

WOMEN IN FIELD BIOLOGY

A JOURNEY INTO NATURE



MARTHA L. CRUMP
MICHAEL J. LANNOO



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Women in Field Biology

Women are contributing to disciplines that were once the sole domain of men. Field biology has been no different. The history of women field biologists, embedded in a history largely made and recorded by men, has never been written. Compilations of biographies have been assembled, but the narrative—their story—has never been told. In part, this is because many expressed their passion for nature as writers, artists, collectors, and educators during eras when women were excluded from the male-centric world of natural history and science. The history of women field biologists is intertwined with men's changing views of female intellect and with increasing educational opportunities available to women. Given the preponderance of today's professional female ecologists, animal behaviorists, systematists, conservation biologists, wildlife biologists, restoration ecologists, and natural historians, it is time to tell this story—the challenges and hardships they faced and still face, and the prominent role they have played and increasingly play in understanding our natural world.

For a broader perspective, we profile selected European women field biologists, but our primary focus is the journey of women field biologists in North America. Each woman highlighted here followed a unique path. For some, personal wealth facilitated their work; some worked alongside their husbands. Many served as invisible assistants to men, receiving little or no recognition. Others were mavericks who carried out pioneering studies and whose published works are still read and valued today. All served as inspiration and proved to the women who would follow that women are as capable as men at studying nature in nature. Their legacy lives on today. The 75 female field biologists interviewed for this book are further testament that women have the intellect, stamina, and passion for fieldwork.



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Preamble

A little over 150 years ago—in 1869—Myra Bradwell was the first woman to pass the Illinois bar exam. Her husband, a lawyer, taught her law because at that time no law school accepted women. The following year, she was denied admission to the Illinois bar, despite the fact that she had passed the bar exam with high honors. The Illinois Supreme Court responded that when the Illinois General Assembly gave the court the power to grant law licenses “it was not with the slightest expectation that this privilege would be extended to women.”¹ Bradwell appealed to the U.S. Supreme Court, which also denied her admission to the Illinois bar. Justice Joseph P. Bradley wrote (and others concurred): “The paramount destiny and mission of women are to fulfill the noble and benign offices of wife and mother”²

One hundred years ago, physician and toxicologist Dr Alice Hamilton became Harvard University’s first female professor, hired as Assistant Professor in the Medical School in 1919.³ Her position came with written limitations. She could not set foot in the Faculty Club. She could not participate in academic processions at commencement. And she was not eligible for faculty tickets at football games. If these were the written conditions, we can be sure she was not treated as an intellectual equal to the male faculty. She was never tenured and retired as an Assistant Professor in 1935.

Fifty years ago, oceanographer Elizabeth Venrick was not permitted to continue on her scientific cruise across the subarctic because the journey would be “too rough for a woman” (Chapter 6). Cetacean biologist Sue Moore was not allowed to join the crew on a fishing vessel because women “bring bad luck” (due to menstruation) to fishermen (Chapter 8). One of us (MLC) was not permitted to survey amphibians and reptiles in the Yasuní region of eastern Ecuador because it was “too dangerous” for a woman (Chapter 8). Ornithologist Mercedes Foster, ichthyologist Lynne Parenti, and others found it a challenge to be included in international fieldwork 50 years ago—women were considered a distraction (Chapter 8).

Fortunately, times have changed. We’ve made profound progress over the past 200 years in accepting women as intellectual equals to men, but we’re not yet where we should be. From Myra Bradwell’s perspective, the good news is that every year from 2016 to 2020, women have outnumbered men in law school. The bad news is that in 2020, only 37% of U.S. lawyers were women, and they make up only 24% of large law firm partners.⁴ Not surprisingly, women lawyers generally are paid less than men. Women now make up about 50% of Assistant Professors in the United States. But the bad news is that the percentage decreases to 45% at the Associate Professor level and

¹ <https://www.nytimes.com/2021/09/09/opinion/abortion-supreme-court-religion.html>; accessed 12 September 2021.

² <https://www.supremecourt.gov/visiting/exhibitions/LadyLawyers/section1.aspx>; accessed 12 September 2021.

³ <https://faculty.harvard.edu/dr-alice-hamilton>; accessed 10 July 2019.

⁴ <https://msmagazine.com/2021/06/03/women-lawyers-stop-attribution-workers-quit-law/>; accessed 12 September 2021.

36% at the Full Professor level.⁵ While 48% of academic fathers achieve tenure, only 27% of academic mothers do so. Male full professors at research-intensive schools earn an average of \$10,000 more per year than their female Full Professor colleagues.⁶

Field biology follows the pattern of these other intellectual endeavors, in that women fought to be accepted in what was largely a “man’s world.” For centuries, women’s place has been assumed to be in the home. The history of women field biologists, embedded in a history largely made and recorded by men, has never been written. Compilations of biographies have been assembled, encyclopedia-like,⁷ but the narrative—their story—has never been told. In part, this is because many expressed their passion for nature as writers, artists, collectors, and educators during eras when women were excluded from the male-centric world of natural history and science. Given the preponderance of today’s professional female ecologists, animal behaviorists, systematists, conservation biologists, wildlife biologists, restoration ecologists, and natural historians, it is time to tell this story.

