

Overlooked No More: Eunice Foote, Climate Scientist Lost to History



Eunice Foote's experiment for her studies on greenhouse gases, as recreated in The 2018 short film "Eunice." Credit...Paul Bancelhon and Matteo Marcolini



By John Schwartz

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Overlooked is a series of obituaries about remarkable people whose deaths, beginning in 1851, went unreported in *The Times*.

In the 1850s, Eunice Foote, an amateur scientist and activist for women's rights, made a remarkable discovery about greenhouse gases that could have helped form the foundation of modern climate science.

But the scientific paper she published that might have added her name to the pantheon of early climate scientists was quickly forgotten, and she faded into obscurity. There isn't even a known photograph of her today.

The idea that [greenhouse gases warm the planet](#) is anything but new, and [anything but unsettled](#).

Foote's ingenious and elegant experiment involved two glass cylinders filled with various substances, including moist air and carbon dioxide. She placed a thermometer in each container, then left them in sunlight.

In her 1856 paper about the experiment, "Circumstances Affecting the Heat of the Sun's Rays," she wrote that a cylinder with moist air became warmer than one with dry air. A cylinder filled with carbon dioxide warmed even more, and, once removed from the light, "it was many times as long in cooling."

She then reached a sweeping conclusion: "An atmosphere of that gas would give to our earth a high temperature."

She noted that "if, as some suppose, at one period of its history the air had mixed with it a larger proportion" of carbon dioxide, then an increased temperature "must necessarily have resulted."

Her paper was presented at the annual meeting of the American Association for the Advancement of Science — but by a male scientist, Joseph Henry, not by Foote. (It is unclear why she did not present the paper herself; she would present another one of her papers on a different topic the next year.)

Katharine Hayhoe, a climate scientist at Texas Tech University, has referred to Foote and her early climate-change work as "[remarkably prescient](#)." She is now working with [other historians, writers and scientists](#) to bring Foote's work to prominence.

On the Heat in the Sun's Rays.

ART. XXXI.—*Circumstances affecting the Heat of the Sun's Rays ;*
by EUNICE FOOTE.

(Read before the American Association, August 23d, 1856.)

MY investigations have had for their object to determine the different circumstances that affect the thermal action of the rays of light that proceed from the sun.

Several results have been obtained.

Foote's 1856 paper describing her greenhouse gas experiment. The paper was presented at the annual meeting of the American Association for the Advancement of Science by a male scientist, Joseph Henry.

"She was really an amazing woman," said Hayhoe, who is an author of the most recent edition of the [Fourth National Climate Assessment](#), the leading [federal report on climate change](#) in the United States. "The fact that she turned glass jars into an experiment on heat-trapping gases is phenomenal."

It would be three years before [John Tyndall, a scientist in England, published his famous paper identifying the gases responsible for the greenhouse effect.](#)

His paper, “Note on the Transmission of Radiant Heat Through Gaseous Bodies,” published in the Proceedings of the Royal Society of London, did not cite Foote’s work.

Tyndall more accurately captured how carbon dioxide and water vapor could warm the planet. Because Foote was using the sun’s energy, her experiment focused on the visible spectrum; Tyndall used spectroscopy and was able to focus on the infrared spectrum, which is the form of heat radiated from the planet toward space.

His method “gave him a sensitive and accurate means of determining very small amounts of absorption, and of measuring accurately the differences in absorption between different gases and of gases at different densities,” Roland Jackson, a scientist, historian and biographer of Tyndall, wrote in [a paper, “Eunice Foote, John Tyndall and a Question of Priority,” published last year by the Royal Society.](#)

Jackson concluded that Tyndall and other major “critical physicists of the period” probably did not know of Foote’s work. “On the face of it, the significance of the paper passed everyone by who could have had a particular interest in it,” he wrote.

Why did Foote’s work disappear for so long? Was this a case of historical erasure, or even intellectual theft? The truth is more subtle and interconnected, Jackson wrote.

For starters, Foote was regarded as an amateur scientist. She was also an American working at a time when the most important work in the field was being performed in Europe. And the world at that time did not exactly welcome the contributions of a woman.

“Eunice Foote was disadvantaged not only by this lack of an academic community in America and poor communication with Europe, but by two further factors: her gender and her amateur status,” Jackson wrote.

Jackson acknowledged that “Foote does seem to have been the first person to notice the ability of carbon dioxide and water vapor to absorb heat, and to make the direct link between the variability of these atmospheric constituents and climate change.” He added, “For that she deserves proper recognition, even if she was not able to explore, and perhaps did not recognize, the distinction between solar radiation and radiated heat from the earth.”

