 176.
Calvinistic theology as a youth and knew the Bible well. When he was nineteen, he began a journey as a Seeker that lasted four years. It was during this time that Fox came to develop the ideas that became the basis for Quakerism. He concluded, among other things, that the way of understanding and reaching God lies within oneself. The Quakers came to know this idea as the “Light,” the more modern term being the “Inward Light” or “Inner Light.” Quakers believe that every man and woman has the capacity to perceive, recognize, and respond to God.

Fox proclaimed his purpose in his journal:

Now, when the Lord God and his son, Jesus Christ, did send me forth into the world, to preach his everlasting gospel and kingdom, I was glad that I was commanded to turn people to that inward light, spirit, and grace, by which all might know their salvation, and their way to God; even that divine Spirit which would lead them into all Truth and which I infallibly knew would never deceive any.

Thus, he began to travel and spread his message, gathering many followers along the way.

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4 Russell, 50.

5 Fox, 34-35.
Fox was not only the leader of a new religious movement, but he was also "a pioneer in a great number of reforms and new religious and social movements." Quaker historian Elbert Russell describes the many social reform movements in which Fox believed and that his followers pursued:

To see a wrong with him was to intervene and set it right. Among the reforms and social movements in which he pioneered were care for the poor and aged, prison reform, just treatment of the American Indians, provision for the insane, opposition to drunkenness, capital punishment, and slavery. He insisted on honesty and truthfulness in all affairs, renounced oaths, believed in the one-price system in trade and just wages for working people. He was opposed to all kinds of war and refused any participation in it. He taught that governments exist for the benefit of the people as a whole and are bound by the moral law. He believed in a religious democracy in the church based on the equality of all, both men and women, before God; and championed the right of women to preach. He refused to conform to customs which gave one class honor, power or wealth at the expense of others. His insistence upon simple dress, upon the singular pronouns in addressing all classes, in refusing to doff the hat to (so-called) social and political superiors sprang from the same spirit of Christian democracy. Many of these things were trivial in themselves but had become symbols of oppressive power or privilege to which the possessors attached prime importance. He was a Nonconformist; he believed in the separation of church and state, and in universal religious toleration.

Obviously Fox had very progressive ideas for the seventeenth century, and many of these ideas continued to be seen as very progressive through the early twentieth century when advances in women’s rights and other movements began to gain momentum.

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6 Russell, 25.
Theology and Traditions of Quakerism

As previously noted, Quaker theology was based primarily on the idea of the Inner Light. George Fox and his followers believed that they and others could find their way to God by looking within themselves. As such, the religious traditions that arose out of the Society of Friends seemed quite different from those of other contemporary denominations. First of all, they rejected the sacraments and baptism, both of which they deemed unnecessary. Through the idea of the Inner Light, they held a belief in the possibility of salvation for all, regardless of past sin. The Inner Light and not the Bible, the Gospel, or the word of any preacher or minister was the primary guidance to the Quakers. Some of the other important tenets of Quakerism that will be expanded on here include the idea of truth, the belief in the equality of men and women, the belief in leading a simple life, and the belief in pursuing humanitarian causes.

Russell explains that there was never a specific theological definition given to the concept of inner light, but that there were three related ideas that could be used to explain it. Essentially these three ideas or experiences were that:

(1) It stood for God as knowable to and within men…
(2) It meant also the capacity in all men to perceive, recognize and respond to God—to his truth, his love and his will…
(3) The Inner Light was also a designation for God as inwardly known; for a man’s whole experience of God.

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9 Russell, 48-51.
Although each of these definitions refer to the Inner Light differently—the first referring to it as being God, the second inferring that it is human capacity to perceive God, and the last referring to the experience of God within—together they give a clear explanation of the Quaker understanding of how one can know and understand God.

Fox had discovered this idea of the Inner Light for himself, and as stated in his journal passage quoted above, he considered it his duty to spread this idea and to help others find salvation. Thus, he began to gather followers who were labeled “Quakers” because they were known to shake extraordinarily during services. Although this term was originally used in a derogatory manner, it has since been reclaimed by members of the Society of Friends who came to accept this name and now refer to themselves as Quakers, which is probably the more commonly used term today. The official name of Fox’s followers was originally “Children of the Light” then “Friends of Truth” before they settled on “Religious Society of Friends” as the group is still officially called.\(^{10}\) They also considered themselves “seekers of truth” or “the first publishers of truth.” This concept of truth was an important one pursued by Quakers, and the purpose of the second chapter of this thesis is to determine the nature of the Quaker concept of truth and how it relates to the scientific concept of truth.

There is also another interesting name the Quakers gave to themselves: “publishers of truth.” This name refers to the tradition of publishing and writing

\(^{10}\) Jorns, 34.
within the Society of Friends.\textsuperscript{11} Frederick Tolles makes the point that in order for Quakers to be publishers of truth in the written word as well as the spoken word, they required the means of printing and distributing their ideas. He quotes from Douglas C. McMurtrie, author of \textit{A History of Printing in the United States}, who says “The first ninety years of printing activity in Philadelphia [was] devoted to the service of the Society of Friends.”\textsuperscript{12} Using statistical evidence, Rosemary Foxton also discusses the importance of the press to the spread of Quaker ideas in England. One study showed that between 1652 and 1684, Quaker works accounted for 8.8 per cent of the total output of titles published, with the peak output being 10 percent in 1659-1660. Also, between 1651 and 1660, no less than 41 percent of the titles published by women writers were from Quaker women authors.\textsuperscript{13} Additionally, Quaker Meetings were noted for having preserved their documents, including not only records of deaths and marriages but also written Testimonies and documents called Disciplines referring to how the Quakers should live their lives.\textsuperscript{14}

\textsuperscript{11} Richard Vann discusses this phenomenon of the plethora of Quaker writings as being a paradox because while they emphasized the immediate personal spiritual experience, they needed some way to record these experiences. As such, they have written more history than any other sect according to Vann [Richard T. Vann, \textit{The Social Development of English Quakerism 1655-1755} (Cambridge, Massachusetts: Harvard University Press, 1969), 1-2.].


\textsuperscript{14} Barbour, 107-112.
What is interesting about the high literacy rate among Quakers is that unlike some other Protestant denominations, Quakers did not emphasize the ability to read so that people could read and interpret the Bible for themselves. Russell points out that early Quakers believed that “the Bible should be used as men use a guide book—to help them find and experience for themselves the truths recorded in it. The Bible was not a substitute for the personal knowledge of God, nor a new law.” Essentially, for Quakers, the Inner Light was what was most important, and one did not need to read the Bible in order to find this, although it could obviously offer inspiration. Rather than providing spiritual guidance, the written word served as an important means of spreading their ideas, particularly against persecution; the Bible was necessary but not sufficient.

This notion of truth may also be discussed on a more personal level, relating to the idea of integrity. Silvanus Thompson, an English Quaker and physicist, insisted in 1915 that anyone seeking the truth through science, religion, or history must employ their own sense of honesty and sincerity, otherwise they cannot possibly arrive at any sense of the truth. He said:

The quest for truth, then, in whatever field we are seeking it, implies a frame of mind that shall be fundamentally sincere, and frank. Sincere: that it shall seek the truth for its own sake and without fear; frank: that it will neither be blinded by prejudice nor let itself be warped by ulterior aims. Truthfulness is a thing of habit even more than of will. In this respect there is a oneness about it which pervades it, whether in the great or the small, whether in things sacred or things secular. He that would be faithful in the great must be faithful in the small. Whether we seek truth in religion, or in history, or in science, sincerity and frankness

15 Russell, 53-54.
are equally essential; while carelessness in what may seem matters of little moment insensibly leads to carelessness in matters of vital and eternal importance.\textsuperscript{16}

In accordance with the Quaker belief in the Inner Light, it becomes apparent that in searching for truth, one must have and find truth within oneself before one can discover truth in the outer world.

Also related to this idea of integrity is the Quaker tradition of not taking oaths. Brinton says that there were at least two reasons that Quakers refused to swear:

(1) swearing was contrary to the command of Christ—‘Swear not at all.’ (Matt. 5:34)—and of James—‘But in all things, my brethren, swear not’ (James 5:12); (2) it also set up a double standard of truth, one in the courtroom and one outside it, with the implication that untruth would be uttered in the absence of an oath.\textsuperscript{17}

As Barbour notes, “rejection of oaths was a more crucial application [than just using plain language, which was also important]; an oath that ‘this time I’m telling the truth’ implies dishonesty at other times.”\textsuperscript{18} Clearly this idea of truth affected the Quaker life in practice as well as in theology. And the Quakers did refuse to take oaths, which led many to persecution, as will be discussed later.

Another component of the traditional Quaker lifestyle was simplicity.

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\textsuperscript{17} Brinton, \textit{Friends}, 141.
\textsuperscript{18} Barbour, 41-42.
They used plain language, including the pronouns “thee” and “thou”19 and they also dressed plainly. The purpose of the simple dress was to oppose the inequality and pride displayed in costume. Seventeenth century Londoners were known for distinguishing social class inequalities through fashion, and the Quakers refused to take part in this sort of inequality and injustice.20 Additionally, Quaker architecture, as seen in their Meeting Houses, displayed simplicity through plainness, beauty, and proportion. Brinton notes that they even went so far as to have committees to ensure that plainness was observed at weddings and funerals.21 Thus, the Quakers became distinctive and were known for their simplicity in dress and language and for the ways in which they pursued simplicity in their worship and everyday lives.22

In addition to the Quaker traditions of simplicity and integrity is the Quaker involvement in social reform movements.23 Pursuit of humanitarian interests has been emphasized in Quakerism since George Fox’s own activism and idealism, as described above. Indeed, a number of Quakers and various

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19 These singular pronouns were previously used in the English language to address anyone who was not superior to oneself, such as one’s friends, family, and servants. The Quakers used “thee” and “thou” to address everyone, including their superiors, as a way of opposing this hierarchy. As Laura Rediehs pointed out to me, it is interesting that modern English has done away with these distinctions, perhaps due to this Quaker influence, but we now use the formal, plural form “you” instead.
20 Barbour, 44.
21 Brinton, Friends, 134-137.
22 Barbour, 57.
23 Jorns discusses more in depth the Quaker involvement in various social reform movements including poor relief, education, temperance, public health, prison reform, and abolitionism.
Committees of the Society of Friends have won the Nobel Peace Prize\textsuperscript{24} and Quakers, as already noted, have been involved in some of the major social reform movements, including women’s rights, abolitionism, and temperance, and Quakers have stood as pacifists through many wars. Quaker interest and involvement in these humanitarian interests will become particularly salient in the examination of the three Quaker women in science in the third chapter.

Equality

Another important tenet of Quakerism, although less so of Quaker theology than Quaker tradition, is that of sexual equality. The origin of this tenet may be seen within Fox’s writings:

For man and woman were helpsmeet, in the image of God and in Righteousness and holiness, in the dominion before they fell; but after the Fall, in the transgression, the man was to rule over his wife. But in the restoration by Christ into the image of God and His righteousness and holiness again, in that they are helpsmeet, man and woman, as they were before the Fall.\textsuperscript{25}

Fox’s biographer, H. Larry Ingle states that “Fox never backed down from his insistence that God called women to be preachers and evangelists just as he had

\textsuperscript{24} Janet Whitney discusses the various Quakers and Quaker groups that have received the Nobel Peace Prize in her essay “Quakers and the Nobel Prize,” Then and Now: Quaker Essays: Historical and Contemporary by friends of Henry Joel Cadbury On His Completion of Twenty-two Years as Chairman of the American Friends Service Committee, Anna Brinton, ed. (Freeport, New York: Books for Libraries Press, 1960), 253-269.

traditionally called men."\textsuperscript{26} In her biography of a Quaker woman preacher, Cristine Levenduski explains that Fox gave a two-fold argument against the interpretation of the Pauline epistle that said women were to keep silence in the church and respect the authority of men over them. First, Fox said that Paul's message could be reinterpreted through new understandings of old teachings because the age of direct revelation had not yet ended. Second, he argued that there were a number of examples present within scripture of women spreading the word of God, which set a precedent for women preaching, even if they had not assumed that precise role in the Bible.\textsuperscript{27} Fox's ideals were also applied in the American colonies through the principles of William Penn (1644-1718), the founder of Pennsylvania. Penn supported Fox's beliefs on the spiritual equality of women to men, and he was instrumental in insuring that women's meetings were established in his Quaker colony.\textsuperscript{28} Thus, from the beginning of Quakerism, women have been an integral part of the congregation.

Many women had significant leadership roles in the Quaker church. Quaker historian Seth Hinshaw notes that it is unknown who the first woman to stand and speak at a Quaker meeting was, probably because it was not something

\textsuperscript{26} Ingle, 104.
\textsuperscript{28} Linda Ford, “William Penn’s Views on Women: Subjects of Friendship,” \textit{Quaker History}, Vol. 72, no. 2. (Fall 1983), 75-102, on pg. 76.
that would have been questioned or noted as particularly unusual to anyone.\textsuperscript{29}

Nevertheless, there were a large number of women who were recognized for the role that they played in helping to establish or spread the Quaker theology, most notably Margaret Fell (1614-1702), who was known as the Mother of Quakerism. Fell had been a Seeker\textsuperscript{30} for almost twenty years when George Fox visited her home, Swarthmore Hall, and convinced her, thus converting her to Quakerism. Her husband Thomas Fell (1598-1658), a member of Parliament and a justice of the peace, became sympathetic to the Society of Friends, although he never joined. Swarthmore Hall became the unofficial center of the Quaker movement, which allowed Margaret Fell to have significant influence in the Society, as did her later marriage to George Fox.\textsuperscript{31}

Another important leader can also be found in Elizabeth Hooton (1600-1672), who was George Fox's first convert and became the first well-known woman minister within the Society of Friends.\textsuperscript{32} Hooton was an important role


\textsuperscript{30} The Seekers were a large group of dissenters from the Church of England and many eventually joined the Quaker movement because it provided them with the theology that they sought (Brinton, \textit{Friends}, vii).

\textsuperscript{31} Fox and Fell were married in 1669, a decade after the death of her first husband Thomas Fell (Russell, 32, 74; Barbour, 316).

model for women in the Society of Friends; one early history of Quakerism said that “After her [Hooton’s] Example, many of her Sex had the confidence to undertake the same Office.”³³ Women did not just serve as ministers; they assumed the same tasks as male ministers, often traveling as the men did, as will be discussed later. Women ministers played an important role in Quakerism; at some times, including a period during the eighteenth century, the number of female ministers was higher than that of male ministers.³⁴

It must be noted here that women did not always have significant positions in Quakerism and often could not hold the same positions as men. Indeed, Hinshaw notes that women often played the important role as mothers and wives in supporting their minister-husbands. He refers to the natural divisions of labor that often restricted women from doing some things the same as men.³⁵ Similarly, Janis Calvo notes that a woman would accept preaching duties in addition to her womanly duties, rather than choosing between being a wife or mother and a preacher.³⁶ While Quaker women did have additional opportunities, they were still expected to fulfill the traditional roles of woman, including that of wife and

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³³ Manners, 1. Quoting from The General History of the Quakers, by Gerard Croese, 1696, pt. 1, pg. 37.
³⁴ Hinshaw, 40-43.
³⁵ Hinshaw, 39, 42.
³⁶ Janis Calvo, “Quaker Women Ministers in Nineteenth Century America,” Quaker History, Vol. 63, no. 2. (Autumn, 1974), 75-93, on pg. 77.
mother, although these trends had changed by the mid-nineteenth century, as will be discussed further in Chapter 3.

**Structure of the Society of Friends**

Fox’s ideas also influenced the structure and traditions of the Society of Friends. Preaching was not typically a part of Quaker meetings; rather, the meetings were held in silence where people could reflect on their Inner Light. However, anyone, man or woman, who was moved inwardly had the privilege to stand and speak, but again, this message came from God within oneself rather than from any outside source.