Field biology, simply defined, is studying nature in nature. Such study ranges from a backyard tea-time break to observe hummingbirds slurping nectar from trumpet flowers (about the extent of what it was thought women could/should be doing two centuries ago) to mammalogist George Schaller’s grand Karakorum and Himalayan expeditions to investigate the behaviors of snow leopards⁸ (the sort of activity women today are doing, and doing as well as men).

Field biologists tend to be a special type of person. Biologist and naturalist E. O. Wilson observed they have a lot more “gee whiz” or “sense of wonder” than other kinds of scientists.⁹ Field biology reflects the lifestyle currently being sold by outdoor clothing companies. In contrast to the images in these slick advertisements, however, field biology is mostly a lot of hard work. After physically demanding days of collecting data, field biologists stay up late skinning birds, pinning insects, or writing meticulous field notes in the dim light of a headlamp or maybe a full moon. Such hard work was once assumed, even by many women themselves, to be too strenuous for females to undertake. Field biology involves self-sacrifice. There is a cost—travel, sleep, comfort, health, perhaps relationships and motherhood. For these committed biologists, however, fieldwork is both the means and the end to a life well-lived and thoroughly tested.

The history of Western women field biologists is intertwined with men’s changing views of female intellect and with increasing educational opportunities available to women. For a broader perspective, we profile selected European women field biologists, but our primary focus is the journey of women field biologists in North America. On both continents, before women were permitted to receive a formal higher education, they gained knowledge of natural history from their fathers, husbands, or

⁵ <https://www.chronicle.com/article/why-we-need-more-women-full-professors>; accessed 12 September 2021.

⁶ <https://www.chronicle.com/article/why-we-need-more-women-full-professors>; accessed 12 September 2021.

⁷ For example, Bonta (1991), Gates (1998), Gates and Shteir (1997), Norwood (1993), Ogilvie (1986), Rossiter (1982), and Schiebinger (1989).

⁸ Schaller (1980), Lannoo (2018).

⁹ Royte (2008).

other men, or they taught themselves. Some followed gender-role expectations and expressed their passion for nature as writers, artists, and educators. Others defied convention and explored wilderness areas and collected specimens. Once women could enroll in institutions of higher learning, they could take biology courses. And once they could do that, they could become biologists.

Think of the individual stories of the women highlighted here as threads in a woven tapestry. Each woman followed a unique path. For some, personal wealth facilitated their work. Some worked alongside their husbands. Some neither married nor had children and pursued their passions unencumbered by family obligations. Many served as invisible assistants to men, receiving little or no recognition. Others were mavericks who carried out pioneering studies and whose published works are still read and valued today. The individual threads represented by these women's stories form the overall story of women in field biology that we tell here. Each woman served as inspiration and proved to the women who would follow that women are as capable as men at studying nature in nature. The 75 female field biologists interviewed for this book are further testament that women have the intellect, stamina, and passion for fieldwork.

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Lannoo is the author/editor of over 100 scientific papers and 7 popular scientific books, including *Leopold's Shack and Ricketts's Lab: The Emergence of Environmentalism* and most recently *This Land is Your Land: The Story of Field Biology in America* (University of Chicago Press, 2018).



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Section 1

Historical Perspective



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1 Introduction

The ancient Greek philosopher Aristotle (384–322 BCE) played a key role in developing a way of understanding the natural world by focusing on knowledge gained mainly through direct observation rather than belief.¹ He largely wrote about what he observed rather than what he was told. His *Historia Animalium*, the first systematic and comprehensive study of animals, became the primary source of zoological knowledge for 2000 years. Aristotle's sometimes keen insights into nature were, however, offset by his misguided view of women. He wrote that women are immature, imperfect, and deficient, and he asserted that women's place is in the home, controlled by their husbands. While he conceded that both men and women could be courageous, he wrote that the quality of their courage was different. Men's courage is "in commanding." Women's courage is "in obeying."²

The history of women in science reflects Aristotle's views. For centuries, women were deemed intellectually inferior to men and incapable of both understanding and doing science. While the story of women's struggles in science is relatively well known,³ the history of women in one of the most physically challenging and male-dominated areas of science—field biology—has not been well documented. Much has changed for the better over the centuries. When Ellen Swallow, an environmental chemist, was an undergraduate at Vassar College in the late 1860s, she wrote that her chaperone, Miss Lyman, was shocked to see ladies in Canada working out of doors.⁴ Today, though, most of us can conjure the image of a young Jane Goodall interacting with chimpanzees at her Gombe Stream study site (Figure 1.1). Imagine this scene being repeated tens of thousands of times, with women examining geologic formations, plants, insects, fishes, amphibians, reptiles, game and nongame birds, mammals, and Indigenous cultures, in streams, lakes, prairies, wetlands, forests, deserts, and tropical islands, and a more general picture emerges. It took humanity only 200,000 years of social evolution for this vision to become close to a reality.

