Eunice Foote's Pioneering Research on CO_2 and Climate Warming: Update*

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Abstract

The first published paper to demonstrate enhanced absorption of solar rays by water vapor and carbon dioxide, and speculate on the potential for climate warming if the latter attained a higher atmospheric concentration, was published by Eunice Foote in 1856.

Introduction

On August 22, 1856, a paper by Eunice Foote was read at the 10th annual meeting of the American Association for the Advancement of Science (AAAS), on the subject of laboratory experiments indicating that water vapor and carbon acid gas (CO_2) absorb energy from solar radiation more efficiently than oxygen or nitrogen, causing an increase in temperature. This is thought to be the first scientific research to demonstrate the existence of what are known today as greenhouse gases. A summary of the presentation was published in an annual review of scientific achievements for that year (Wells, 1857).

The journalistic coverage by Wells and the background of the people involved were reported in a previous paper by this author (Sorenson, 2011). Eunice Foote's research was not published, or even listed, in the AAAS Proceedings volume for the 1856 meeting, and AAAS had not yet begun publication of its journal *Science* (volume 1 in 1883). Consequently, it was assumed that formal publication of the research did not occur.

New Information

Recently, a reprint copy of Eunice Foote's report entitled "Circumstances affecting the heat of the sun's rays" (Eunice Foote, 1856b), printed in Saratoga Springs, New York, was found in the Saratoga Springs City Historian's files, and made available to this author. Upon seeing "From Silliman's Journal" printed at the top of the first page, an examination of the American Journal of Science and Arts (AJS) was conducted, and

the original paper was found in the November 1856 issue (Eunice Foote 1856a). The text of the reprint and the AJS article were found to be the same.

A second reprint was found in Saratoga Springs, entitled "On the heat in the sun's rays", written by Eunice Foote's husband Elisha Foote (Elisha Foote, 1856b). This paper had also been read at the 1856 AAAS meeting, but not included in the Proceedings volume, yet was published in the AJS November 1856 issue (Elisha Foote, 1856a).

Judging by the similarity in subject matter and the two authors' marital status, it is likely that the laboratory research for these papers was collaborative in nature.

In the author's previous paper (Sorenson, 2011), he questioned whether the commentary on the potential for atmospheric warming was from Eunice Foote's paper or was added by David Wells. The published AJS paper clearly shows that the idea of climate warming due to rising levels of atmospheric CO_2 originated with Eunice Foote:

"The highest effect of the sun's rays I have found to be in carbonic acid gas. ... An atmosphere of that gas would give to our earth a high temperature; and if, as some suppose, at one period of its history, the air had mixed with it a larger proportion than at present, an increased temperature from its own action, as well as from increased weight, must have necessarily resulted."

Acknowledgements

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