The Quakers originally organized themselves into Meetings in response to the persecutions faced by many Quakers; some level of organization was needed in order to supply relief to those who had been imprisoned and to their families. Eventually, several different types of Meetings evolved. There were silent Meetings for worship, business Meetings that were divided into local Monthly Meetings and regional Yearly Meetings, as well as separate Women’s Meetings for business. All of these Meetings were meant to be non-hierarchical, self-governing undertakings.

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37 Barbour, 66-67.
38 While most of these practices are still used within the Society of Friends today, this thesis does not intend to speak for current practices, but rather its intention is to explain the organization of the Society in the nineteenth century.
39 Barbour, 67.
The Women’s Meetings were originally established on the recommendation of George Fox so that women could conduct their own business. Mary Garman discusses the importance of women’s meetings, which caused some early controversy among the Friends. Around 1659, women began to hold meetings separately from the men in order to discuss the persecutions that many Friends had faced and to try to find ways to help those who had been persecuted. They were able to collect funds for the prisoners and their families and circulated letters of encouragement, allowing women to gain experience in organizing themselves in important leadership positions.

Margaret Bacon further discusses the role of the Women’s Meetings: “The chief duties of the Quaker women were to watch over the ‘conversation’ or moral behavior of their members, particularly the young; to speak to those who strayed; to provide for the poor and the ill; and to provide for the education of children.”

Although all of these duties were considered those of women generally in seventeenth century society, it was nevertheless significant that women exercised these functions within their own business meetings. Of course, decisions of the women’s meeting could be overruled by the men’s meeting, and the women depended on the financial provisions of the men’s meeting; nevertheless, these

41 Barbour, 67.
43 Bacon, Mothers, 43.
women still had opportunities not available to women of other sects, including experience in business affairs. 44 Although the Women’s Meetings did allow women some functionality within the Society of Friends, they also served as a tool of sexual segregation, keeping women subordinate to the Monthly and Yearly Meetings, which were run entirely by men. It was not until the very end of the nineteenth, and even later for Orthodox Quakers, that women began serving on various committees for the Yearly Meetings and separate Women’s Meetings ceased to exist.45

Membership in the Society of Friends is also an important component of the group’s organization. During the first century or so of the Society’s existence, members were simply those who attended the meetings and accepted Quaker beliefs.46 In 1737, though, children of members became members of the Society, thus instituting birthright membership for the first time. With this formal definition of membership in place, the Society shifted in focus from being evangelical and trying to recruit new members to being more insular and trying to educate those within the Society, particularly children, to Quaker morals and

44 Bacon, Mothers, 44; Barbour, 68.
46 Richard Vann makes the argument that membership, at least in the 17th and 18th centuries, primarily had to do with involvement in the business meetings and with poor relief—meaning that members were both responsible for providing, and were eligible for receiving, poor relief (Vann, 143-157).
ideals. Russell quotes from Thomas’ *A History of Friends in America* to explain this fundamental change in the Society:

> The vast importance of this step was not appreciated from some time. It changed the Society of Friends from a church of believers, at least in theory, to a corporation or association of persons some of whom always would be of those who were not spiritually minded. Youth had been no hindrance in the early days, provided the person was believed to be spiritually minded; after the adoption of this regulation membership for a large number had no connection with change of heart.

The idea of birthright membership was particularly poignant in the nineteenth century when Quakers recognized that most of their members had become such because their parents were Quakers; this fact is particularly important when examining the case studies of this thesis, because each of the three women under focus were birthright Quakers since their parents belonged to the Society.

In addition to being born into the Society of Friends, another way to become a member of the Society was through the process referred to as “convincement” which was not necessarily evangelical because it merely involved the discovery of one’s Inner Light. But as Brinton notes, “Convincement was only the first stage. Conversion, or change of character, often required a long, slow struggle, working out in the silence of the meeting for...”

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47 Russell, 215-216; Vann, 143.
49 Vann, 143.
50 For a more thorough discussion of convincement see Vann’s chapter on “The Theory and Practice of Conversion.”
Essentially, once someone had found the light within himself or herself, he or she had been convinced and was now part of the Society of Friends, although the actual conversion process might not occur until one had been a member for some time.

Membership was taken very seriously by Quakers, as evidenced by their strict policy of disownment, which was most rigorously enforced during the Quietist Period in the late eighteenth century. Quakers were expected to conform to the Quaker ideals, as discussed above, and anyone who violated these ideals was subsequently disowned by the Society. "The grounds for disownment were a mixture of ethical and ecclesiastical transgressions. They ranged all the way from neglect of the plain dress and speech and 'marrying out of the meeting' to drunkenness, sexual immorality and rendering military service." Disownment was a very serious act, particularly in the earlier days of Quakerism. Holden says that between 1748 and 1783, 6,700 of the 30,000 members of the Philadelphia Yearly Meeting were disowned. "The greatest single cause of loss was due to marriage delinquency [meaning marrying outside the Society]. The second most frequent cause was disownment of 908 Friends for participation in revolutionary activities." Even after they had been disowned, though, many people were permitted to attend meetings and participate in Quaker worship. In this way

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52 Brinton, *Friends*, 185.
53 Russell, 227.
Quaker influences affected a number of people who did not officially belong to the Society of Friends.55

Just as Fox had done, his followers began to travel and to recruit followers in order to help people find their Inner Light. Quaker ministers thus played an important role in Quakerism, but this role was not one of teacher. Rather, the purpose of these ministers was to help people find their own "Inward Teacher" or Inner Light. As Elbert Russell has said, "There were no human beings whom the Quakers despaired of."56 Quakers traveled all over the world trying to spread their message; and they believed that anyone could find their Inner Light and be converted to Quakerism. One group even went so far as to go to Rome and try to convert the Pope.57 Although their ideas were spread and they did attract a number of followers into their movement, the number of Quakers in society remained fairly small.

These travels also took the Quakers to the American colonies. Fox had proclaimed that women and men were equal, and this idea became apparent through traveling ministry; women composed a high percentage of the first Quaker visitors to America, spreading the ideas of Quakerism to the new settlers as well as settling there themselves.58 Margaret Bacon cites one calculation that recorded that thirty-three percent of the first eighty-seven ministers to visit New England between 1656 and 1700 were women. Another statistic reveals that of the

55 Russell, 227.
56 Russell, 177.
57 Russell, 177.
103 Friends to visit Great Britain from America between 1700 and 1800, almost half were women.\textsuperscript{59} Most of these women were married and had children, suggesting that for many Quaker women the commitment she made to her religion was more important than that made to her husband and family; it also shows that the husbands of Quaker women respected, or at least allowed their wives to embark on these journeys, further demonstrating the elevated role of women in that society. One Quaker minister, Charity Cook, left her home and family in North Carolina to travel to England and the European continent. The youngest of her seven children was three months old when she left her husband in charge of taking care of the family.\textsuperscript{60} Another story of a woman minister says that she had eleven children, and once they were "of a reasonable age" such that her husband could take care of them, she went on a four-year preaching mission. This was not an easy life for these women, because fever or illness could claim the lives of their husbands or children before they returned. They also risked their own lives by traveling, because they felt that they had been called to do so by the Lord.\textsuperscript{61}

**Persecution**

The Quakers were persecuted severely under both the Commonwealth rule and the Restoration period in England. Religious toleration was only extended to those who conformed to the Anglican Church at this time, and Quakers were

\textsuperscript{58} Russell, 39.
\textsuperscript{59} Bacon, *Mothers*, 29, 34.
\textsuperscript{60} Bacon, *Mothers*, 35-37.
certainly not conformists. Many Friends spent considerable time in prison for various offenses, including for example, the refusal to take oaths or serve in the army, the refusal to remove their hats in court, and charges of blasphemy and witchcraft. Quaker traditions were accorded little leeway because they appeared to threaten the existing order by denying the state religion and other national laws. A number of different laws were established in the 1660s that were aimed directly at Quaker religious practices. One of these, the Quaker Act, passed in 1662, "imposed heavy penalties on persons maintaining on religious grounds the unlawfulness of all oaths and on Quakers if they left their homes and assembled to the number of five or more for worship not authorized by law." Even as Friends began to settle in the American colonies they were still persecuted for their religious differences. The land that had been settled largely in the name of religious freedom did not afford religious freedom to all sects. In Maryland in 1688, for example, colonists recounted the leniencies previously afforded to Quakers; they began to fine Quakers for their failure to serve in the military, and Quakers were banned from political office because they refused to take the required oaths. In 1704 there was a movement in the Carolinas to establish the Church of England there, after which Quakers were again subject to the same persecutions as they had been in England. It was in New England though where the Quakers suffered the worst abuses. "The Puritan reverence for

61 Bacon, Mothers, 35-37.
62 Russell, 60-64.
63 Russell, 92.
order and the disorder they perceived in Quakerism contributed to Puritan hostility. So did the Puritan emphasis on male authority as contrasted with the Quaker practice of equality between men and women.

Quaker Successes in Business, Industry and Science

In order to discuss the role of Quakers in science, it is first necessary to examine their successes in business and industry, which inevitably led to considerable Quaker patronage of the sciences and education. Arthur Raistrick points out that George Fox began gathering followers amongst the lesser yeoman farmers and artisans of the northern counties of England in the 1650s at a time when England was still predominantly agricultural. Nevertheless, as England became more industrial, the Society of Friends gathered more members from the commercial and productive classes. Raistrick says:

In spite of all disabilities and persecutions [Quakers] are to be found in the early part of the eighteenth century permeating the whole of basic industry, trade and finance, supplying outstanding members of the medical profession, and even appearing in the lists of the Fellows and Council of the Royal Society. The backbone of the expanding iron industry is seen to be a widespread net-work of Quaker concerns; the banks are prominently Quaker; the Treasury attempting to redeem the silver coinage of the country and so restore its commercial prestige abroad, turns to the Quaker Lead Company for its supplies of pure silver. In smaller industries it is the same—in clock making one need only mention such as Tompion, Quare, Graham, all Quakers; in the china industry, Cookworthy; Huntsman in connection with cast steel; Allen and

64 Barbour, 88-89.
Hanbury in pharmacy; Fry in the very beginnings of the chocolate trade, and so on through many trades.66

Thus, in the seventeenth and eighteenth centuries in England, Quakers were very involved and influential in industry and commerce, areas which in turn influenced various kinds of scientific and technological initiatives.

Raistrick discusses the role of Quakers in both science and industry. One area that seems to connect these two is that of the development of instruments where an industry was created as a consequence of scientific and technical advances and which in turn provided the means for perpetuating these advances. He focuses in particular on three different men, mentioned in the quotation above, in seventeenth century England who each excelled in clock, watch, and instrument making, one of whom was responsible for producing many of the instruments used at the Greenwich Observatory.67 American Quakers also contributed to advances in technology. David Rittenhouse (1732-1796) was a prominent colonial astronomer and clockmaker, and a few others in the United States formed their own companies for supplying scientific apparatuses.68 It goes without saying that these instruments were essential to scientific work.

Another way that Quaker merchants helped the cause of science was by gathering plants from around the world and founding herbariums and

66 Arthur Raistrick, Quakers in Science and Industry: Being An Account of the Quaker Contributions to Science and Industry During the 17th and 18th Centuries (New York: Philosophical Library, 1950), 12.
67 Raistrick, 224; Richard Sutton, Quaker Scientists (Greensboro, North Carolina: Guilford College, 1962), 9.
68 Sutton, 9-10.
Two of the most noted Quaker botanists were Peter Collinson (1693-1768) and John Bartram (1699-1777) both of whom had large gardens in America with many exotic plants. Some other Quakers used their wealth to help promote science less directly—by founding educational institutions. For example, both Cornell University and Johns Hopkins University were founded respectively by Ezra Cornell and Johns Hopkins, both philanthropic Quakers in the nineteenth century, although neither of these schools maintained any formal ties to the Society of Friends.

Settlements in America

One of the places in America where Quakers did not experience religious persecution was William Penn’s colony, which became Pennsylvania, because Quakers held the political power in this state from its inception. Penn received a royal charter for the Pennsylvania Colony, and he set out to establish a “holy experiment” there. Essentially, Penn wanted the colony to be ruled by Quaker ideals, namely truth.

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69 Sutton, 8.
70 It is not surprising that these early Quakers chose scientific pursuits in the field of botany for reasons that will be explained more thoroughly in the second chapter.
71 Raistrick, 248-260.
73 Barbour, 90.
74 Russell, 117; Brinton, Friends, 182.
He was consciously trying to give the nations an example of a free democracy. His definition of a free government was: 'Any government is free to the people under it, whatever be the frame, where the laws rule and the people are a party to those laws; and more than this is tyranny, oligarchy or confusion.'

As Brinton says, the Quakers in Pennsylvania succeeded in establishing more than merely governments based on the important Quaker principles—they also created their own distinctive culture and way of life. Although Pennsylvania was by no means a utopian society, it did at least offer Friends the opportunity to enjoy their livelihoods without risk of religious or political persecution.

Their numbers began to grow in America because “the religion of Friends was easily adapted to wilderness conditions” due to its simplicity and its dependence on the Inner Light, which was carried within oneself. Many of the new settlers in America sought some sort of guidance that would allow them much freedom, and many found that the Society of Friends provided just that. “Quakerism appealed to those who saw the need to be religious but found unsatisfactory whatever beliefs they had brought from England.” Others joined the Society of Friends because it was the only religious congregation in their area.

Regardless of how people in the newly settled American colonies came to join the
Society of Friends, Quakerism was an important religious movement in North America.80

Separations

By the mid-nineteenth century, American Quakerism became schismatic and a number of separations occurred. Although there are different reasons given for why and how these separations occurred, my focus here is on the specific events and how these affected the structure and theology of the Society of Friends.81

The first separation occurred in 1827 after the Philadelphia elders forbade Elias Hicks (1748-1830) the right to preach. Barbour says that “the character of Hicks’ thought is best described as that of an extreme quietist or spiritualist tinged with rationalism. Formal theology he saw as ‘head learning’ designed to foster pride and destroy godliness.”82 Essentially he placed more emphasis in his theology on the Inner Light and rejected most outward sources, even the Bible and Christian traditions. Hicks gained a good number of followers, many of whom did not understand his ideas but supported his right to preach them.83

Theological differences were not the only matter driving Hicks and his supporters

80 Barbour, 58.
81 Readers who are interested in reading more specific analyses of these divisions or the earlier divisions that occurred in English Quakerism are urged to examine any of the works on Quaker history, which tend to address this issue in more detail, particularly Holden’s book which focuses entirely on these separations.
82 Barbour, 174.
83 Brinton, Friends, 190.
away from the more Orthodox position; additionally, they were troubled by the
terprises of the more wealthy Friends, which they felt did not benefit all
Friends, and they objected to the selling and trading of goods produced by slave
labor. Most of all, they objected to the power system that had been constructed
within the Society, which is why the elders forbade Hicks from preaching—
because it threatened the order they had established. In most Meetings there
ensued struggles between Hicks' supporters (Hicksites) and Orthodox Quakers,
and one or the other group inevitably gained control. The Philadelphia Yearly
Meeting remained Orthodox and took the position that Hicksites were neither
Quakers nor Christians, and thus anyone who chose to follow Hicks, or anyone
who associated with a Hicksite member, was disowned from the Meeting.

As Brinton notes, the position adopted by the Hicksites was liberal enough
to allow a wide variety of theological opinions and it emphasized democracy and
tolerance; no further divisions occurred within the Hicksite group. The Orthodox
group, though, experienced yet another division which began in 1845, less than
twenty years after the first separation.

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84 Elders were men and women of the Society of Friends who were chosen to
provide guidance and counsel to the Meeting. Part of their duty was to limit the
freedom of the individual in order to increase the freedom of the group, and in
order to accomplish this, the Elders would often provide criticism of individuals.
By the nineteenth century though, particularly in Philadelphia, the Elders were
attempting to regulate the theological doctrine so strictly that there was a backlash
to their authority, which essentially led to the Hicksite separation (Barbour, 4;
Brinton, Friends, 93-97).