ORIGINS: EUROPE

During the Early Middle Ages of Western Europe, from the collapse of Roman civilization in the fifth century to the early tenth century, women, especially married and noblewomen, enjoyed some degree of respect due to the chivalric system and the cult of the Virgin Mary.⁵ Educational opportunities for women were mostly centered in monasteries and convents, where women could control their own destinies rather

¹ Anderson (2013).

² Ogilvie (1986).

³ Bonta (1991), Gates (1998), Gates and Shteir (1997), Norwood (1993), Ogilvie (1986), Rossiter (1982), Schiebinger (1989).

⁴ Hunt (1958), p. 32.

⁵ Ogilvie (1986), p. 9.



FIGURE 1.1 Jane Goodall interacting with a young chimpanzee at her Gombe Stream study site in Tanzania. (Photo used with permission of the Jane Goodall Institute. © the Jane Goodall Institute/By Hugo van Lawick.)

than live as the legal property of their fathers or husbands. These early institutions also served as health clinics.⁶ Women tended medicinal gardens and administered to the sick herbs, purges, bloodletting, and other therapies passed down through oral tradition.

The High Middle Ages, lasting from the tenth to the thirteenth century, were generally more peaceful and secure times that allowed people—mostly men—to focus on new ideas. Women were not permitted to attend classes at the newly established universities. Thus, independent and intellectually curious women during this era continued to enter convents, where they could exercise their creativity and become educated.⁷ One of these was Hildegard von Bingen (1098–1179 CE), a natural historian who established St. Rupert's, a Benedictine abbey on the Rhine River, in Germany.⁸ von Bingen is considered by many the foremost natural historian of her time; her reputation was such that she advised bishops, popes, and kings.⁹ She wrote at least 14 books on religious philosophy, medicine, and natural science. Her greatest work, *Physica*, continues to be a practical handbook detailing the curative powers of nearly 1,000 plants and animals. von Bingen's natural history writings were based primarily on her own observations. She was a woman ahead of her times.

The Late Middle Ages, from about 1250 to 1450, initially brought famines, the plague, wars, and social unrest. By the middle of the fifteenth century, not only had the human condition improved, but also the printing press had been invented. Mass-produced books provided access to written information that earlier had been accessible only to men through academic associations. Noble and wealthy women were permitted to attend university classes in Italy but generally not elsewhere in Western

⁶ Minkowski (1992), p. 289.

⁷ Ogilvie (1986), p. 9.

⁸ Lipscomb (1995), p. 324.

⁹ Halsall (2018).

Europe, where the presence of women was thought to “disrupt serious intellectual endeavor.”¹⁰

Toward the end of the Late Middle Ages, male scholars and artists concentrated less on religious thinking and more on understanding the nature of people, the world, and people’s place in the world. This new outlook favored critical thinking over superstition and emphasized individual rights. A few intellectuals even dared to ask whether these individual rights should apply to women and whether perhaps women should have access to better education and more control over their own lives. Most of society, however, did not accept these ideas, and women typically adhered to some subset of acceptable roles.

The European view of nature changed after the “discovery” of the New World began ongoing contact between Europe and these continents. By the sixteenth century, a new paradigm had developed: plants and animals could be studied for their own sake, not as an appendage of medicine. It became acceptable and exciting to reveal nature’s secrets. Universities established botanical gardens, and private gardens became popular. A publishing explosion yielded herbal and other types of natural history books, including the *Aberdeen Bestiary* (1542) and Conrad Gessner’s five-volume *Historiae animalium* (1551–1558 and 1587), today considered the beginning of “modern” zoology. Collecting natural objects became fashionable as a social activity and intellectual pursuit.¹¹ The European elite supported networks of collectors who provided them with unusual, rare, and exotic objects. These private collections, ranging from fine art to natural wonders, were called “cabinets of curiosities.” The cabinets often were entire rooms, essentially miniature museums. Margaret Cavendish Bentinck, Duchess of Portland (1715–1785), was a renowned collector of natural objects. As a child, Bentinck collected seashells and other treasures. Her collecting instinct continued throughout her life, but she also funded natural history expeditions to bring back exotic curiosities.

The Renaissance, with its emergent philosophies, discoveries, and writings, further changed how humans viewed nature. In 1660, the Royal Society was founded in London. Its motto was *Nullius in verba*—“Take nobody’s word for it.”¹² Five years later, the society established the *Philosophical Transactions of the Royal Society*, the world’s oldest continuously published scientific journal. The period saw the emergence of modern inquiry based on the scientific method of observation, experimentation, empiricism, and inductive reasoning. It became fashionable for women to stay informed about scientific discoveries, though generally at a superficial level. Some independent women played a professional role in science, but because they were excluded from male organizations and activities, their achievements often went unrecognized. Men continued to assert that women were intellectually inferior to them.

During the Age of Reason/Age of Enlightenment, from the late seventeenth century through the eighteenth century, women were still perceived as a distraction to male scholarly pursuits. In fact, they were deemed so dangerous to academic life

¹⁰ Schiebinger (1989), p. 151.

¹¹ Simmons (2016), p. 59.