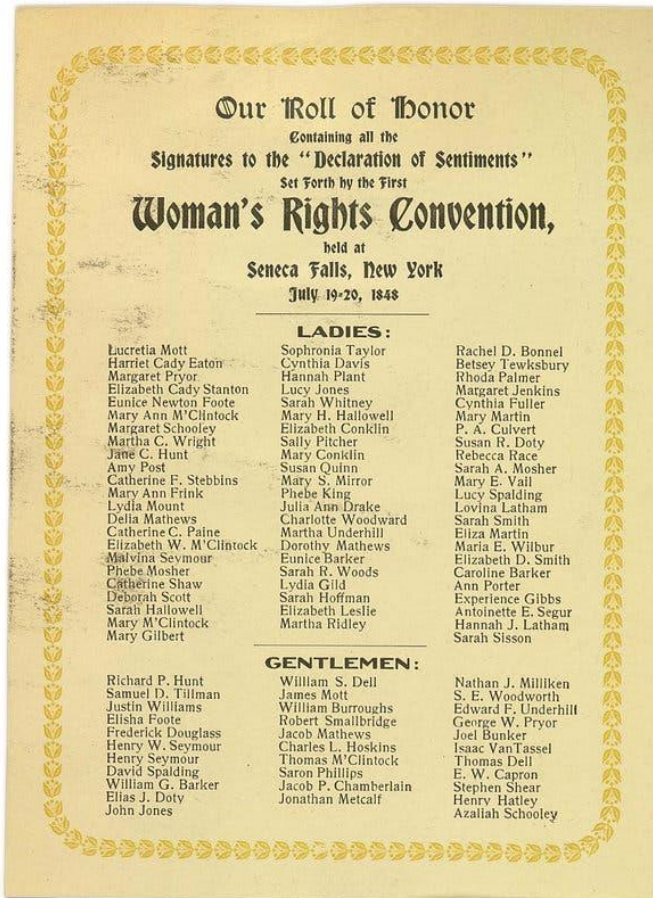
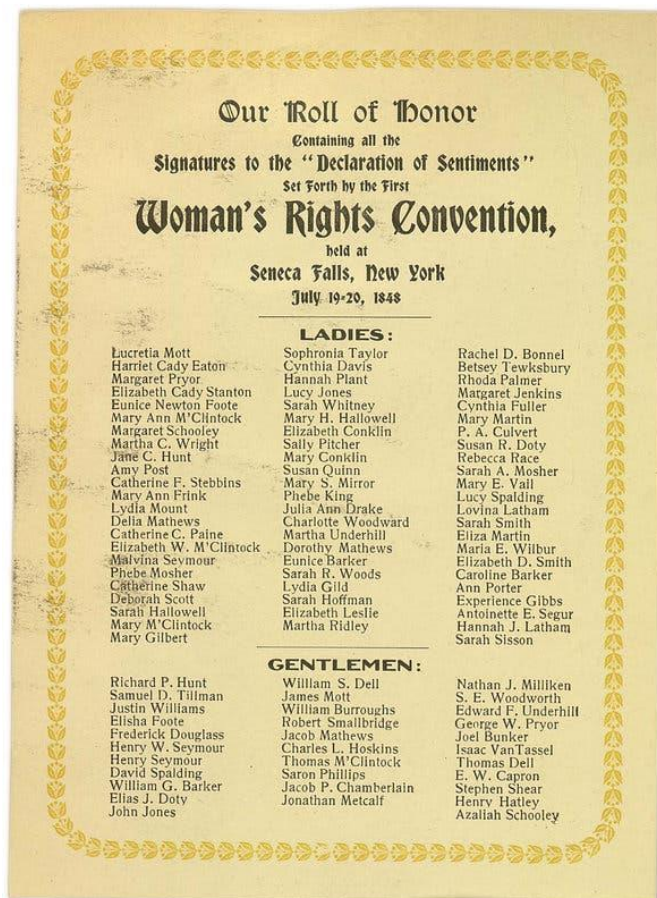
Hayhoe of Texas Tech put it this way: “The conclusion she came to is correct, but the conclusion was not actually supported by her experiment,” because she didn’t distinguish between visible and infrared radiation “and the greenhouse effect is primarily due to the latter, not the former.”

But Foote, she said, “was the first person to say in print that if carbon dioxide levels were higher, the planet would be warmer.” That alone, she said, was “an amazing accomplishment, and she should be absolutely celebrated for that.”

Marveling at how much Foote was able to accomplish given the limited horizons for women of her time, Hayhoe pondered, “What would she have accomplished if she had been born today?”

Eunice Newton was born in Goshen, Conn., on July 17, 1819, one of 11 children of Isaac Newton Jr., [a farmer and entrepreneur](#), and Thirza Newton, a homemaker. She attended the Troy Female Seminary, a school that [encouraged female students to attend science lectures at a nearby college and had its own chemistry labs for experiments](#).

Science was not Foote's only passion. She was also a prominent feminist and a signer of the declaration that emerged at the 1848 [Seneca Falls Convention](#), one of the nation's first organized events for women's rights. Her name is fifth on the list. Her husband, Elisha Foote, a judge and amateur scientist whom she married in 1841, also signed the document, which called for "the civil, social, political and religious rights of women."



Foote was the fifth name on the list of signatures on the declaration that emerged at the 1848 Seneca Falls Convention. Her husband also signed the document. Credit...Library of Congress

She also published on many different topics, and as a result she never built up the reputation that comes with accumulated research in one area or field.

She died on Sept. 30, 1888. She was 69.

Paul Yeaton, a great-great-grandson of Eunice Foote, said he knew little of his illustrious ancestor growing up. However, he said, "reading the monograph, jeez, it's pretty remarkable, her powers of deduction."

In hearing about the recent surge in research and publication that recognizes Foote's work, he said, "It's nice that somebody got their due rights."

A short film about Foote, called "[Eunice](#)," was made in 2018.

Another relative, Liz Foote, a scientist pursuing a Ph.D. in environmental studies in Hawaii, said, "It's an honor personally to be part of a family tree with someone like Eunice in it." She added, "I'm just thrilled that we could be hearing more of her story now."

Correction: April 27, 2020

An earlier version of this obituary misstated the first name of the scientist who presented Foote's work at the annual meeting of the American Association for the Advancement of Science. He was Joseph Henry, not John.

John Schwartz is a reporter on the climate desk. In nearly two decades at The Times, he has also covered science, law and technology.