85 Brinton, Friends, 191-192.
This separation is known as the Gurneyite/Wilburite separation. "Joseph John Gurney's (1788-1847) name was attached to the more extreme evangelical group, and that of John Wilbur (1774-1856) to those who represented the older, more mystical type of Quakerism which also contained definite evangelical elements." The Gurneyites were seen as radical activists, whereas the Wilburites considered themselves Conservative Friends—differences that Holden claims underlay the purported theological differences. Essentially the separation occurred after "Wilbur's effort to follow Joseph John Gurney around a circuit of New England Meetings to warn them that Gurney's encouragement of Bible study and Sunday School programs conflicted with the heart of quietist worship: dependence solely on God." Again, each group appealed to the various Meetings, causing divisions in many of them. Wilbur was subsequently disowned by his own Monthly Meeting, even though Brinton notes that the Wilburites were the ones who claimed to be the heirs of the original Society of Friends; the major difference separating the Wilburites from the original Friends was that the former group derived their code of behaviors from tradition rather than experience of the Inward Light as the earlier Friends had done.

Brinton summarizes these divisions quite succinctly, distinguishing the latter separation from the first one:

86 Brinton, Friends, 192.
87 Barbour, 187; Holden, 87.
88 Barbour, 187.
89 Brinton, Friends, 192-193.
There were then in the second half of the nineteenth century in America three kinds of Quakers designated by the names of three persons. The Hicksites represented the more mystical, liberal, noncreedal branch; the Gurneyites, the more evangelical, authoritarian and theologically conservative branch; and the Wilburites, a branch whose position was between the other two. The doctrinal differences among the three were not clearly defined since they had no formal written creeds. It was more a matter of emphasis than of content. Among the Wilburites there was more opportunity than in either of the other two for a genuine synthesis of the mystical and evangelical elements in Quakerism.90

In another work, Brinton provides a useful diagram of the divisions. He shows the Hicksites branching off to the left, noting that “branches turning toward the left believe in salvation through the Inward Light.” On the other side are the Orthodox Quakers with the Gurneyites on the extreme right and the Wilburites branching off from there closer to the Hicksites, but still on the right side of the diagram. “Branches turning toward the right believe in salvation through the atonement of Christ.”91 There are other smaller branches on the diagram, showing that other separations occurred, but these are the three primary ones. Thus, while these different groups can be distinguished through their theological differences, it is also important to note that there are differences in emphasis and organization that accompanied these theological shifts.

90 Brinton, Friends, 193.
Education

Education has been important to the Quakers since their origins. In 1668, George Fox urged the Quaker community to establish two schools, one for boys and one for girls. Although the first two schools were not coeducational, it is significant to note that in accordance with the Quaker belief in the equality of the sexes, education for both females and males was a priority from the very beginning and in any case the separation of the sexes in education was not a trend that continued.

The great majority of these [dayschools] are coeducational, for the Quaker conception of the equality of the sexes, already plainly stated by George Fox, finds its natural expression in coeducation. The same preference for coeducation is exhibited in boarding-schools and even in the Quaker colleges in America, of which latter all but one are today coeducational.92

This statement was written by Quaker historian William Wistar Comfort, who served as President of Haverford, which was the one school that was not coeducational when he wrote this book in 1941.93 Edward Parrish, the first president of Swarthmore College, also wrote an account of Quaker education, An Essay on Education in The Society of Friends, published in 1866. One of the subjects that Parrish addressed was the “Relation of the Sexes at School.” Parrish said:

93 According to a presentation about the history of Haverford College on their library website, “Viewing the Evolution: 166 Years of Haverford History,” Haverford was not coeducational until 1980. http://www.haverford.edu/library/sc/haverford166/HTML/female.html
The impression, with some, that such association [of the males and females together at school] would distract the mind from a due attention to study, and lead to the frivolity so deplored in ordinary society, is not justified by the facts. The mental attrition of the class-room is especially favorable to students forming a just estimate of each other's capacity, and thus losing false ideas of perfection in each other, the frequent source of romantic attachments. Constantly subjected to artless association and competition, they seldom exhibit that unnatural constraint and coyness which distinguish the unaccustomed intercourse of boys and girls, when first thrown together in what is called society...\(^9^4\)

Clearly Quaker beliefs regarding education did not draw upon some of the misogynistic ideas of the nineteenth century, including those of Edward Clarke, M.D., a professor at Harvard who claimed in his book *Sex in Education; Or, A Fair Chance for the Girls* (1875) that educating women would cause them to draw too much blood to their brains and not retain enough in their reproductive systems in order to bear and rear children.\(^9^5\)

The primary purpose of these schools was to teach children what they needed to know in order to make a living; there was no initial desire to attain knowledge for knowledge's sake, but rather to prepare them for life. Comfort noted that the distinguishing feature of Quaker education was "the Society's conviction that character is more important than intellectual brilliance; it is better to be good than to be smart."\(^9^6\) As such, religious education was an important component of Quaker schools and involved attending weekly meetings for

\(^9^5\) Edward Clarke, *Sex in Education; Or, A Fair Chance for the Girls* (Boston, J.R. Osgood & Co., 1873).
worship and using texts that had been written for and by Quakers. The Quakers felt that their children could best develop their characters by learning and following Quaker ideals and being incorporated into the Quaker community through these educational experiences.

The purpose of creating their own schools instead of enrolling their children in public schools is explained by Comfort: “The reason for all this investment in elementary and secondary education is the same as that of the Catholic Church in America: the desire to insure a certain control, not of the curriculum, but of other character-forming influences.” Again, it was the education that shaped the character that was most important, and this principle applied to Quaker and non-Quaker students alike. Indeed, Comfort notes that the Quaker population was not large enough to completely fill all of the Quaker schools, so there were probably more non-Quakers in attendance than Quakers. He speculates that non-Quakers went to Quaker institutions because of the spirit of the campus and the prospect of friendly influences.

Howard Brinton has also written a pamphlet on this subject entitled *Quaker Education in Theory and in Practice* (1940). In this essay, he outlines four social doctrines that are essential for Quakerism; the four he lists are community, harmony, equality, and simplicity. He then discusses how these four

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96 Comfort, 121.
98 Comfort, 120.
99 Comfort, 118, 126-127.
testimonies have been employed in Quaker education in the past through an examination of educational policies, which include the following:

Community
1. Development of a sense of belonging to the Quaker community.
2. A religiously guarded education.
3. Dedicated and concerned teachers.

Harmony
5. Appeal to the inward sense of rightness.

Equality
6. Equal education of both sexes.
7. Equality in education of races and classes.

Simplicity
8. Moderation in dress, speech and deportment.
9. Scholastic integrity.
10. Emphasis on practical subjects in the curriculum.100

Clearly the Quaker ideals already discussed within this chapter, including the Quaker notion of the Inner Light and the emphasis placed on equality and simplicity, were critical to the underpinnings of Quaker education.

Science, one of the “practical subjects” was probably the second most essential component of Quaker education after Quaker religious and moral ideals.

It is not altogether intentional, but it is an observable fact that Quaker youth tends to elect, and to distinguish itself by its proficiency in, natural science rather than in literary or linguistic lines. In general, Quaker talent as developed in Quaker schools has shown itself in science rather than in the liberal arts.101

Comfort suggests that the Quaker preference for science over artistic pursuits relates to the general Quaker fear of “the lure of artistic beauty.”102 Additionally,

100 Brinton, *Quaker Education*, 41-42.
101 Comfort, 116-117.
102 Comfort, 116.
Brinton notes that "Fiction in literature and drama was not considered to be 'in the Truth.' It portrayed a non-existent world."\textsuperscript{103} Brinton also quotes from Quaker moralist Jonathan Dymond who wrote in 1829 that "Science is preferable to literature, the knowledge of things to the knowledge of words."\textsuperscript{104} Thus, this focus on science within the educational institutions and the purported preference of Quakers for the sciences rather than the liberal arts relates to the Quaker search for truth and was most likely one of the influences leading many Quakers to scientific pursuits.

\textbf{Centers of American Quakerism}

Although Quakerism did spread across the United States after arriving here only decades after the establishment of the Society of Friends, there were a few important centers of Quakerism that also relate to the case studies of this thesis. Pennsylvania, as already discussed was essentially the American capital of Quakerism, and within this state there were two areas that were especially noted for the achievements of Quakers: Philadelphia and Chester County. Another center of Quakerism that emerges within the case studies is that of Nantucket Island in Massachusetts, which was settled almost entirely by Quakers.

In the eighteenth century, Philadelphia served as an important center in America, both politically and intellectually. Philadelphia was for a short time the

\textsuperscript{103} Brinton, \textit{Quaker Education}, 48.  
\textsuperscript{104} Brinton, \textit{Quaker Education}, 80. As quoted from Jonathan Dymond, \textit{Essays on the Principles of Morality} (1829).
nation's capital and it also contained a large Quaker population. Not incidentally, Philadelphia was also the early center of American science; indeed, it could be said that American science was born in Philadelphia and that Quaker patronage was critical in its establishment.\textsuperscript{105} Additionally, the early medical center of the United States could be found in Philadelphia with its various medical institutions.\textsuperscript{106} Philadelphia was also the site of the Yearly Meeting for Monthly Meetings of Pennsylvania, Delaware, New Jersey, and parts of Maryland, which established even further its importance as a center of Quakerism.

Chester County, also in Pennsylvania, was another important Quaker center, and a number of important Quakers came out of this area, including Graceanna Lewis and Ann Preston, two of the women to be discussed in the case studies of this thesis. Howard Brinton quotes from the first page of the Chester County Quarterly Meeting Minute Book which describes itself as:

Belonging to the People of God called Quakers of Chester County in the Province of Pennsylvania in America. Begun by Divers of those People who in great freedom of spirit left their native country of England and transported themselves and families to this Remote part of the world.\textsuperscript{107}


\textsuperscript{107} Brinton, \textit{Friends}, 182-183.
The primary issue that the Chester Meeting focused on was abolitionism. The Philadelphia Yearly Meeting had proclaimed in 1696 that Friends should not take part in the slave trade or encourage the importing of slaves. This statement, though, was not strong enough for the Friends of the Chester Quarterly Meeting who were strongly anti-slavery. They appealed to the Yearly Meeting numerous times regarding this issue, and by 1719, a Discipline was authorized telling Friends that they should not buy or sell Indian slaves or import black slaves. And, by 1730 the purchase of imported slaves became an offense for which one could be disowned.

The other area that was heavily populated by Quakers was Nantucket Island in Massachusetts, where Maria Mitchell, the third case study for this thesis, was born and raised. Thomas Chalkley, John Richardson, and John Fothergill founded the Quaker community there during the expansion of the Society of Friends that occurred in America during the first half of the eighteenth century. In 1708, not very long after Quakers had begun settling there, a Nantucket Women’s Monthly Meeting was established. Nantucket was well known for its whaling industry, and the men were frequently absent from the island as they went on many whaling trips. Thus, it is not surprising that the women of the island were strong-minded and found it necessary to have their own meeting for

109 Russell, 210; Barbour, 120-121.
110 Russell, 200-201.
conducting business and worship. The Nantucket women were especially involved in concerns regarding education, the poor, and local morals.¹¹¹

Influence of Quakerism

Elbert Russell gives much credit to the influence of Quakers on Western thought and society in this passage:

…the Society has exercised an influence on the thought, religious practices and social ethics of the English speaking world out of all proportion to its numbers. Many of its once radical beliefs and practices are now generally accepted in English and American Protestantism; but while many of Fox’s contentions have been conceded, there remains of the original Quaker heritage “yet much land to be possessed.” The Society has still a “testimony” to elements of the Christian gospel not yet fully acknowledged by even Protestant Christendom, such as simplicity in manner of living, complete spiritual democracy in the church, the ministry of women, inward spiritual authority, personal religious guidance, sincerity and truthfulness in speech, freedom of conscience and worship, simple mystical public worship, a classless Christian Society, reliance on spiritual forces only to overcome evil, international peace and the brotherhood of man regardless of sex, class, nation or race. There is still an urgent need also for its ministry of impartial love in a divided, war-torn world.¹¹²

It thus becomes apparent that Quakers, although a perpetual minority in society, have instituted some important ideas that have become integral to our society, including advances towards sexuality equality and work in various peace and social reform movements.

¹¹¹ Bacon, Mothers, 45-46.
¹¹² Russell, xxvi.
Chapter 2
The Connections Between Science and Quakerism

In examining the nature of Quakerism, as I did in the previous chapter, it is apparent that there is some connection between the ideas prevalent in Quakerism and those ideas that are central to the pursuit of science, particularly when examining the work of Quaker women in science in nineteenth century America. Probably the most striking similarity between Quakerism and science is this idea of the search for truth, which I will examine in this chapter in both the scientific and the religious contexts. Additionally, there are branches of science, including natural history and the observational sciences, that seem to particularly relate to Quaker ideals, and these connections will also be examined here. It is possible that there exists another connection relating to the nineteenth century tradition of Transcendentalism, and although I will not discuss this connection in detail, I will offer some suggestions as to how it might further illuminate the relationship between science and Quakerism.

The Numbers

Before one can begin a discussion about how Quakers in particular are drawn to the sciences, it is important to establish that Quakers were represented in science in proportionally significant numbers. Two studies in particular on the role of scientists from various religious sects help to shed some light on this
inquiry and to demonstrate that Quakers did indeed constitute a significant group within the sciences.¹

The first of these two studies was done by Harvey Lehman and Paul Witty in 1931 and their results were published in *Scientific Monthly* in an article entitled "Scientific Eminence and Church Membership." Lehman and Witty used the 1927 edition of *American Men in Science* to find the names of the most notable scientists, who were indicated with the appearance of asterisks next to their name. The total number of scientists deemed notable was 1,423 for this particular year.

Lehman and Witty then cross-referenced the names with *Who's Who in America*, which listed each individual's religious denomination. Seventeen percent of the 1,423 names were discarded at this point either because they did not appear in *Who's Who* or because the information given there was insufficient. Of the 1,189 names left, seventy-five percent did not indicate their religious denomination, leaving 303 names for this study. Lehman and Witty conjectured that the 886 scientists who did not list their religious denomination probably did so because they either did not belong to a church or because they did not think that the information was of sufficient importance to include in their answers to the

¹ There have, of course, been many studies conducted on the relationship between church membership and other various factors such as education. For the purposes of this thesis, though, the results of these two specific studies are the most significant and thus the only ones that will be discussed. Other studies include Anne Roe, *The Making of a Scientist* (New York: Dodd, Mead, and Company, 1952); and Robert H. Knapp and Hubert B. Goodrich, *Origins of American Scientists: A Study Made under the Direction of a Committee of the Faculty of Wesleyan University* (Chicago: University of Chicago Press, 1952).
questionnaire, even though the questionnaire specifically asks that a “religious denomination (if any)” be given.2

Lehman and Witty then tabulated the results, demonstrating in Table I the distribution of church membership of the 303 outstanding scientists listed in the 1926-1927 edition of *Who's Who In America* and in Table II providing data on the distribution of church membership in the United States as a whole. While Methodists, Baptists, and Catholics represented the largest groups (each one being around twenty percent of the total), the denominations most represented were Congregationalist, Presbyterian, and Episcopalian (again, each one being close to twenty percent). Friends held 1.98 percent of the distribution among the scientists (six of the 303 were Quakers) but only constituted .30 percent of the total population. These two statistics were then combined in Table III, which gives the proportional representation, or the “number of times each denomination reaches, falls below, or exceeds the quota (expected from church membership data) among starred names in *American Men of Science.*”3 The results of this table show that Unitarians had the highest representation with 81.4 proportional representation, with Swedenborgians coming in second (only because one of the scientists belonged to this denomination and it only constituted .02 percent of the total population), Congregationalists were third with 9.308 and Friends were fourth.