¹² Anderson (2013), p. 52.

that until the late nineteenth century, faculty at the University of Oxford and the University of Cambridge were required to be celibate.¹³ Paris was the exception. During the seventeenth and eighteenth centuries, well-educated and socially prominent women offered their private sitting rooms for informal gatherings called *salons*, where men and women discussed science. Parisian women gained access to current scientific knowledge through hosting *salons*, although a major purpose of the gatherings was to identify and support talented young men.¹⁴

Enlightenment philosopher Jean Jacques Rousseau (1712–1778) strongly influenced intellectual thought during the eighteenth century. He wrote of women's duties:

To please, to be useful to us, to make us love and esteem them, to educate us when young, and take care of us when grown up, to advise, to console us, to render our lives easy and agreeable; these are the duties of women at all times, and what they should be taught in their infancy.¹⁵

Rousseau emphasized the parallels between physical and mental strength and believed that “participation in science required a certain strength that women simply lack.”¹⁶

Rousseau, however, believed that botany was the exception because its study was neither “complicated” nor “difficult;” it required only patience.¹⁷ He wrote:

I am convinced that at all times of life, the study of nature lessens the taste for frivolous amusements, prevents the tumult of the passions, and provides the mind with profitable nourishment by filling it with an object worthy of contemplation.¹⁸

In essence, nature study would keep women out of trouble. Botany was considered acceptable for women also because it was associated with herbal healing and gardening, respectable hobbies for women. There was a caveat, however: women should not exceed the level of amateur in their botanical studies. Not all women agreed.

ORIGINS: NORTH AMERICA

Before women could become scientists, they needed access to education. As will be discussed in Chapter 2, it took a long time for society to believe that women should be educated. By the late nineteenth century, women professionals in the eastern United States tended to become school teachers, while women who had trained west of the Appalachians found opportunities to become researchers. With their expanded curricula, which included the new science of ecology, Land Grant colleges, especially in the Midwest but also at Cornell (the only Ivy Land Grant), created opportunities for women field biologists, as did the University of Chicago and the California Academy of Sciences.

¹³ Schiebinger (1989), p. 151.

¹⁴ Schiebinger (1989), pp. 31–32.

¹⁵ Ogilvie (1986), p. 13.

¹⁶ Schiebinger (1989), p. 236.

¹⁷ Schiebinger (1989), p. 243.

¹⁸ Schiebinger (1989), p. 242.

Ecology forms the framework of much of field biology, so it is informative to examine the emergence of women in this field. In her treatise on the history of women ecologists, Langenheim¹⁹ lists five women who received degrees in ecology between 1902 and 1916. Three had trained in the Midwest and two in the East. During the period bookmarked by the First and the Second World Wars, American midwestern and western institutions continued to graduate many women field biologists. Of the nine women Langenheim lists as receiving degrees in ecology between 1917 and 1945, six had trained in the Midwest, two had trained along the East Coast, and one in England. After the Second World War, educational opportunities for women expanded, and traditional curricula in the East began to include disciplines incorporating field data. Harvard, Yale, Duke, Florida, Colorado, and a number of other schools hosted significant ecological programs and graduated their first women PhDs, while the midwestern and western schools continued to contribute. Between 1949 and 1971, Langenheim lists 28 women who received degrees in ecology—13 from schools west of the Appalachians, 14 from eastern schools, and 1 in England.

After the Civil Rights Acts were passed in the 1960s, many of the problems faced by women were finally acknowledged, and women were afforded more opportunities. Of the 13 women Langenheim lists as receiving degrees between 1972 and 1975, 10 came from west of the Appalachians and 3 from Ivy League schools. The percentage of prominent women ecologists who were married and had children increased in the decade after the Second World War. As women became more accepted as ecologists, they found they could be both scientists and mothers.

While the overall trend is for an ever-increasing acceptance of women as professional equals, many of the issues women historically faced in field biology remain today. Among the problems that persist are microaggressions, sexual harassments, glass ceilings, and unequal pay.²⁰ These problems vary by institutional type and institution. Academic institutions and some NGOs are among the best at providing equal rights and opportunities; federal agencies tend to be middle of the road; and state agencies are variable but when bad, can be among the worst. In certain institutional types and regions, the old boy network remains strong and embarrassingly resilient to change.

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¹⁹ Langenheim (1996).

²⁰ Nicholson et al. (2008), Jones and Solomon (2019).

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2 Pre-1880 (Late Age of Discovery)

The Age of Discovery carried forward the thinking of the Age of Enlightenment by emphasizing reasoning and individualism over tradition. It also brought profound changes in the biological sciences and the way we think about nature. In 1833, English polymath William Whewell coined the word science, which replaced the term natural philosophy. Charles Darwin (pushed by Alfred Russel Wallace's similar thinking) published his theory of evolution by natural selection in 1859, and Gregor Mendel proposed his laws of inheritance in 1866. The germ theory of disease was finally accepted, and Louis Pasteur invented pasteurization. But change had not yet come regarding society's perception of women, who were still considered a distraction to male scholarly pursuits. Gradually, secondary education became more available for women, and in some countries women were permitted to attend colleges and universities.

As with most factual histories, the story of women field biologists does not lay out "straight, tense and inevitable ... as if life had been made and not happened."¹ Instead, it proceeded in fits and starts; there were dead ends and times when progress in one discipline raced ahead of advancements in all others. Some disciplines, such as botany, followed Rousseau's opinion and were heavily represented early, while others such as anthropology and archeology had to wait until the twentieth century. In this noise, however, there can be detected enough of a signal to create a framework of understanding. During the Age of Discovery, women interested in field biology were scattered and isolated both geographically and temporally. Eventually, they would become collegial in a process that was at first gradual and then accelerated following the formation of women's schools and colleges. As they were recruited as faculty, women began intellectually influencing women.

EUROPE

Here, we highlight 16 pioneering field biologists representing eight countries. Maria Sibylla Merian, Catharina Helena Dörrien, and Amalie Dietrich were German; Jeanne Baret and Jeanne Villepreux-Power were French; Elisabeth Christina von Linné was Swedish; Marie-Anne Libert was Belgian; Anna Atkins, Elizabeth Andrew Warren, Anna Worsley Russell, Marianne North, Mary Anning, and Eleanor Ann Ormerod were British; Ellen Hutchins was Irish; Elisabetta Fiorini Massanti was Italian; and Olga Fedchenko was Russian.

The scientific interests of these women included plants, invertebrates, and fossils. Recall that Rousseau (1712–1778) felt that women could study botany, because it

¹ Maclean (1976), p. 127.

required little physical strength or mental fortitude. Indeed, by the late 1700s, botany had become a popular focus of study for women, particularly those belonging to the higher social classes. Dörrien, Baret, Linné, Atkins, Warren, Hutchins, Massanti, Russell, Fedchenko, Dietrich, and, in a sense, Libert were botanists. Merian and Ormerod were entomologists; Villepreux studied marine invertebrates; and Anning collected fossils. Merian, Dörrien, Atkins, Russell, and North were also illustrators. Merian, Dörrien, and Linné were inspired by their fathers and Baret by her lover. Most of these women worked near home; a few traveled widely, often alone. Merian sailed to Suriname; Dietrich explored Australia; North explored much of the Southern Hemisphere; and Baret circumnavigated the globe.

Maria Sibylla Merian (1647–1717) was born in Frankfurt am Main, Germany.² Her father owned a publishing house that printed high-quality books detailing natural history and other subjects. He died when she was three. A year later, her mother married the painter and art dealer Jacob Marrell, who encouraged Merian to paint. Because the painters' guild forbade women to use oils, she learned how to paint with watercolors and to engrave. At a young age, Merian became fascinated with insects. At 13, she began raising silkworms on mulberry leaves and painted, in fine detail, stages of their life cycle. She recorded silkworm metamorphosis at a time when it was thought that insects arose through spontaneous generation from rotting organic matter.

In 1665, 18-year-old Merian married her stepfather's apprentice, Johann Graff. Five years later, the couple and their 2-year-old daughter moved to Nuremberg. There, Merian continued to paint despite a local painting guild that banned participation by women. Germany was in the throes of witch hysteria, with thousands of suspected witches already having been executed. Because many insects were considered poisonous and spawn of the Devil, persons associated with insects were suspected of being witches. Popular belief held that butterflies could be witches in disguise. Undeterred, Merian reared caterpillars in her kitchen and continued her investigations. In 1679, she published the first of her two caterpillar, or *Raupen*, volumes (English translation: *The Wondrous Transformation of Caterpillars and Their Remarkable Diet of Flowers*). The first volume contained 50 copperplates, all engraved by Merian, depicting the lepidopteran life cycle, with caterpillars associated with their host plants. In 1683, she published the second volume of *Raupen*, containing another 50 plates.

Not long afterward, Merian left her husband and moved with her elderly mother and two daughters to an experimental Labadist colony in Holland.³ At that time, Labadists were traveling overseas to convert Indigenous peoples to Christianity and establish new colonies. Those who visited Suriname brought back specimens of bizarrely shaped and outrageously colored butterflies, moths, and beetles. Merian's interest was piqued, and she began planning an eventual trip to South America.

After her mother died in 1690, Merian and her daughters moved to Amsterdam. The Netherlands provided a far more permissive culture for women than did her native Germany and even accepted women as professional artists. After 8 years of

² This profile is based in large part on Todd (2007) and Pieters and Winthagen (1999).

³ Labadists were members of a Protestant religious movement that lasted from the 1660s to the 1730s.

working as a scientific illustrator in Amsterdam, she was financially independent. In 1699, Merian sold her paintings and unnecessary belongings, wrote her will, and boarded a ship for the 2-month voyage to Suriname with her 21-year-old daughter, Dorothea.⁴ She financed her travels herself and was the first European explorer to travel to the New World not financed by a patron or government; she could pursue her objectives in her own way, accountable only to herself. Her biographer, Kim Todd, wrote:

In this environment, her painting shifted, absorbing the techniques she'd learned in Amsterdam, as well as the vibrant colors, the eeriness that got under the skin. ... The pictures almost pour over the sides of the page, and show their subjects glimpsed from strange angles: a view from beneath a banana branch, the underground life of a cassava root. Unlike her European plants and caterpillars, centered and balanced, these portraits show asymmetry ... Even the chips in Merian's study book expanded—the extravagance of wings resulting in an extravagance of parchment.⁵

The fieldwork was challenging. Many of these tropical butterflies and moths were harder to catch than European species. The rain forest seemed impenetrable with its dense tangle of vines and understory. Many insects were too high in the trees for her to reach. Eventually she used a ladder, but that would carry her only so far toward the canopy. Thus, tracking the life cycle of some species proved impossible. To deal with the staggering abundance of insect life, Merian consulted the knowledge and enlisted help from local Indigenous peoples and enslaved Africans, who became her liaisons with the rainforest world.