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3 Lehman and Witty, 547.
with 6.6. Thus, Quakers were represented at a rate six times higher among scientists than expected, given their small percentage of the total population.⁴

Lehman and Witty concluded their article with a summary and comment on their findings. They noted that while only twenty-five percent of outstanding scientists in America indicated their religious affiliation in their biographical sketch in *Who's Who*, fifty percent of all individuals listed there reported their religious affiliation, suggesting that scientists in general attach little importance to this item. Second, they noted that for the twenty-five percent of scientists who did provide this information, an overwhelming majority came from the more liberal denominations. "The Unitarians and the Congregationalists provide strikingly higher percentages of research workers than do the Catholics, the Lutherans and the Baptists."⁵ Quakers can certainly be counted here with the more represented liberal denominations. The third observation that they made pertained to the small number of scientists who report membership in the Catholic Church, and in the fourth note, they provided a speculation as to why this phenomenon occurs.

The conspicuous dearth of scientists among the Catholics suggests that the tenets of that church are not consonant with scientific endeavor. It is true, of course, that strict adherence to many Protestant credos would preclude acceptance of certain principles essential in many types of scientific work. The Protestant is generally acknowledged, however, to be less strict than is the Catholic in adhering to ecclesiastical pronouncement. And certain Protestant churches have so enhanced their concepts that it is possible to be fairly liberal in one's thought and still retain membership in church. Thus, it appears that membership in the Congregational and the Unitarian churches is somewhat consonant

⁴ Lehman and Witty, 547.
⁵ Lehman and Witty, 548.
with scientific enterprise. Noticeable indeed is the close relationship between the liberality of the church and the number of scientists which it shelters.\(^6\)

Although Lehman and Witty do not provide any additional evidence to support this speculation regarding the dearth of Catholic scientists, it seems to be a claim that many other people have also made. Mark Massa claims that there is an entire literature discussing the academic underachievement of Catholics, suggesting that there was something inherent to Protestantism that encouraged at least the more liberal Protestants, such as the Quakers, to go into the sciences.\(^7\)

Indeed, one of the most well known works relating Protestantism and science is Robert Merton’s work looking exclusively at the Puritan ethos and the impetus it gave to science.\(^8\) In relation to the above quotation, Merton argues specifically that “the mere fact that an individual is nominally a Catholic or a Protestant has no bearing upon his attitudes toward science. It is only as he adopts the tenets and implications of the teachings that his religious affiliation becomes significant.”\(^9\) And, as will be discussed further in this chapter, it was precisely the strict adherence to the Quaker theology that led many Quakers into the sciences.

The second study related to this topic is “Social Origins of American Scientists and Scholars” published in *Science* by Kenneth Hardy in 1974. Hardy’s

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\(^6\) Lehman and Witty, 549.


study was more detailed than that of Lehman and Witty in that it examined the religious background of scientists and other scholars in addition to other important influences including geographical, academic, social class, and familial aspects. He began by discussing the previous research that had been done on this subject, mentioning first Lehman and Witty's study. Other related research included two geographical studies of scientists conducted by E.L. Thorndike in the 1940s, Anne Roe's *The Making of a Scientist* (1952) where she examined religious background, geographical location, and the socio-economic class of scientists, and R.H. Knapp and H.B. Goodrich's study of the institutional background of scientists listed in the 1944 edition of *American Men of Science*.10

Hardy's study employed the productivity index which is "an index of the relative productivity of schools, states, and regions in terms of their being the origins of scientists and scholars" and he measured it by "the total numbers of men and women receiving doctorates from U.S. universities during each of the following periods: 1920 to 1929, 1930 to 1939, 1940 to 1949, 1950 to 1959, and 1960 to 1961."11 The most interesting results that Hardy produced emerge from his institutional comparisons. He first identified the 295 baccalaureate institutions that had more than one hundred graduates who went on to receive their doctorate between 1920 and 1961. He listed the most productive twenty percent of these schools in Table 4, ranking them by their productivity index and indicating what,

if any, their religious affiliation was. Although Quaker institutions were not the most numerous for the period 1920-1961 (there were thirteen Methodist institutions and five Quaker ones), it is striking where the Quaker institutions are found in this table. For the period 1920-1939, the three Quaker institutions listed (Earlham, Haverford, and Swarthmore) were within the top twenty-five institutions. For the period 1950-1961, the two Quaker institutions listed (Swarthmore and Haverford) were within the top eleven positions. No other denomination displays such high overall rankings.12

In Table 5, Hardy then ranked the productivity indices for denominational schools and the top denomination in each period (1920-1939 and 1950-1961) was Quakerism. In the first period, the productivity index for Quaker schools was 79.9 followed in second place by Reformed and Christian Reformed schools with a productivity index of 56.9. In the second period, the gap between first and second was larger still, with the Quaker productivity index at 139.4 and the Jewish one following in second with a productivity index of 82.5.13 Hardy then discussed the trends for each denomination.

Quaker. By far the most productive of the denominational schools are those sponsored by the Society of Friends. While some of the productivity of these schools may be attributable to their selecting students with high academic aptitude, and while only a minority of the student body are Quakers, these schools are so superior in productivity, not only among the denominational schools but also among all of the schools in the entire sample, that it seems highly

11 Hardy, 499.
12 Hardy, 501.
13 The productivity index for the Jewish denomination was based entirely on one school, Yeshiva in New York (Hardy, 501-503).
probable that a specific Quaker influence is at work. These schools are very high in all fields of specialization except education, where they are only average.\textsuperscript{14}

While I cannot offer, nor does Hardy offer, an explanation for his last statement, it is striking that he attributed this remarkable trend to a “specific Quaker influence.”

The other interesting component of Hardy’s study is that he analyzed the values associated with high productivity and low productivity. He associated productivity with a set of particular cultural values in Table 7:

- **Naturalism.** Belief in a world of order, law, pattern, meaning.
- **Intrinsic valuation of learning, knowledge.** To be learned, wise, is highly valued. Broad conception of valued learning.
- **Dignity of man.** Optimism concerning man’s ability to discover truth, accomplish things, change the world.
- **Personal dedication.** Seriousness of purpose, sense of mission, positive mysticism. Long-range striving. Responsibility beyond family.
- **Equalitarianism.** Active promotion of causes to improve states of disadvantaged. High status for women, children. Pacifism.
- **Antitraditional.** Not satisfied with established ways of doing things. Restless, inquiring spirit.
- **Centered on near future.** Concerned with this world. Orientation toward the foreseeable future.\textsuperscript{15}

As will be discussed more in depth in this chapter, the three most striking values that relate to Quakerism were naturalism, dignity of man, and equalitarianism, although the others also apply in lesser degree.

Unfortunately these studies neglected to break down their statistics by sex—neither study indicates whether women scientists were more prevalent

\textsuperscript{14} Hardy, 502.
\textsuperscript{15} Hardy, 504.
within one denomination or if there were similar proportions of women represented in different denominations, aside from Hardy’s comment that the rates of women earning PhDs was much lower than that of men. Nevertheless, these studies have demonstrated that Quakers did occupy an important place within science, and they additionally suggested possible reasons for this phenomenon. It is the point of this chapter, then, to further discuss these reasons and suggest some other connections that may exist between Quakerism and science that could be responsible for the significant number of Quakers within science.

**Truth and Quakerism**

As mentioned in the first chapter, the Quakers considered themselves Seekers of Truth. This designation seems striking when one examines the connections between science and Quakerism, because scientists could also be considered seekers of truth. This section will examine the notion of truth within

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16 Hardy also notes the prevalence of women’s colleges among the most productive colleges listed in Table 4. He attributes their high productivity to their attraction of “a clientele of high socioeconomic status and with strong career orientations, which often lead these women into scientific and scholarly pursuits. This finding may reflect an important valuation upon education, personal development, and social contribution for women beyond their roles as wives and homemakers” (Hardy 501). But he still makes no effort to compare the number of women to the number of men by denomination or as a total. Margaret Rossiter offers some statistics, also derived from American Men of Science, regarding the baccalaureate origins of female scientists in 1938, but none of the institutions she mentions were Quaker colleges [Margaret Rossiter, Women Sciences in America: Struggles and Strategies to 1940 (Baltimore: Johns Hopkins University Press, 1982), 146-147].
the Quaker tradition, after which I will examine briefly scientific notions of
truth and how the two might be related. The essential question here is: what is the
connection between the Quaker search for truth and the scientific search for truth
and, for Quakers, did the former lead in some way to the latter?

The Quaker concept of truth is not easily defined because it encompasses a
number of ideas relating to the Quaker belief of the Inner Light. George Fox
discussed Truth in his journal, directly relating truth to the Inner Light.

Now I was sent to turn people from darkness to the light that they
might receive Jesus Christ, for to as many as should receive him in
his light, I saw that he would give power to become the sons of
God, which I had obtained by receiving Christ. And I was to direct
people to the Spirit that gave forth the Scriptures, by which they
might be led into all Truth, and so up to Christ and God, as they
had been who gave them forth. And I was to turn them to the grace
of God, and to the Truth in the heart, which came by Jesus, that by
this grace they might be taught, which would bring them into
salvation, that their hearts might be established by it, and their
words might be seasons, and all might come to know their
salvation nigh.17

For Fox, the founder of the Quaker movement, it was through one’s Inner Light
that one recognized and accepted God, and one could discover the Truth in doing
so. Quaker theologian Dean Freiday later elaborated on this concept of truth:

“Their [the Quakers’] homes, their businesses, their dress, their speech all
reflected this concern for Truth—a term broad enough to mean Christ, the Gospel,
and hypocrisy-free integrity... Truth was not only something to proclaim but to

17 George Fox, Journal, revised and edited by John Nikalls (Cambridge:
University Press, 1952), 34.
Freiday's description portrays an active truth, suggesting that Quakers sought to achieve truth even in their daily lives.

And indeed, part of Quaker ethics involved the idea that one could and should be truthful in his or her daily life; the way to achieve this truthfulness was through the Quaker Testimonies of honesty, equality, simplicity and peace. Being truthful did not just entail honesty in business, but, as Freiday's quotation reflects, it also encompassed the simplicity of Quaker dress and speech and many other aspects of Quaker life. The idea of truth affected how the Quakers behaved and it encouraged them to lead simple, honest lives.

Howard Brinton notes the role that Truth played specifically in the decision-making process within the Quaker Meeting; here, the idea of Truth essentially related to the idea that the good of the whole was more important than the good of the few or the individual and although this idea grew out of the early Quaker beliefs, it was still held to be important in the nineteenth century. In the business meeting of the Society of Friends, decisions were made unanimously.

"When the consideration reaches a stage which indicates that a reasonable degree of unity has been attained, the clerk announces what he believes to be the sense of the meeting." Brinton continues by saying that

19 Brinton does note that the "degree of unity necessary for a decision depends on the importance of the question and the character and depth of feeling of those who oppose the general trend of opinion." So it is not always the case that complete unanimity is attained, unless it concerns a matter of great importance; Brinton provides here the example of the toleration of slavery, which was discussed
At its best, the Quaker method does not satisfy anyone completely. The objective of the Quaker method is to discover Truth which will satisfy everyone more fully than did any position previously held. Each and all can then say, 'That is what I really wanted, but I did not realize it.'

Thus, even the process of decision-making within the Society of Friends reflects this belief that there is a consensual truth that approximates ultimate truth and that is available to all. As I will discuss in the next section, the practices of scientific communities often parallel the discovery of truth that occurred in these Quaker Meetings.

Brinton also discusses the role of truth in education in his book *Quaker Education in Theory and Practice* (1940). He quotes from Quaker moralist Jonathan Dymond whose book *Essays on the Principles of Morality* (1892) was for a time used in Quaker schools.

> It is to little purpose to take a boy every morning into a closet and there teach him moral and religious truths for an hour, if, so soon as the hour is expired, he is left for the remainder or the day in circumstances in which these truths are not recommended by any living examples.

Clearly truth was not simply an abstract principle, but was discovered in the living world. As noted in the previous chapter, Quaker schools tended to focus more on

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repeatedly over many decades before the Society agreed to refuse membership to anyone who owned slaves [Howard Brinton, *Friends for 300 Years: The History and Beliefs of the Society of Friends Since George Fox Started the Quaker Movement* (Wallingford, Pennsylvania: Pendle Hill, 1974), 107].


science than on the liberal arts because nature was less controversial; thus, things such as music or fiction in literature and drama were omitted from the curriculum of these schools. These subjects and pursuits were not considered to be "in the Truth" because they "stirred up feelings which corresponded to no objective facts that resulted in no specific actions. More than that, [music] was considered a waste of time."²² Again these ideas emerged in part from the concern for simplicity, because simplicity was closer to truth, and the ultimate goal of a Quaker was to attain truth.²³

**Scientific Truth**

In order to compare the Quaker concept of truth to the scientific concept of truth, we must also examine what is entailed in scientific truth.²⁴ Although the concept of scientific truth and the scientific methods used to arrive at this truth

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²³ Quakers also rejected music during worship because they felt that it deprived worshipers of their duty of retirement, a duty that required waiting in silence and stillness. Some felt that if music were permitted during leisure time that it would come to have a place in the more serious worship, which would detract from their "character of Christians" (Brinton, *Friends*, 135, referring to a passage from Clarkson’s *Portraiture of Quakerism*).
came into question during the twentieth century, we are dealing here with a
nineteenth century concept of truth that was widely accepted. It thus becomes
necessary to examine how scientific truth was understood in the context in
question—nineteenth century America.

Let us begin, though, in seventeenth century England, in the same time
and place from which Quakerism emerged. Steven Shapin discusses this topic in
his book *The Social History of Truth*.25 Here Shapin points out that in seventeenth
century England, the capacity to know truth was roughly synonymous with
personal honor. Honesty and honor were joined together as fundamental
characteristics of a gentleman. He makes the point that women and non-
gentlemen did not naturally possess integrity and so could not be trusted to tell the
truth. This criterion acknowledges a hierarchy with the lower beings at the bottom
and God at the top identified with a notion of pure truth. Those who were closest
to God, namely English gentlemen, were the ones with the greatest capacity for
recognizing and warranting the truth. Shapin relates this truth seeking to the life
and work of Robert Boyle, who was well known as both a gentleman and a
scientist. But it is important to note here that in seventeenth century England,
truth was not as intricately tied to the application of a scientific method as it
would later become. Rather, truth was seemingly tied to personal qualities and
social status, which reflected a perception that those with the highest status were
the ones who could best attain the truth.
Of course, it is necessary to point out that Quakers did not practice the gender bias on which this hierarchy was based. Quaker women were just as likely to find truth as were Quaker men. In fact, Quaker women were expected to search for the truth in the same way as Quaker men—by following their Inner Light. At the same time, it is interesting to note that this notion of truth as an individual quest, as it was perceived to be by seventeenth century scientists, was shared by the Quakers who also believed in the process of individual truth-seeking.

In the nineteenth century, truth became more intricately linked to science within the positivist tradition. At this point, it was university-trained scientists following a particular method rather than gentlemen who were perceived to be closer to truth. Auguste Comte postulated three stages in the development of human knowledge. The first stage was theological, where everything that happened was caused by gods. The second stage was metaphysical, in which natural objects moved according to certain innate qualities they possessed. And the final stage was positive, in which hypotheses and empirical tests supplied scientific answers.

Comte believed his positive philosophy applied to all aspects of life including the social world. As Gertrud Lenzer has written, “The claim that social phenomena can and must be studied by the same positive methods used in the

natural sciences completes natural philosophy."\textsuperscript{26} For Comte, the basis of positive philosophy was mathematics and the limits of mathematics were found not in nature but in our intelligence.\textsuperscript{27} He established science, based on empirical evidence, as the ultimate basis of human knowledge and mathematics as the ultimate basis of science. Truth thus became more intricately linked to scientific method during this period than it had been previously. Most prominent scientists of the nineteenth century were influenced by the positivist tradition. In this development, individuals still discovered truth through their own resources and energy, but were now armed with a scientific method that could verify it. The scientific method was also valuable because it could be employed by anyone, thus making science an individual pursuit that was verifiable by the community in the same sense that a Quaker was guided by his or her Inner Light to arrive at consensus within the Quaker meeting.\textsuperscript{28}


\textsuperscript{27} Lenzer, li.