Fewer than 2 years into her stay in Suriname, Merian began to feel feverish, weak, and shaky. In the summer of 1701, she packed her notes, sketches, paintings, and specimens of plants and animals, including butterflies, cocoons, beetles, and pickled snakes, turtles, iguanas, geckos, and hummingbirds. She and Dorothea boarded a ship to Amsterdam.

Back home, Merian recovered and began her book. To help make ends meet, she sold some of her preserved specimens to collectors. In 1705, she published *Metamorphosis Insectorum Surinamensium*, her magnum opus, consisting of 60 copperplate engravings in folio depicting changes in color and form during the life cycles of Surinamese butterflies, moths, beetles, bees, and flies as well as engravings of a few spiders, amphibians, and reptiles. The book brought her world-fame among art collectors and naturalists alike. *Metamorphosis* is widely considered to be one of the most beautiful natural history books ever published.⁶

In 1717, Merian died from a stroke. Shortly before her death, Russian Czar Peter the Great, an avid collector and owner of a massive cabinet of curiosity, purchased many of Merian's original drawings. This collection, now belonging to the Academy of Sciences in St. Petersburg, is the best collection of Merian's original drawings in the world.⁷ Over the next century, her style became the standard for insect illustration. The next influential book to illustrate life in the New World was Mark Catesby's

⁴ Lewis-Jones and Herbert (2016).

⁵ Todd (2007).

⁶ Pieters and Windhagen (1999).

⁷ Etheridge (2011).

Natural History of Carolina, Florida and the Bahama Islands, published in 1729–1747. Much about this book echoes *Metamorphosis*, from the size and layout to the ecological composition of his paintings.⁸ Merian's influence of portraying segments of biological communities extended to other naturalist painters, including William Bartram, John James Audubon, Prideaux John Selby, and John Gould.⁹ Maria Sibylla Merian, a female natural historian of the late seventeenth/early eighteenth century, had shaped a new way of viewing and portraying nature. In 1867, the Artis Library was built in Amsterdam to promote the knowledge of natural history. Merian's name appears on the façade of the building, nestled among 35 famous men of science, including Aristotle, Pliny, and Linnaeus.¹⁰

Catharina Helena Dörrien (1717–1795) was born into a scholarly family in Hildesheim, Germany. She was educated at home by her father, where she studied geography, history, religion, Latin, and science. Her parents both died before she was 20, and by age 30 she had moved to Dillenburg to work as a private teacher for her friend's children. Her friend's husband, Anton von Erath, encouraged her botanical interests, and she began collecting, studying, and illustrating the flora of the region. Dörrien was one of the first German botanists to use Linnaeus' classification and nomenclature system. She published a much-praised catalog of the plants of Orange-Nassau principality; as a result, she became the most celebrated female German naturalist of her time. Her research led to her election to the Botanical Society of Florence, Berlin Society of Friends of Nature Research, Regensburg Botanical Society, and the Berlin Society.¹¹ Dörrien challenged the way German women were being educated, with its emphasis on practical household skills. She argued that in addition to maintaining a household, women should receive a well-rounded education, including history and science—an education that would fulfill them intellectually.

Jeanne Baret (1740–1807) was born the daughter of poor farm workers in the Loire valley of France.¹² She was an “herb woman,” schooled in the largely oral tradition of medicinal plants. The internationally renowned botanist Philibert Commerson lived near her village. The two met in the early 1760s; she knew the curative power of plants and he wished to learn more. In 1764, 26-year-old Baret and Commerson moved to a fashionable apartment in Paris, near the city's botanical garden the Jardin de Roi. In 1764, Baret gave birth to a son. Commerson wanted nothing to do with the boy; the newborn went to a foster mother and died a few months later.

In 1766, Louis Antoine de Bougainville received permission from King Louis XV to circumnavigate the globe. His expedition was the first to have a professional naturalist on board. Commerson volunteered for the position. Because women were not allowed on ships, Baret could not accompany him, but Commerson could bring an assistant “equally capable of pressing specimens and dressing his master.”¹³ Commerson and Baret colluded to have her go along as his assistant, disguised as a

⁸ Etheridge (2011).

⁹ Etheridge (2011).

¹⁰ Etheridge and Pieters (2015).

¹¹ Maroske and May (2018).

¹² Ridley (2010).

¹³ Ridley (2010).



FIGURE 2.1 Jean (Jeanne Baret). Art by Bronwyn McIvor, drawn after an imagined portrait of Baret, 1817, artist unknown. (Used with permission of Bronwyn McIvor.)

man (Figure 2.1). Two ships would make the expedition. *La Boudeuse* was a frigate, and the larger and faster vessel. The *Étoile*, a storeship, would carry goods ranging from food to bartering trinkets.

Within a few days of the ships' launch in late 1766, rumors circulated. Commerson's assistant was behaving strangely. The sailors relieved themselves at the "heads." Baret never did. When confronted, Baret claimed to be a eunuch, playing to the fear of eighteenth-century sailors of being captured by pirates and sold into slavery in the Ottoman Empire, to be circumcised or castrated. When the expedition neared the equator, the equatorial virgins stripped naked for the ritualized "Crossing of the Line." Baret endured the immersion fully clothed.

In June 1767, Commerson and Baret collected their first plant specimens, around Rio de Janeiro. Commerson's leg had become ulcerated, so he found a comfortable place to rest while Baret collected. One of her finds was a showy red vine, later named by Commerson in honor of the expedition commander: *Bougainvillea*. Baret thought the scarlet bracts and seeds might cure blood poisoning. She collected boughs, made poultices for Commerson's leg, and saved a handful of seeds to take back to France for cultivation.

Throughout the expedition, Baret worked harder than she imagined a male assistant would work so as not to arouse suspicion. At sea, she dried botanical specimens and inspected them for signs of mold and insect infestation. Nonetheless, the crew

became increasingly suspicious. In Papua New Guinea, they decided it was time to determine the assistant's gender. On 11 July 1768, while washing her clothes with the other servants, she was "inspected" at gunpoint, then gang-raped. Commerson feigned surprise to learn that Baret was a woman. Bougainville remained silent about the rape. Two months later, Baret knew she was pregnant.

In early November, the expedition landed at Port Louis on Île de France (now Mauritius), their first French-controlled land in over 22 months at sea and home to the foremost French botanical garden outside Paris. Commerson and Baret stayed in Mauritius to assist with botanical work. Baret was given her own room in the servants' quarters, her first privacy in nearly 2 years. In April 1769, 9 months after the rape, Commerson and Baret temporarily left Port Louis for the settlement of Flacq. There a coffee planter and his wife adopted Baret's baby.

Commerson died in early 1773. His will stipulated that Baret would receive 600 livres and could live in his apartment for 1 year while she organized his natural history specimens to be sent to the Royal Collection. While working as a barmaid in Mauritius, Baret met a soldier. They married, returned to France, and Baret received her inheritance. Later, the Ministry of Marine acknowledged Baret's bravery and exemplary behavior during the Bougainville expedition and awarded her a yearly pension of 200 livres.

The collections of Baret and Commerson, buried in boxes in government storehouses, survived the bloodiest phase of the French Revolution when libraries were burned and museums were razed. A national library and national natural history museum were later established for the enjoyment of *all* French citizens. Today, parts of their collection from the Bougainville expedition are housed in this museum, built on the grounds of the former Jardin du Roi. Jeanne Baret died in obscurity at the age of 67.¹⁴ She had botanized on the Strait of Magellan, in rain forests, and in habitats in between and was the first woman to circumnavigate the globe. She had provided France with valuable natural history specimens, yet she lived at a time when being a female botanist simply wasn't acknowledged. Today she is celebrated as a woman who pursued her passion, undeterred by tragic hardships.

Elisabeth Christina von Linné (1743–1782), the daughter of Carolus Linnaeus, was the first female Swedish botanist. She was likely tutored at home, along with her brothers and her father's students. At age 19, Linné noticed flashes of light emanating from orange nasturtium flowers in the family's garden at twilight.¹⁵ She published a paper with the Royal Swedish Academy of Sciences describing this phenomenon, which is now named after her: the Elizabeth Linnaeus Phenomenon.¹⁶ She died at the age of 39. After her death, Erasmus Darwin (grandfather of Charles Darwin) referred to Linné's paper in one of his publications. Later, the English Romantic poets William Wordsworth and Samuel Taylor Coleridge, both of whom were interested in

¹⁴ Ridley (2010).

¹⁵ Vargues (2013); <https://www.nybg.org/blogs/science-talk/2013/12/flashes-in-the-twilight/>; accessed 16 March 2018.

¹⁶ Scientists initially believed that "flashing flowers" were an electrical phenomenon or phosphorescence. Today it is thought that quirks in our retinal circuitry cause us to perceive twinkling colors at twilight in the absence of actual plant illumination.



FIGURE 2.2 Marie-Anne Libert; image in the public domain.

botany, read Darwin's paper and alluded to the phenomenon of flashing flowers in their writings.