The Relationship Between Religious Truth and Scientific Truth

In 1915, Silvanus P. Thompson, an English Quaker physicist, gave the Swarthmore Lecture to the London Yearly Meeting.29 His talk was entitled "The Quest for Truth" and he addressed this topic from a number of different perspectives including science, religion, and history. While he did make distinctions between each of these perspectives, it is obvious that they were in some way related for him. He explained the distinctions between historical truth and scientific truth:

In science, far more than in history or philosophy, it is possible to arrive at something like real certainty. The scientific fact once discovered requires no citation of authority to procure its acceptance: it can be demonstrated over again by an independent observer.30

In science, facts can be verified through experiment and they can be measured quantitatively; in history one has to make do with fewer facts or documents using only the test of criticism to verify these facts.31

In addition to discussing religious and moral truth, Thompson also discussed the Inner Light in his lecture and he noted in this section that the conception of truth had been enlarged, as was discussed above.

Now it would seem that we, in these days, are in a happier position than the early Friends, happier than the thinkers of the preceding centuries, having the advantage that we live in a time when the conception of truth has been enlarged; when the search for truth for

29 Richard Sutton, Quaker Scientists (Greensboro, North Carolina: Guilford College, 1962), 4, 10.
31 Thompson, 39, 43.
its own sake has taken newer forms and has extended over wider areas of thought. It was the misfortune of earlier theologians, that they had no independent standards of truth such as are available by the methods of scientific investigation. The whole idea of truth as being verifiable by experiment is relatively modern.32

Although, as Thompson said, one could now arrive at truth through verifiable scientific methods, he noted that the individual experience gained from the Inner Light was still a valuable asset. "In the ultimate resort, then, after we have done all we can, as in the light of God, to test and to try our intuitions of truth, that which remains as truth must, for any one of us, be a matter of personal experience, or be confirmed by personal experience."33 Again, while the methods of arriving at truth in history and especially in science are immensely important and useful, it was the warrant given this truth by individuals that mattered most in the end.

Thompson’s analysis suggests that nineteenth century Quakers were beginning to realize that the search for truth could be aided by non-spiritual means relating to the investigation of the natural world. That is not to say that these nineteenth century Quakers abandoned their spirituality in search for scientific truth, because as the next section will discuss, many of these Quakers enjoyed scientific pursuits because they regarded them as an expression of their spirituality. But it is likely that they did not perceive a conflict between the scientific and religious quest of truth, as was possibly the case for other religious

32 Thompson, 113.
33 Thompson, 115.
For example, when Darwin published *On the Origin of Species* in 1859, many people, such as Adam Sedgewick and Louis Agassiz, reacted negatively because it denied their understanding of natural processes and the creation of the world, which were based largely within Christian theology. As Geoffrey Cantor argues in his essay “Quaker Responses to Darwin,” many Quakers accepted Darwin’s theory of natural selection because they believed that theology belonged in its own sphere and that scientific theories could be tested by scientific methods; thus the two could not be in conflict.

It is then possible that as Quakers began to search for truth in less spiritual ways, the greater dependency on scientific method led to secularization. In his book *Without God, Without Creed: The Origins of Unbelief in America* (1985), James Turner argues that 1870 was a watershed in the secularization of American religion, although he discusses it more in terms of unbelief than secularization: “In 1850, the intellectual ground of belief in God had seemed like bedrock; by 1870, it felt more like gelatin.”

One of the causes that Turner points to for this

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34 Geoffrey Cantor makes the interesting point that as pacifists, the Quakers were appalled by the military language used to describe the so-called conflict between science and religion; they not only disagreed with the idea that this conflict existed but also with the language used to describe it [Geoffrey Cantor, “Quaker Responses to Darwin,” *Osiris* 16 (2001), 321-342, on pg. 341.]. For further discussion of the “warfare thesis” see David C. Lindberg and Ronald L. Numbers, *God and Nature: Historical Essays on the Encounter Between Christianity and Science* (Berkeley: University of California Press, 1986). It would be interesting from here to examine what, if any, influence their pacifism had on their choice of what field within science to pursue.

35 Cantor, “Quaker Responses,” 333-334.

phenomenon was the growing importance of professional scientists after 1860
and the fact that "they presented what often seemed a clear cultural alternative to
the religious way of dealing with the world."\textsuperscript{37} Indeed, science was starting to
claim pieces of the authority that had once rested entirely within the church.

Howard Brinton also discusses secularization, but more specifically within
the Quaker context, in his discussion on the last period of Quaker history. In the
Modernist Period (1900-1950) Quaker emphasis shifted from the mystical and
evangelical elements to the rational and humanistic elements.\textsuperscript{38} Brinton notes that
while "rationalism and the religion of social service had always been present in
Quakerism… they were [previously] subordinate to the mystical and
evangelical."\textsuperscript{39} He continued:

But subordination of the rational and the social to the mystical and
evangelical did not continue to the same degree. Many Quakers
became primarily intellectual and humanitarian in outlook. The
searching for inner guidance in the heart and outer guidance in the
Scriptures receded, though it never altogether ceased.\textsuperscript{40}

He attributes this shift and the secularization of Quakerism to advances in science
in the nineteenth century.

All through the nineteenth century science had been coming
forward as the most reliable guide to truth, and in the twentieth
century it came to be revered as the most dependable source of
knowledge. Rapid acceleration in the application of science had
given to man an extraordinary control over nature. Reliance on the
divine seemed less essential. Such reliance was sometimes

\textsuperscript{37} Turner, 123.
\textsuperscript{38} Brinton ends the Modernist Period in 1950 because this book was first written
in 1952, so it is likely that in fact this period stretches to the present.
\textsuperscript{39} Brinton, Friends, 196.
\textsuperscript{40} Brinton, Friends, 198.
considered a sign of weakness or ignorance.41

If science was the main cause of this secularization, then higher education was the main tool of its implementation. "In most colleges science took precedence and other studies employed the scientific method as far as was practicable. Even courses of study in religion and ethics sought for a scientific basis."42 It is apparent here that science and Quakerism are intricately connected, to the point where it might be said that science influenced a shift in the theology of Quakerism.43

Quakerism and Natural Theology

At the same time, definite connections can be drawn between these ideas of the search for truth and the prevailing notion of natural theology in the eighteenth and nineteenth centuries.44 The concept of natural theology stems largely from William Paley's work *Natural Theology* (1802).45 In this text, Paley made the famous argument about the watch; essentially he argued that if one

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41 Brinton, *Friends*, 198.
43 It would be interesting here to examine the curriculum of Quaker colleges during this period in comparison to non-Quaker colleges to see if greater emphasis was placed on science by the Quakers and how this emphasis manifested itself in courses on religion and ethics.
happened to kick a stone lying on the ground, one would not question how
that stone came to be there because one would just assume that it had always been
there. However, if one happened to find a watch upon the ground, then one would
necessarily ask how it had come to be in such a place. He then noted how intricate
the design of the watch was, and how all of its parts worked together for a specific
purpose, and that they were perfectly suited just for this purpose. It was through
this argument about the designer of this mechanism that he extended this principle
to all of nature. The belief that the Creator made the world was prevalent at this
time, particularly among religious groups such as the Quakers. They further
believed that they could find and study God through a study of nature, since God
had created nature. It was this desire to become closer to God through nature that
became known as the tradition of natural theology.

Given that Quakers were interested both in becoming closer to God and in
scientific pursuits, it is hardly surprising that they took part in the natural theology
tradition. Geoffrey Cantor’s work discusses explicitly the connection that Quakers
found between nature and spirituality. He has argued that Quakers in the
eighteenth and nineteenth centuries were drawn largely to the observational

46 Geoffrey Cantor discusses the work of Quaker writer Maria Hack (1777-1844)
who wrote popular works for children including *Harry Beaufoy; or, the Pupil of
Nature* (1821) in which Harry Beaufoy, a ten-year-old boy is being taught by his
mother about nature. Hack’s book is interesting here because she adapts Paley’s
*Natural Theology* into a dialogue for children such that Harry is taught by his
mother that animals are machines that work in the same manner as Paley’s watch
due to the power, wisdom, and goodness of God’s creation [Geoffrey Cantor,
“Aesthetics in Science, as Practised by Quakers in the Eighteenth and Nineteenth
Centuries,” *Quaker Studies* 4 (1999), 1-20, on pgs. 5-6].
sciences—rather than the theoretical and mathematical ones—because of the prevalence of aesthetic values in the Quaker community. However, aside from noting that this article comes from the Quaker Studies Research Association conference of 1998, which was devoted to the topics of art, aesthetics, and creativity, Cantor does not specifically define what he means by “aesthetic” in this context.\(^47\) I can only conjecture that his use of this term refers to the Quaker appreciation of natural beauty—that is, the beauty of nature which they believed to be derived from God’s Creation.

Although Quakers dismissed music and fictional literature as discussed above, the practice of botanical illustration was popular among Quakers partially because it appealed to their interest in aesthetics.\(^48\) Cantor surmises that Quakers found botanical illustrations to be more acceptable than portraiture because “while the former sought to capture the truth of the Book of Nature, portraits were liable to reflect the vanity of the sitter.”\(^49\) Cantor also notes that Quaker illustrators were careful to represent nature with integrity; although one would not, for example, paint a flower that has been ravaged by insects, it was important to “observe carefully what God... created without imposing [one’s] own hubristic

\(^{47}\) Cantor, “Aesthetics,” 1, 3-4.

\(^{48}\) Gary Sandman gives a brief history of Quaker art in which he notes that an informal hierarchy developed within the arts. “Dance, theater, music, and novels were strictly forbidden because they excited passion. Poetry and painting were grudgingly tolerated since poetry could be edifying and painting was truthful in that it copied what existed. Crafts with their many facets were encouraged because they were not seen as art” [Gary Sandman, Quaker Artists (Kishwaukee Press, 1992), viii.].

interpretation."\(^{50}\) Apparently art, when done honestly and with the purpose of revering nature and God's creation, was acceptable among the Quakers who rejected both literature and music as untruthful and useless.\(^{51}\)

The opportunity to observe nature attracted many Quakers into the fields of astronomy, botany, and other branches of natural history. For example, Quaker naturalist Graceanna Lewis pursued her study of nature within the context of natural theology—looking at nature in order to understand God. "She remained a Quaker and often said that she loved nature because it better helped her to comprehend the Creator."\(^{52}\) Lewis' biographer, Deborah Warner, puts her in the context of natural theology in nineteenth century America.

For Americans in the early decades of the nineteenth century, science embraced things political, economic, moral and aesthetic, as well as natural. Not yet a set of recondite professional specialties, science offered a multitude of benefits besides a rational understanding of the natural order. No open conflict then existed between the truths of science and those of revealed religion. Rather, in the guise of natural theology, science served religion by enhancing an appreciation of the order created by God.\(^{53}\)

\(^{50}\) Cantor, "Aesthetics," 14-15.

\(^{51}\) One could draw connections here between Quakerism, particularly in its earlier, stricter period, and Puritanism, which also led its followers away from art and music and toward the sciences. For further information about Puritanism and science see Merton's essay "Puritanism, Pietism And Science" in his book Social Theory and Social Structure. For information concerning the differences between Quakers and Puritans see Mary Cochran Grimes, "Saving Grace Among Puritans and Quakers," Quaker History, Vol. 72, No. 1 (1983), 1-26.

\(^{52}\) Margaret Bacon, Mothers of Feminism: The Story of Quaker Women in America (San Francisco: Harper & Row, 1986), 159.

Similarly to Cantor, Warner argues that the pursuit of science was more of a vocation for Quakers in line with their beliefs and value systems than merely a professional career choice.

Cantor provides another example, a manufacturing pharmacist and amateur meteorologist named Luke Howard (1772-1864) who was presumably an English Quaker.

Howard insisted on the classic congruence between beauty and truth... Science was one means of seeking truth and truth in the physical world was manifested through the aesthetic of beauty. Hence every natural phenomenon is duly proportioned and what we see as beautiful speaks of God's design.54

Howard pursued the study of meteorology partly because it allowed him to appreciate the design of the natural world as God had created it. Cantor quotes some passages from Howard's writing, including one that described the aim of meteorology, which was to "discover a chain of causes and effects, demonstrative like the rest of creation, of the infinite wisdom and goodness of its Author."55

Clearly Howard engaged in the Quaker appreciation of natural aesthetics.

While Howard searched for evidence of God in his meteorological studies, many other Quakers pursued their theology within the study of botany. As Cantor says, "When they [the Quakers] observed nature they engaged God through His works. Thus botany readily shaded into theology."56 Further, "Unlike the more esoteric aspects of science, botany offered an immediate experience of God's

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Creation.” Jonathan Hutchinson, a Quaker surgeon articulated the importance of botany in a letter in 1880; botany “is really a knowledge of the works of the Deity in plant life: what plants are, and how they have become so; and is full of the beautiful and wonderful.” In the first chapter, I mentioned briefly two Quaker botanists, Peter Collinson and John Bartram, who were both engaged in this science and were patrons of others in the field. Another prominent Quaker botanist was Priscilla Wakefield.

Wakefield is particularly exemplary for my argument because she was a Quaker woman who was particularly interested in the study of botany as a means of studying theology. She referred to the study of nature through botany as “the most familiar means of introducing suitable ideas of the attributes of the Divine Being, by exemplifying them in the order and harmony of visible creation.” Botany is, in general, an important area to consider when examining women in science, because women played a critical role in the development of botany in the eighteenth century and botany in turn helped many women enter the sciences when other fields were shut off to them. As Ann Shteir argues,

Botany became part of the gender economy for women in England, and they could make it work for them. During 1790-1830 women were particularly visible as writers of botany books. Cultural discourse and social norms gave new prominence to their roles as mothers and educators. A new maternal ideology in the eighteenth

century lent authority to women in scientific education and popular science writing.  

Priscilla Wakefield's work *Introduction to Botany, in a Series of Familiar Letters* (1796) was written in the form of a series of letters between sisters and brought the study of botany to a more familiar level for middle-class women.  

These Quaker naturalists clearly stated their purpose in pursuing science: to find evidence of the Divine Creation, and appreciating the Creator by showing their appreciation of his creation. This seems to have been especially the case for the observational sciences as Cantor has argued:

> It would also appear that Quakers possessed an additional motivation for emphasising the observational sciences and their associated aesthetics. Instead of seeing a rational theology they emphasized the workings of the 'Inner Light' as a major source of religious understanding.  

This connection between science and religion was obviously not unique to the Quakers. In fact, while many may have worked within the tradition of natural theology, they did not originate the idea of looking for evidence of God's work in nature, nor were they unique in doing so. William Paley and his book *Natural Theology* inspired a number of scientists and theologians to consider these ideas, but neither Paley nor his followers were Quakers.

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Further Connections: Quakerism and Transcendentalism

While the work of Quakers in science seems to relate to this notion of natural theology, Ann Preston’s biographer introduces another topic—transcendentalism—that can also be used to explain the Quaker interest in pursuing both science and medicine. Transcendentalism was a literary movement that emerged in nineteenth century New England, and it was led by a number of noted thinkers including Ralph Waldo Emerson, Henry Thoreau, and Margaret Fuller.