The plant pathologist Marie-Anne Libert (1782–1865) was born in Malmedy, Belgium. Her father recognized her intellectual potential and facilitated her education. Libert was first educated by Sépulcrine nuns, and then attended a girls' boarding school in Prüm (now part of Germany).¹⁷ After returning home, Libert became fascinated with nature. She collected, identified, and cataloged local plants and taught herself Latin, which she used in describing more than 200 new taxa. Her talents went beyond description. When late season blight first attacked potatoes in northern Europe in the mid-1840s, it was Libert who identified the culprit as a fungus. She described the pathogen and named it *Botrytis vastatrix*. Her identification of this pathogenic fungus contributed to the founding of plant pathology.¹⁸ She later described other pathogens, including the fungus *Fusarium coeruleum* that causes dry rot in potatoes. Libert was elected an associate member of the Linnaean Society of Paris in 1820. Emperor Friedrich-Wilhelm III awarded her a gold medal of merit. In 1862, at the age of 80, she became the first woman to join the Belgian Royal Society of Botany (Figure 2.2).

¹⁷ Maroske and May (2018).

¹⁸ Maroske and May (2018).

Anna Atkins (1799–1871), born in Kent, England, was a botanist and one of the earliest female photographers. Growing up, Atkins was surrounded by science, influenced by her zoologist/chemist/mineralogist father who was affiliated with the Royal Society and the British Museum. In her early 20s, Atkins illustrated her father's translation of Lamarck's *Genera of Shells*. Later, she found she could better capture the details of marine algae and other botanical specimens using cyanotypes.¹⁹ Using this process, she photographed seaweeds seemingly floating over blue backgrounds, transforming algae into art. Atkins published the world's first natural history book with photographic images, *Photographs of British Algae: Cyanotype Impressions* (1844).²⁰ The book contains hundreds of algal species native to Great Britain. Later she collaborated with her close friend Anne Dixon on two additional books using cyanotypes. Atkins gave her specimens to the British Museum in London. She was elected a member of the Botanical Society of London in 1839 (Figure 2.3).²¹

Ireland's first female botanist, Ellen Hutchins (1785–1815), was born in Ballylickey, County Cork. She made detailed watercolor paintings and meticulously prepared specimens, recording over 400 species of vascular plants, about 200 species of algae, 200 liverworts and mosses, and 200 lichens. Although as an illustrator she never published under her own name, she was admired by leading botanists as a major contributor to the field.²² Her specimens, many of which are now housed in the Natural History Museum in London, are still highly valued. More than 200 of her drawings reside in the archives of the Royal Botanic Gardens, Kew. Other specimens and drawings are housed at Trinity College, Dublin; the Linnaean Society, London; and the New York Botanical Garden. She died just before her 30th birthday. Each year Ireland celebrates Ellen Hutchins Festival in Bantry Bay, West Cork. The event features botanical workshops, exhibitions of botanical art, nature walks, and talks as part of National Heritage Week.

The year after Ellen Hutchins was born in Ireland, Elizabeth Andrew Warren (1786–1864), botanist and marine algologist, was born in Truro, Cornwall. She was fascinated by the seaweeds and other plants she found while exploring the shoreline and spent most of her life in the village of Flushing, collecting along the southern coast of Cornwall. British women at that time had no opportunity for higher education. To make up for that, she corresponded with other botanists and worked closely with several scientific societies, including the Royal Horticultural Society of Cornwall. The Royal Horticultural Society of Cornwall sponsored annual competitions for the best and rarest botanical specimens. Warren won most of the prizes. When she was put in charge of organizing efforts to record and collect indigenous Cornish plants, she contributed nearly 75% of the specimens. Warren corresponded with fellow botanist William Hooker, learned much from him, and sent him numerous specimens for Kew Gardens over the years. The Royal Cornwall Museum in

¹⁹ Cyanotyping was an early printing process that uses chemicals and sunlight to produce cyan-blue prints.

²⁰ Gates (1998).

²¹ Cyanotypes of British Algae by Anna Atkins (1843). The Public Domain Review; <https://public-domainreview.org/collections/cyanotypes-of-british-algae-by-anna-atkins-1843>; accessed 17 March 2018.

²² www.ellenhutchins.com/ellen-hutchins; accessed 15 March 2018.



FIGURE 2.3 Anna Atkins; image in the public domain.

Truro houses Warren's plant collections. Museum visitors can see her specimens, most of which retain their pigment and are in excellent condition today.

Countess Elisabetta Fiorini Massanti (1799–1879) was born into an aristocratic family in Terracina, in the Papal States (territories in the Italian Peninsula under the rule of the pope from 756 to 1870). The family moved to Rome, where, under her father's supervision, she studied literature, music, history, geography, Latin, English, French, and German.²³ She studied botany with several naturalists. Massanti published her first work at age 24—descriptions of 30 species of angiosperms, including their locations and phenology. Her most significant contributions dealt with ferns, mosses, fungi, lichens, and algae. Her last work was *Florula del Colosseo* (*Flora of the Colosseum*), a survey of plant diversity at the Colosseum that revealed a substantial loss of species since a survey undertaken two decades earlier. She mourned the loss and wrote that the archeological restoration of the Colosseum was destroying nature's contribution to the ancient amphitheater. Massanti's sentiments regarding the destruction of the Colosseum's flora contrasted with those of many people in the late 1800s who felt that humans had the "right" to conquer nature. Her career made her the most celebrated Italian female botanist of her time. She was a member of five scientific academies and was elected a member of the Pontifical Academy of the New Lincei.

²³ Logan (1999).