Ralph Waldo Emerson, was particularly interested both in Quakerism and in science, and it seems that Quakers, including both Ann Preston and Maria Mitchell, were interested in his ideas and had heard him lecture. Frederick Tolles discussed the influence of Quakerism on Emerson in his essay “Emerson and Quakerism” published in 1938. Tolles drew a number of connections between the development of Emerson’s thought and his interest in Quakerism. Indeed,

63 Sharyn Clough has suggested to me that a connection could also be found in Pragmatism, which was a contemporary philosophy of Transcendentalism. One of the assertions of Pragmatist Charles Peirce was that science was approaching truth asymptotically such that scientists would eventually discover all of the truths that were to be had. They believed in the idea that truth could be verified through action, similar to Freiday’s concept of truth as something to be done, as mentioned above. While the Pragmatist search for truth does seem to relate to the notion of the Quaker search for truth, I have been unable to find any connections directly linking Pragmatism and Quakerism. So while a connection may exist and it may be interesting for someone to search for one, I am uncertain as to what how this connection can be made. For more information on Pragmatism see John P. Murphy, Pragmatism: From Peirce to Davidson (Boulder: Westview Press, 1990).

Emerson even gave a lecture in 1835 on George Fox as part of a series of lectures on biography. In his biography of Emerson, Robert D. Richardson Jr. makes the connection between science and Quakerism seem clear:

As Fox combined the idealist and the realist, so the truth of Quakerism seemed to Emerson to illuminate the connection between the spiritual and the natural. Emerson’s periods of greatest interest in Quakerism are also the periods of his greatest interest in science. Both science and the Quakers taught that all great truths are self-evident; no other authorities can or should be invoked. In notes for his Fox lecture Emerson pushed the connection: ‘I say natural but who shall tell me the limits of the natural? Spiritual helps are natural, they are part of the nature with which every man is endowed.’ In the convergence of Quakerism and science with the Platonism and the Stoicism that already form the central stream of Emerson’s thought we can see a common principle: the crucial illumination that the spiritual is not a realm apart from the natural but is instead revealed—and alone revealed through the natural.

Indeed it seems that as Richardson says, the connection between the spiritual and the natural was present in both Quakerism and Transcendentalism, so it would be interesting for someone to study these connections further. But even if no one examines this other possible connection between science and Quakerism, it is nevertheless clear from the discussions about truth and natural theology that a connection between science and Quakerism does exist and that it did lead a number of Quakers into the sciences.

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Quaker Women in Nineteenth Century America

Although there have been Quaker women involved in science in many different time periods and locations, this chapter is going to focus on three Quaker women who lived and worked in the Northeastern United States during the nineteenth century: Maria Mitchell, Graceanna Lewis, and Ann Preston. These three women are representative of Quaker women in science more generally because they had different family backgrounds, received different educations, and pursued science in different fields. Nevertheless, they all experienced, albeit in different ways, the increase in opportunities available to American women in the nineteenth century. Given these new opportunities and their Quaker heritages, these three women were each motivated to pursue scientific investigation, thus pushing the boundaries allotted to women during this period. They also all became scientific teachers, and in that sense they respected these boundaries by conforming their interests to one of the few professions open to women in the nineteenth century.

This chapter draws largely on the biographical treatments available for these three women. There are numerous books on Maria Mitchell, a few of which have excerpts from her journals and private letters. Deborah Jean Warner has published a biography of Graceanna Lewis and Marcia Bonta has written some smaller essays about Lewis as a Quaker naturalist. Ann Preston is mentioned in
many books about the role of women in medicine at this time, although the only full biographical account of her is an unpublished dissertation written by Pauline Poole Foster. In using these secondary sources and some of the documents written by these three women, it is possible to examine how the lives and works of these women illustrated the connections between science and Quakerism.

What can we learn about Quaker women in science and the connections between science and Quakerism from the lives and works of these three women? As noted above, these women’s experiences were different. Maria Mitchell was an astronomer, and although she did not remain a member of the Society of Friends for her entire life, the Quaker influences in her life are nevertheless apparent. Graceanna Lewis was a naturalist who fits into the natural theological tradition well, because she sought evidence of God within nature. Ann Preston was a medical doctor whose adherence to the Quaker belief in Inner Light led her into a field that was open only to a few women during that time. Thus, from examining the life and work of each of these women, we understand how, at least in these three specific cases, Quakerism was an influential force that led them into the sciences and in some senses governed their scientific work.

**Astronomer Maria Mitchell (1818-1889)**

Maria Mitchell was born on Nantucket Island, which was at the time largely inhabited by Quakers. Her own family was Quaker, and she was the third of ten children born to William and Lydia Coleman Mitchell. The Society of
Friends was a very influential force in Maria Mitchell’s life, although she did not remain a member for her entire life. Mitchell was disowned by the Friends Meeting when she was twenty-five, although there are conflicting stories about whether it was by her own initiative following her brother’s disownment or if it was on the initiative of the Friends because Mitchell could not profess her faith as they requested.¹ One of Mitchell’s biographers, Henry Albers points out that

We should not draw the conclusion from this ‘disowning’ that Mitchell was without religious beliefs. She unambiguously described astronomy as the ‘study of the works of God,’ and her diaries are filled with references to church services that she attended and sermons that she heard.²

Helen Wright’s account of Mitchell claims that she later attended, although she never joined, the Unitarian church.³ Nevertheless, her family’s Quaker background gave Mitchell some opportunities, particularly educational ones that might not have been available to her otherwise.

Education was an important component of the Mitchell family life. William Mitchell had a number of different occupations, one of which was schoolmaster. Maria was among her father’s students both in and out of the classroom. William Mitchell was also a very skilled amateur astronomer, and he allowed Maria to assist him in his observations.⁴ Before women started gaining

² Albers, 22.
³ Wright, 54.
⁴ Albers, 10.
access to scientific positions in the late nineteenth century, the only way that they
had to get into science was through their fathers and brothers, which is precisely
what Maria did. In 1831, Maria observed a solar eclipse by her father’s side.
Then, in 1847, she made an observation that made her famous. By that time she
had her own small observatory on top of the house, where she would spend her
evenings with her telescope. On the night of October 1, Maria Mitchell observed
what she thought to be a comet. Sixteen years earlier, the King of Denmark,
Frederick VI, had offered a gold medal to the first person to discover a comet
using a telescope. Although there was an initial dispute about the priority of
Mitchell’s discovery, she was eventually awarded the medal and her name
became famous across Europe and the United States. In 1848, the very next year,
she was elected an Honorary Member of the American Academy of Arts and
Sciences; in 1850 she became a member of the American Association for the
Advancement of Science; and in 1869 she was elected to the American
Philosophical Society. She was the first woman to gain such recognition from the

5 For further discussion of the influence of male relatives in helping women to
enter the sciences see Londa Schiebinger, The Mind Has No Sex?: Women in the
Origins of Modern Science (Cambridge, Massachusetts: Harvard University Press,
1989).
6 According to Albers, Mitchell’s membership certificate shows that the word
“Fellow” was crossed out and replaced by “Honorary Member” (Albers, 31). It is
unclear from these accounts whether this was merely a designation of female
membership or if her status was in some way inferior to that of the Academy’s
male members.
Mitchell had always been an avid reader, and she became the first librarian of the Nantucket Athenaeum in 1836, after having tried her hand at teaching for a year by opening her own school for girls. Her brother Henry pointed out that in the twenty years that Mitchell worked at the Athenaeum, she perused enough of the books there, particularly those related to science, to have in essence acquired a college education. Mitchell was also very skilled with a number of scientific instruments, including the sextant. In 1849, Mitchell was hired to do computational work for the American Nautical Almanac. Most biographical accounts of Mitchell are quick to point out that she was self-sufficient for more than fifty years, possibly the only American woman to do so through scientific employment beginning in the 1850s.

In 1865, Mitchell became the first professor of astronomy and director of the observatory at the newly founded Vassar College, the first college in the United States exclusively for women. Here she was known for her unconventional teaching style that included field trips and observational work rather than lectures. Mitchell always had a close relationship with her father, and his connections in the scientific world became very useful to her as well. Because Mitchell’s mother

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7 Wright, 230, 240; Albers, 181.
8 Albers, 23.
had died in 1861, William Mitchell accompanied his daughter to Poughkeepsie, New York and became a much-loved figure on the Vassar campus.

Mitchell was a strong advocate for higher education for women, and she gave a number of talks and wrote a few essays on that topic, including "The Collegiate Education of Girls," a paper read at the Congress of the Association for the Advancement of Women in 1880. In this paper Mitchell asked the questions "Whom shall we help to a collegiate education?" and "How shall we make the higher education of women still higher?" It becomes apparent through her answer to this first question that Mitchell did not necessarily support education for all women, but only those who were "well-born, well-bred, and healthy." She reiterated this argument in her diary in 1887 adding also that a girl whose family is large should be responsible and stay home and help her mother with the household.

Nevertheless, Mitchell supported a woman's right to excel in any way possible, as she notes in a lecture:

I am far from thinking that every woman should be an astronomer or a mathematician or an artist, but I do think that every woman should strive for perfection in everything she undertakes... Any special capacity, and sense of peculiar fitness for a certain line is of itself an inspiration from God, the line is marked out for her by His finger. Who dare turn from that path? And if she be of only moderate capacity, the duty of using to the utmost her power for good is still upon her... Are we women using all the rights we

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have? We have the right to steady and continuous effort after knowledge, after truth. Who denies our right to life-long study? Yet you will find most women leave their studies when they leave the schoolroom... We have another right, which I am afraid we do not use, the right to do our work well, as well as men do theirs. I have thought of this part of the subject a good deal and I am almost ready to say that women do their work less thoroughly than men... When you leave Vassar College, you leave it the best educated women in the world... You and I think a great deal about our rights! I have thought more on that subject since I have been in Vassar College than in my whole life before. For myself it is of little consequence; for you, who have long lives before you and to whom new responsibilities are sure to come, it is of great moment.12

Clearly the issue of women’s rights was an important one to Mitchell, and as she noted in this lecture one of the ways to obtain these rights was through education. Although she was very active in advocating opportunities for women in higher education, she was not as active in the woman suffrage movement. “Miss Mitchell took no prominent part in the woman suffrage movement, but she believed in it firmly, and its leaders were some of her most highly valued friends.”13 Mitchell was an important role model for women in science and in general. Although she had to resign her position at Vassar in 1887 due to illness, the trustees offered her the position of Emeritus Professor of Astronomy, noting that she served “as a noble model of true womanhood.”14

12 Albers, 197-199.
Naturalist Graceanna Lewis (1821-1912)

Graceanna Lewis was born in Chester County, Pennsylvania, another area settled primarily by Quakers. As Lewis' biographer Deborah Jean Warner notes,

She and her relatives were neither rich nor poor. Their plain Quaker ways shielded them from extravagant desires, their habits of industry and frugality prevented serious losses. They worked as farmers, teachers, and doctors, earning enough to support themselves comfortably, but always reserving ample time for their many community responsibilities. For such people, taught to eschew the theater and other such frivolities, science was a particularly acceptable leisure activity.15

Thus, her family was very practical and her mother in particular was recognized and respected widely for “her intelligence, well balanced judgment, and extreme competence in practical matters.”16 Graceanna’s father John Lewis died when Graceanna was only three years old. However, her mother Esther Fussell Lewis was able to take care of and provide not only for her five children (only four of whom survived infancy) but also for various other relatives and neighbors.

Esther Lewis, who had previously been a teacher, educated her children at home and instilled an early interest in science in her daughter Graceanna. Once the children were old enough, they attended Kimberton Boarding School, a Quaker school only two miles from their home. The curriculum at Kimberton included courses in astronomy, botany, and chemistry, further increasing Graceanna Lewis’ interest in the natural world. In particular, the influence of

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14 Albers, 313.
16 Warner, 12.
Abigail Kimber, a botanist, was important in teaching Lewis how to identify plants and in showing her that it was acceptable for women to do this type of work and make their own scientific contributions.

Although she did not immediately enter the sciences, Lewis took the path followed by many women of her time, that of teaching. Teaching was of course one of the only ways that young women could earn a living for themselves. So, in 1842, Lewis went to York, Pennsylvania to become a teacher in her uncle’s boarding school for girls. This uncle, Bartholomew Fussell, was a physician interested in social reform, so it is not surprising that his school included courses in physiology, taught by himself, and courses in astronomy and botany taught by Lewis. Unfortunately the school only remained open for two years, after which Lewis continued teaching briefly elsewhere but then returned home, where she devoted herself entirely to her family and to social reform.17

It was during this time that Lewis became very active in the abolitionist movement. “Self-serving motivations aside, Graceanna and her relatives did believe simply and literally in the brotherhood of man, and in the American promise of liberty for all.”18 The Quaker community during the nineteenth century spoke out loudly against slavery, particularly the Hicksite section to which Lewis and her family belonged. Abolitionism and the political activism associated with it was Lewis’ primary concern during this part of her life, but once the Civil War

17 Warner, 16, 21-22.
18 Warner, 29.
ended and Emancipation had been proclaimed, her abolition crusade was over. And it was at this point in her life that she turned to science.\textsuperscript{19}

Although Lewis had known from an early age that she was interested in science, it was not until she was thirty-nine that it was clear that science was her chosen career.\textsuperscript{20} She studied with John Cassin, at that time America's leading ornithologist and curator of birds at the Academy of Natural Sciences in Philadelphia. Cassin was also a Quaker and quickly became both an instructor and friend to Lewis. During the seven years (1862-1869) that Lewis studied with Cassin, she was able to use the resources of the Academy, including both its library and its museum. Warner claims that "by 1869 [Lewis] was truly the best educated woman naturalist in the United States."\textsuperscript{21} Bonta notes further that Lewis knew "something about every aspect of natural history" having studied botany, ornithology, zoology, dendrology and various other things such as algae and extinct mammals.\textsuperscript{22} Indeed, the ornithologist Spencer Fullerton Baird told her in a letter in 1870 that she possessed "a more profound knowledge of the philosophy of many branches of Zoology and Natural History than a large percentage of the men of the best reputation of the day."\textsuperscript{23}

\textsuperscript{19} Warner, 47-49.
\textsuperscript{20} Warner, 48.
\textsuperscript{21} Warner, 53.
\textsuperscript{23} Bonta, "Graceanna Lewis," 35.
Unfortunately, Lewis was never able to attain any professional position and thus did not become as well known in natural history as she might otherwise have become, although she maintained her interest in nature for much of the rest of her life. By 1876, less than two decades after she had embarked on a scientific career, her focus had shifted away from the scholarly pursuit of science, although some of her publications in the *Friends’ Intelligencer and Journal*, such as “Birds and Their Friends,” did come as late as 1896.24 Warner notes that “As Graceanna became less fettered by the constraints of scientific propriety, her aesthetic expression became more frequent.”25 Lewis’ interest in nature never waned though, and she began to capture nature through artistic expression with drawing and paintings as well as prose and poetry.26 Thus, Lewis became part of the Quaker tradition of botanical illustration discussed in the previous chapter. She also became involved in the back-to-nature or the nature study of the 1870s, which followed the motto coined by Agassiz “Study nature, not books.”27

In terms of her scientific work, Lewis engaged in what Deborah Jean Warner refers to as “extravagant theory building.” Warner discusses how the

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27 Warner, 8-9, 100-109.
ideas of Darwin, Haeckel, and Huxley regarding the evolutionary tree of life were taken literally by Lewis who suggested that the tree was more than a metaphor.

Its form was determined by the basic natural forces—magnetic, electromagnetic, crystallizing, and vital—an idea she may have derived from Huxley himself. These forces determined the perpendicular axial form of plants and animals, and they undoubtedly also influenced the order of the relationships scientists discerned between different groups in the animal world.  

Her ideas were very teleological and she tenaciously sought evidence to support her belief in the Divine Creation. Among Lewis’ intellectual mentors were Louis Agassiz and the Naturphilosophe Lorenz Oken, both of whom advocated teleological views of nature. Indeed, Agassiz rejected Charles Darwin’s theory of natural selection because it did not leave room for the role of the Creator; unfortunately for Lewis, Agassiz’s ideas were essentially discounted by the time of his death in 1873. As can be seen here, Lewis’ ideas were quite radical and even if she had been more well-known, her ideas would have probably been rejected outright. Warner suggests that if Lewis had not chosen such a difficult theoretical and metaphysical problem, and rather focused more specifically on an observational program, as other Quakers had done, that she might have gained more recognition and greater stature as a scientist.

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28 Warner, 73.
29 For more information about Oken’s theories see Pierce C. Mullen, *The Preconditions and Reception of Darwinian Biology in Germany, 1800-1870*, University of California, Berkeley dissertation (1964).
30 Warner, 61-78.
31 Warner, 7.
Physician Ann Preston (1813-1872)

Ann Preston, like Lewis, was born in the Quaker-populated Chester County of Pennsylvania. As Preston’s biographer, Pauline Poole Foster, notes, Chester County was both an agricultural center and the specific town that Preston lived in, Londongrove, was noted for its “stimulating intellectual climate” which provided Preston with the opportunity to become “an intelligent and informed woman.”

Even with this opportunity, though, Preston held a domestic role for the first half of her life, helping to raise her brothers and sisters and nursing her sickly mother. By the time that Preston’s youngest brother had reached the age of twenty, though, she no longer needed to be their surrogate mother. At this point, she decided to go on the lecture circuit, which provided her with a larger income than she could receive from teaching. The topic that she chose to lecture on was physiology and hygiene. Although she had no formal training in this area, she had plenty of informal experience.

Then, when Preston was thirty-seven, the Female Medical College in Philadelphia opened its doors, and she became a member of its first class.

32 Chester County experienced the schisms of Quakerism that were discussed in the first chapter. While some members of the county chose to follow the more Orthodox Quakerism, Ann Preston’s family, like Graceanna Lewis’ family, decided to follow Elias Hicks in the separation. Interestingly, Nantucket and Maria Mitchell’s family also experienced these schisms, although there the division was between the Gurneyites and the Wilburites, with Mitchell’s family joining John Gurney’s side (Pauline Poole Foster, *Ann Preston, M.D. (1813-1872): A Biography: The Struggle to Obtain Training and Acceptance for Women Physicians in Mid-Nineteenth Century America*, University of Pennsylvania dissertation (1984), 6; Warner, 30; Wright, 55).

33 Foster, 4-5.
Although the College was not incorporated by Quakers, a few prominent Quakers, including Bartholomew Fussell and Joseph Longshore, were among the first to conceive of the idea of opening a medical college with the sole purpose of educating women in medicine. As will be discussed later, the Quakers had an important involvement in medicine including their patronage of medicine, especially women’s work in medicine, which was not universally supported during the nineteenth century.

Preston continued her own lecturing while attending classes at the College, and gave a few lectures for women only. As Foster notes,

The lecture tours served Ann Preston well. They satisfied her desire to inform the women of the country about proper hygiene, sanitation, and the care of their bodies, a need which she considered vital to the prevention of many of the maladies which victimized them and their children. They made her known to the public; this increased her private practice and enhanced the reputation of the Female Medical College. They provided a sizeable source of revenue which, when added to her salary at the college and the income from her private practice, gave her the means to live comfortably and independently.

At that point in time, a medical education was comprised of eight to ten months of course work, taken over two years, with the second year being a mere repeat of the first. Preston completed her course of study and decided to return for a third year of course work. By the time she had finished her third year, the Female Medical College was looking for female physicians to hire onto the faculty and the first person that they considered was Ann Preston. So, in 1853, she was

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34 Foster, 151-152.
35 Foster, 180-181.
offered the chair of physiology and medical institutes, and she became the first female professor in a regular medical college in the United States.  

Then, in 1865 she was elected by the faculty to become the first woman dean of the Female Medical College.

During her time at the Female Medical College, Preston did quite a bit to improve the opportunities available to women in the medical field. One of her greatest efforts was the founding of the Woman’s Hospital of Philadelphia. The women of the Female Medical College were having trouble finding places in Philadelphia to obtain clinical instruction; although there were a number of medical facilities in Philadelphia, they all refused to recognize female doctors, as did many of the professional societies. The only panacea to this problem in Preston’s mind was the establishment of a facility that would be run and organized entirely by women and would treat only women and children. When the Woman’s Hospital of Philadelphia finally opened in 1861, it owed much of its success to the efforts of Ann Preston, who “conceived the idea, did the planning, contacted the legislators and contributors, decided upon the building, supervised the necessary renovations, and purchased the equipment and supplies.”

Susan Wells illuminates another important contribution that Preston made to the medical field, particularly for women: “As professor of physiology at the

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36 Foster, 165, 177-178.
37 Foster, 185.
38 Foster, 311.
39 Foster, 247-249.
40 Foster, 249.
Woman’s Medical College, she chose to educate women physicians rather than to argue for their right to medical training. Repeatedly and in many contexts, Preston maintained that the equity of admitting women to the medical profession was ‘beyond controversy.’”41 Wells then pulls a number of quotations from Preston’s various addresses to further illustrate this point:

You and I feel that “our true sphere is that circle which we are able to fill”; that it was fixed by God in the capabilities and adaptations of our nature; and we can well afford to look with quiet pity upon those self-elected arbiters, who, gratuitously, have taken upon themselves the labor of marking out for us its boundaries.

Ladies, we should gain nothing by meeting such as these in argument. Prejudices are not amenable to reason. Your business is, not to war with words, but “to make good” your position “upon the bodies” of your patients by deeds of healing.

Despite of opposition, we think it may be truly said, that public sentiment in this country already decides that woman, in studying the science, and practicing the art of Medicine, is not stepping outside of her fitting place.42

These quotations clearly reflect Preston’s belief that medicine could and should be practiced by anyone who desired to do so—regardless of their sex. She also argued that the practice of medicine was clearly within a woman’s traditional role, since, as she had done for her family, women were expected to care for the ill.

42 Wells, 63. Quoted respectively from Ann Preston, “Introductory Lecture to the Course of Instruction in the Female Medical College of Pennsylvania for the Session 1855-1856,” 2; Preston, “Introductory Lecture,” 8; Ann Preston, “Valedictory Address to the Graduating Class of the Female Medical College of Pennsylvania for the Session of 1857-58,” 8.
And Preston believed that women had the capacity to be caregivers both within the home and within the professional world.

In examining the literature on women in medicine, Ann Preston’s name seems to be an important one. Although not all of the books focus specifically on her work in the field of medicine, most do at least note her contributions. In his book *The Quaker Heritage in Medicine*, J. Russell Elkinton discusses the intricate connections that link Quaker belief to this profession:

The important beliefs may be summarized in two statements: 1) that a caring, loving God (as brought to us in the Christian message) gives unity to all life and that His spirit is potentially present in every human being; 2) that truth must continually be searched for experimentally to the end that this Divine Power may become manifest in all men. The actions that derive from these beliefs are: a) to heal, relieve, or comfort each patient in body, mind, and spirit; b) to experiment, to understand, to increase our skills in the search for truth that will enhance our abilities to promote the healing powers of God; c) to strive to improve the quality of the lives of all men. These beliefs and actions by no means are limited to doctors who are Quakers, but they are our heritage of Quaker achievement in the art and science of healing.43

Elkinton also emphasizes here the role that the search for truth played in medicine; through experimentation, he said, Quakers were engaging in a search for truth and the divine, which would then aid them with their healing practice. It should be noted here that Elkinton’s essay is part of the hagiographic Quaker literature. While many Quakers were involved in medicine, they were certainly not the only sect represented there with important figures and even their own

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hospitals. Although Ann Preston is not one of the individuals that Elkinton mentions in this book, it is clear that her role as both a doctor and a teacher of medicine belonged within the Quaker heritage of medicine.

**Connections Between Them**

These three women were acquainted with each other, or at least Mitchell and Preston were both acquainted with Lewis; it is unclear whether Mitchell and Preston were actually connected, except through Lewis. Warner notes that Preston and Lewis had known each other through their early reform activities, but they also had a connection through Lewis’ uncle Bartholomew Fussell. Lewis had taught for a short period at Fussell’s school for girls, and Fussell was a key figure in promoting medical education for women. Additionally, Fussell’s nephew, who was presumably Preston’s cousin, Edwin Fussell, was a key figure at the Women’s Medical College, serving as Dean immediately prior to Preston.⁴⁴ Lewis and Mitchell were also acquainted and Mitchell tried to help Lewis obtain a position at Vassar when the professorship in natural history became vacant. Although the given reason that Lewis was not chosen for this position was that she did not have any experience in geology, Mitchell speculated that the real reason was Lewis’ sex. Warner claims that Lewis held Mitchell in great admiration even though their attitudes toward science differed greatly; while Mitchell emphasized the professional opportunities, Lewis preferred to

⁴⁴ Warner, 95; Foster, 310-311.
understand science as a means of cultivating a greater appreciation of God.\textsuperscript{45} It is hardly surprising that these three women also knew and either influenced or were influenced by other important Quaker women in science including Mary Townsend, Sarah Adamson Dolley, and Hannah Longshore.\textsuperscript{46}

In addition, there were a number of similarities between these women. As noted in the first chapter, each of these three women was born and raised in a community that was inhabited predominantly by Quakers, and Preston and Lewis both eventually moved to Philadelphia, another historical center of Quakerism. Being surrounded by Quakers and Quaker ideals from an early age, it is obvious that each of these women would have been influenced by Quakerism in some way. Also, they reciprocated the influence, giving back to their Quaker communities through their social activism.

As women trying to succeed in the male dominated world of science, it is hardly surprising that these women all became advocates of women's rights, although each did so in her own way. As already noted, Mitchell was very vocal on the issue of providing women with better opportunities in higher education. Preston certainly helped improve the plight of women in the medical field. Lewis was similarly concerned about women's rights, although she never got involved in

\begin{footnotes}
\item[45] Warner, 59-60, 80-81.
\item[46] Warner, 95.
\end{footnotes}
the political battle.\textsuperscript{47}

Another similarity is the fact that none of these three women ever got married. Warner claims that this was a trend common to Quaker women in particular.

Among Quaker women in the nineteenth century, spinsterhood was not uncommon. Two-fifths of the women in Philadelphia Meetings never married. The roll of Graceanna’s close relatives and friends who remained unmarried included two of her three sisters, her cousins Susan and Ada Fussell, Mary Townsend and her two sisters, the artist Mary Peart, the astronomer Maria Mitchell, Rachel Bodley and Ann Preston of the Women’s Medical College, and Mary Grew and Abby Kimber, both accomplished teachers and active abolitionists. Like Graceanna these women all derived enormous satisfaction from their public activities, their friends and their families. There is absolutely no evidence that they seriously regretted their spinsterhood.\textsuperscript{48}

Marcia Bonta also notes this phenomenon and attributes it to their Quaker heritage. She says that “since the Society of Friends instilled in women a sense of their own worth aside from wife and motherhood, many of them did not marry.”\textsuperscript{49}

Although each of these women was very close to her family, none of them ever got married or had their own children. But while other women were busy having families, these women were making new strides in fields where women had to work twice as hard in order to succeed. Thus, it seems that for Quaker women there was less incentive to marry, because they did not have to occupy the role of

\textsuperscript{47} Warner suggests that perhaps Lewis and her sisters did not learn at an early age, like other women did, “the extent to which their gender denied them easy access to the educational expectations and opportunities open to young men.” This fact, if true, might explain why she was never fully compelled to engage herself in this fight (Warner, 14).

\textsuperscript{48} Warner, 22-23.
wife and mother in order to feel successful in a world in which these were the primary roles afforded to women. And it is hardly surprising that Quaker women, who were viewed as men's equals at least within their own communities, were the ones who felt this way; given the role of Quaker women described in the first chapter, such as those women who became traveling ministers and left their families behind to do their work, it seems that Quaker women were much more active than other women because they had more incentive to work than to marry.50

**Quaker Influences In Their Lives**

Having examined each of these women in at least a little detail, we can now ask the question: to what extent did each woman's Quaker background influence her desire and ability to go into the sciences?

In the case of Maria Mitchell, it is not evident that Quakerism had much of an impact on her life, although it could be argued that her family was very influenced by Quaker ideals and that these ideals were stressed during her upbringing, thus influencing her indirectly. Education in particular was something held to be very important in the Mitchell household, so it is hardly surprising that

49 Bonta, "Graceanna," 29.
50 Margaret Rossiter also discusses the role of marriage throughout her book *Women Scientists in America*, although she focuses more on the impact of marriage on a woman’s scientific career, in terms of unemployment levels and anti-nepotism laws, rather than examining the successes of unmarried women in the sciences [Margaret Rossiter, *Women Scientists in America: Struggles and Strategies to 1940* (Baltimore: Johns Hopkins University Press, 1982.).]
later in her life Maria Mitchell became a professor at a women’s college and advocated more opportunities for women in higher education. Given what has already been said in the first chapter about the importance of education in Quaker communities, it is feasible to say that the Mitchell family’s interest in education was either due to or at least supported by their Quaker beliefs.

The Quaker influence in Graceanna Lewis’ life is apparent through her motives for pursuing both science and social activism. In terms of social reform, she was encouraged to work for the abolitionist movement by her family and the larger Quaker community in which she lived. In terms of her interest in science, she was motivated by her desire to better understand God and God’s creation. Quakerism instilled in Lewis a desire to learn more about the Creator than she could attain from religion alone. Clearly she learned about God from Quakerism, but science gave her a means of celebrating and furthering this knowledge.

Ann Preston presents an interesting case for this study because she was not necessarily a scientist, but rather a doctor. While this thesis purports to examine Quaker women in science alone, Preston’s life and work provide a more concrete study of the Quaker influence than perhaps that of Maria Mitchell. And although medicine, particularly as it was practiced in the nineteenth century did not employ the same methodology as science, it provides for us here an interesting example of how one woman, driven by her Quaker sense of the Inner Light, was motivated by a desire not only to help sick people but also to help women who wanted to pursue medicine but had previously been discouraged. Preston, according to her
biographers, had a strong sense of her ability to pursue whatever vocation she desired, and although the general belief at the time considered medicine to be an improper field for women to work in, Preston felt that it was proper and it was her place to do such work. At the same time, medicine can perhaps be seen as a branch of science, that of the physiological sciences. Although the source of this quotation is not given, Eliza Judson mentions something said by someone who knew Preston well:

I found her ready to accept the demonstrated facts of physiological science, and without superstition or bigotry; not suspicious of ulterior or final results, provided only it was the light of truth that fell across her pathway. Liberal and advanced in her views and culture, her teaching as Professor of Physiology to women embodied a fair and faithful exposition of the science as now understood by the medical profession.51

Although medicine as a practice is perhaps not a science, medicine as a course of study—for Preston was a professor and had been a student at the Women’s Medical College—could be considered a science. As Quaker historian Philip Benjamin points out, medicine served as a “happy combination of science and service” for many Quaker women following the opening of the Women’s Medical College, which provided them with the opportunity to practice medicine when such opportunities were scarce.52

At the same time, it is important to note that these women were not isolated in Quaker communities, and that while Quaker ideals were influential in

51 Eliza E. Judson, Address in Memory of Ann Preston, M.D. (Philadelphia, 1873), 23.
their lives, these were not the only important influences. Indeed, these three middle- to upper-class women lived in the Northeast of the United States in the nineteenth century—a time and place where women of these economic groups were beginning to make significant strides towards equality. Although the members of their sex would not gain the right to vote until a century after these three women were born, other achievements such as access to higher education were achieved at this time.\textsuperscript{53} Thus it is important to note that other non-Quaker women were also going into the sciences at this time simply because now it was a viable option for them.\textsuperscript{54} While Quaker ideals were influential in the lives of these three women, it is impossible to say that Quakerism provided them with opportunities that would not have otherwise been available to them. Nevertheless, it is still interesting to analyze how their Quaker ideals and their scientific works were mutually supportive.

\textsuperscript{53} Margaret Rossiter also discusses the advances made by women in both higher education and science in the nineteenth century.  
Quaker Influences in Their Science

In addition to examining what influence Quakerism had in the decision that each of these three women made to go into the sciences, we can also examine what influence their Quakerism had on their science itself and vice versa. In the previous chapter, I discussed the notion of truth and how pervasive this idea was both within Quakerism and within science. Additionally, I noted some inherent connections between Quaker beliefs and the tradition of natural theology which was prominent in the eighteenth and nineteenth centuries. Thus, the question becomes: Where are these ideals of truth and the notion of seeking evidence of God within nature found within the work and ideas of these three women?

One clear example of the connection between science and Quakerism given by one of these women is found in a poem written by Ann Preston entitled “The Ideal is The Real.”

We make this life a mournful, empty dream,
And stones for bread we give,
And know not that the soul’s realities
In its Ideals live.
These are the stars that shine within its night,
The angel ones it sees,
And evermore, unconsciously, it learns
Its possible from these.
There are no limits to the Real,
Save those that bound the pure Ideal.

The thoughts of beauty dawning on the soul
Are glorious Heaven’s gleams;
And God’s eternal truth lies folded deep
In all man’s lofty dreams.

Sarah Adamson Dolley and Wells discusses Hannah Longshore, both of whom were Quaker doctors and contemporaries of Ann Preston.
"Twas first in Thought's clear world that Kepler saw
  What ties the planets' bound;
And through long years he searched the spheres, and there
  The answering law he found.
Men said he sought a wild Ideal;
The stars made answer,—it is Real.

Paul, Luther, Howard—all the crowned ones
  That star-like gleam through time,
Lived boldly out before the clear-eyed sun
  Their inmost thoughts sublime.
These truths, to them, more beautiful than day,
  They spoke to quicken men;
And deeds at which the blinded gazers sneered
  They dared to practice then,
'Til they who marked their young Ideal
In meekness owned it was the Real.

Thine early dreams, which come like 'shapes of light,'
  Come bearing prophecy;
And Nature's tongues, from leaves to 'quiv'ring stars,'
  Teach loving Faith to thee.
Fear not to build thine eyrie on the heights
  Where golden splendors lay,
And trust thyself unto thine inmost soul
  In simple faith alway;
And God will make divinely Real
The highest forms of thine Ideal.

In this poem it becomes apparent that for Ann Preston, science and religion were
inextricably linked. She says that in looking for the ideal within nature, one is
more likely to find the real. She uses the example of Kepler who was looking for
some way to explain how the universe works and how the planets move in what is
perceived to be uniform motion. Although the answer he sought was deemed by
many to be a crazy dream or too ideal of a notion, he did discover the answer.

Additionally, this poem has evidence of Quaker ideals, particularly the
idea of the Inner Light. She says that one must "trust thyself unto thine inmost
soul/ In simple faith alway." By focusing on what is in oneself, and by following one’s Inner Light, “the highest forms of thine Ideal” will become one’s reality. And of course this idea of Inner Light was important in Preston’s life; she worked in a field that was not widely open to women at the time, and justified her pursuits by saying that she had been led into this career by her Inner Light.

Verse seems to have been a common way for these women to express the connections that they saw between science and theology. At Maria Mitchell’s funeral, the President of Vassar College said that Mitchell had been seeking truth for her entire life and that he thought she had found the truth that she was seeking. Mitchell actually addressed this issue herself in her journal on July 1, 1883. She said almost poetically:

I went to hear Rev. Mr. — at the Universalist Church. He enumerated some of the dangers that threaten us: one was ‘The doctrines of scientists,’ and he named Tyndall, Huxley, and Spencer. I was most surprised at his fear of these men. Can the study of truth do harm? Does not every true scientist seek only to know the truth? And in our deep ignorance of what is truth, shall we dread the search for it?

55 Regina Morantz-Sanchez discusses the experiences of nineteenth-century American women who were trying to pursue medicine. As she argues, these women struggled against the professionalization of medicine while trying to bring forth another set of values into medicine, those of nurturing and cooperation, both values considered to be traditionally feminine. Because these feminine values contrasted with those deemed necessary for the professionalization of medicine, women encountered many difficulties upon entering the field of medicine (Morantz-Sanchez, 5-7). In her book Restoring the Balance: Women Physicians and the Profession of Medicine, 1850-1995, Ellen S. More argues against this perceived struggle between being a physician and being a woman. Instead, More suggests that it is imperative for female physicians to find the balance between the two (More, 2-10).

56 Foster, 183.
57 Mitchell, Maria Mitchell, 240.
I hold the simple student of nature in holy reverence; and while there live sensualists, despots, and men who are wholly self-seeking, I cannot bear to have these sincere workers held up in the least degree to reproach. And let us have truth, even if the truth be the awful denial of the good God. We must face the light and not bury our heads in the earth. I am hopeful that scientific investigation, pushed on and on, will reveal new ways in which God works, and bring to us deeper revelations of the wholly unknown.

The physical and the spiritual seem to be, at present, separated by an impassable gulf; but at any moment that gulf may be overleaped—possibly a new revelation may come...

It is thus apparent that Maria Mitchell was part of the natural theological tradition; much like Graceanna Lewis and Ann Preston, she was searching for evidence of God’s works within nature. Mitchell also considered herself a truth-seeker, and although she may not have remained a Quaker for her entire life, the influence of Quaker theology is clearly present here.

Graceanna Lewis also followed the natural theological tradition. Although it is difficult to determine the extent of the influence of Lewis’ religious beliefs on her intellectual and scientific ideals, it hardly seems surprising that a woman so devoted to the Quaker theology would hold scientific views that closely corresponded with these religious ideas. She believed strongly in the notion of being able to find evidence of God within nature, so her belief in the Divine Creation and her rejection of Darwin’s theory of evolution by natural selection does not seem remarkable or unlikely.

Lewis wrote about specifically evolution in relation to the search for truth in an article entitled “Truth and the Teachers of Truth” published in Friends’
Intelligencer in 1896. In this article, she demonstrated her teleological views about evolution by talking about the notion of progress and how it is directed by God toward a specific goal.

The great lesson to be learned from the Past is that of Progress—progress in external nature and in the soul of man! The geologic story is an intensely interesting one, confirming the view of progression from lower to higher, throughout immensely long periods of time. The purpose of gradual improvement has been steadily held from the beginning to the present. Could aught but Divine Power hold such a purpose for uncounted millions of years? Are we to dispute the record of his work left by God himself in the earth which he has made and which he is slowly and surely perfecting? On the contrary, let us study in a reverent spirit the best works on geology, and in an equally reverent frame of mind, acquaint ourselves with animal and plant life, both extinct and living, including man with his wondrous spiritual power, in direct communication with his creator.59

In this essay, Lewis also discussed truth, relating it to a metaphorical light.

He who chooses darkness grows pale and feeble for want of enriching light; he who excludes the common air, lacks its invigoration. He who closes the door of the soul by shutting out knowledge, or by the barrier of unbelief, must miss the full inflow of new truth from its eternal source. The world of mind would become sterile as the sands of Sahara without a continued spiritual influx; its advance would be checked and a retrograde movement begun, leading downward to the plane of mere animal existence, rather than upward and onward to the unknown destiny of man. Fortunately, since man is man and God leads him, no such result is to be feared. But individuals and communities may fall behind, for want of strength and courage and faithfulness in the acceptance of new truths.60

58 Mitchell, Maria Mitchell, 243-244.
60 Lewis, 282.
To Lewis, the absence of truth created a sterile existence, one that she likened to
the Sahara desert and described with words such as “darkness” and “feeble” and
images such as shutting the door and gasping for air.

In comparing these three passages, one must note that each of these
women made some reference to “light.” While the Quakers were not a unique sect
in focusing on light within their theology, it is an interesting metaphor that
becomes more than a metaphor in the Quaker context because there it is certainly
a reference to the idea of the Inner Light. Thus, their use of the light metaphor
may demonstrate at least some adherence to Quaker theology, so it is quite
interesting that it appears in all three women’s writings.

Although it is now clear that there were a number of connections between
these three women and that important elements of Quakerism can be found in
their lives and works, it is not apparent from the narratives of these three women’s
lives that Quakerism influenced their decision to go into science aside from the
reasons discussed in Chapter 2 that affected both Quaker men and Quaker
women. Graceanna Lewis chose to go into the sciences because she wanted to
find evidence of God’s work in nature. While she was influenced in this pursuit
by her Quaker ideals, she was part of the larger tradition of natural theology.
Thus, it cannot be concluded that Lewis’ motivation to pursue science stemmed
entirely from Quakerism. The one influence that was unique to Quakers, as
discussed in the previous chapter, was the idea of the search for truth, which
allowed Quakers to connect theology with science. Maria Mitchell clearly
exemplified the role of the truth-seeker, and yet her connections to the Society of Friends were not sufficient to make the claim that she would not have gone into astronomy had it not been for her family's Quaker background. In Chapter 1, I discussed the Quaker belief in the equality between men and women. This belief was certainly unique to Quakers in the nineteenth century, but Quakers nevertheless lived in the larger society; while they may have believed that women were equal to men, it was difficult to achieve this equality outside of their Quaker communities. Indeed, Ann Preston encountered much opposition from men in the medical community when she advocated equal opportunities for women.

What Is Next?

Although a lot can be learned about Quaker women in science through this examination of the life and works of these three women, this is not the only way that biography can be employed here. In his essay "Existential projects and existential choice in science: science biography as an edifying genre," Thomas Söderqvist notes that "in spite of the recent flourishing state of science biography... there is a widespread ambivalence and uncertainty as to the role and place of biography among historians of science." Nevertheless, Söderqvist argues that biography is indeed an important genre to use in our studies because it

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allows scholars to examine the lives of scientists as important in their own right; biography can reveal something not only about the larger social context in which these scientists existed, but also something essential about the scientists themselves. As he says: “existential biography is ultimately also an analysis of the life of the concrete, individual researcher, not a case-study of what it means to be a scientist in general.”

To Söderqvist, it is important to come to an understanding of the lives of others in order to understand how we live our own lives; biography thus becomes the study of an individuals who can make his or her own choices rather than merely “the passive recipient of prepackaged views.”

Geoffrey Cantor has done just such a study in his biography of Michael Faraday as a Sandemanian and a scientist.

Söderqvist’s method can also be used for the topic of Quaker women in science. One can start with the question: is there a recognized interaction between being Quaker and being a scientist? Then, the lives of these three women, or other Quaker women scientists, can be examined as different stories in which individual women lived their lives. Of course primary sources will be essential for this analysis, because it is necessary to return to the woman’s own writings rather than trying to transform another biographical treatment of her. For each woman, it will become apparent that science and Quakerism were linked in different ways.

62 Söderqvist, 62.
Although this method focuses on the individual rather than the group, there should emerge some overarching themes that connect each of the women.
Conclusion

This thesis has investigated Quaker women in science by examining the connections between Quaker theology and scientific ideology. Since Quakers have always been unusually committed to social and intellectual equality between men and women, it might seem at first that this belief in equality provided women with greater opportunities, thus encouraging them to follow pursuits in primarily male-dominated fields, such as science. However, the situation was more complicated than that.

I have argued in my study of three Quaker women in science in nineteenth century America that it is not at all apparent that these women were encouraged to go into the sciences in order to demonstrate that women were capable of doing "men's work." Nor is it apparent that they were encouraged to pursue science because it was something that their brothers or other male relatives or friends were doing. So it does not seem to have been the case that Quaker women went into the sciences simply because they wanted to be equal to men.

It does seem that this equality manifested itself in more subtle ways. Girls were educated in the same manner as boys, and at a minimum, Quakerism did not deter women from entering the sciences, which was the case in other sects at this time. The families of Maria Mitchell, Graceanna Lewis, and Ann Preston did not choose the path of science and medicine for their daughters, but they were nevertheless very supportive and encouraging of the scientific and medical pursuits of these three women.
Although Mitchell, Lewis, and Preston each chose to pursue science for different reasons, there were nevertheless similarities among the three of them. For example, none of them ever married. There were also a number of social connections between them; they were either direct acquaintances or had associations with each other through friends or members of their extended family. Other similarities may be found in their writings and in the form of explicit Quaker ideals. In Chapter 3, I discussed the role that "light" played within all of their writings. Although this aspect of Christian doctrine is not unique to Quakers, each of these women drew upon it to support their scientific ideas and interests.

In addition to examining the lives and works of three specific Quaker women in science, I have also tried to demonstrate the inherent connections that exist between Quaker theology and science, which suggests in turn that it is not unusual for there to have been a number of Quakers in science, a fact that has been demonstrated by multiple studies. It would be useful, though, for someone to conduct a statistical study of Quakers in science compared to other denominations that considers the sex ratios in order to see if one could make the claim that Quaker women are more likely to go into the sciences than women of other denominations.

The first of the two inherent connections between Quakerism and science that I explored in the second chapter drew on the idea that both Quakers and scientists are considered "seekers of truth." Although one could examine the topic of truth in both the religious and scientific contexts more thoroughly, I
nevertheless found connections between the two that suggest it was the practice of searching for truth that led many Quakers into science in the nineteenth century. In an increasingly secular world, the extension of the search for truth to the natural world makes topical and practical sense.

The second connection related to the fact that many Quakers studied nature as a way to get closer to God, a kind of natural theology. Quaker writings demonstrate that many Quakers were so infused with their theology, at least until the end of the nineteenth century, that they were motivated to seek palpable evidence of God’s Creation within their scientific work. Botany, in particular, was a field that attracted both Quakers and women, albeit for slightly different reasons. The Quakers treasured the closeness to God that they could achieve through botanical observations, and they gloried in the aesthetic aspects of botanical illustrations. Women gained access to botany because it was perceived to be an acceptable pastime for women, and although most women never reached the professional and more technical levels within the field, they nevertheless achieved success in the field for a period in the eighteenth and nineteenth centuries, as Ann Shteir has demonstrated.1 Additionally, as Geoffrey Cantor points out, botany was a science that one could cultivate regardless of one’s financial status.2

and created botanical gardens; but those who were not wealthy could just as easily explore and seek understanding of the plants that surrounded them.

Given that this is one of the first works specifically on Quaker women in science, there is much more to do. Part of this thesis has tried to address this matter and suggest other connections that might be explored or other ways that the material could be examined. For example, in the second chapter I discussed a few additional schools of thought—namely Transcendentalism and Pragmatism—that could be used to draw further connections between the central ideas of Quaker theology and science. And in the third chapter I offered an alternative, drawing on the work of Thomas Söderqvist, of how biography could be used as a tool in examining Quaker women in science. The final suggestion that I have relates to the historiography on Quaker women and Quaker scientists that I covered in the Introduction.

As previously explained, there exist two distinct literatures directly relating to the topic of Quaker women in science. One of these two literatures covers Quaker women and the other Quaker scientists. I have tried to demonstrate that the topic of Quaker women in science is viable and thus it seems necessary to somehow draw a bridge between these two literatures, while at the same time creating a new literature on Quaker women in science. And indeed, these two

literatures are not mutually exclusive in that they both contain some discussion of Quaker women in science, signifying that the bridge between the two necessarily lies within this distinct but related subject.

One possible way to make this bridge would be by examining in more depth the work that Quaker women did both in science and in social activism. The primary emphasis of the literature on Quaker women is the role that they played in many important social reform movements. But many of the Quaker women who did work in science were also active in one or two social movements. It would be interesting to speculate what aspect of Quakerism drew these women to both science and to social activism. Concurrently it would be interesting to ask the same question of Quaker men in order to determine if there was something specific to women that drew them into these two fields or if the connection between the two is not unique to Quaker women.

This examination of Maria Mitchell, Graceanna Lewis, and Ann Preston, and the connections between science and Quakerism that can be seen within their lives and works is thus only a first step in studying Quaker women in science. The next step is to do a larger study; perhaps, if enough Quaker women in science can be identified, then a prosopographical study would be useful in trying to make larger claims about Quaker women and the work that they have done in the sciences.
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