

The Brief Life of a Molecule

D. A. Pratt, reply by Freeman Dyson

JULY 17, 2008 ISSUE

In response to:

The Question of Global Warming from the June 12, 2008 issue

To the Editors:

I very much appreciated Freeman Dyson's article entitled "The Question of Global Warming" [NYR, June 12]. However, I did not understand how he arrived at the comment that the average lifetime of a molecule of carbon dioxide in the atmosphere is about twelve years. Since I think this is an important point in the article, I would love to see an attempt at an additional explanation for those of us who did not "get it" the first time.

D.A. Pratt

Regina, Saskatchewan

Canada

Freeman Dyson replies:

You can get a rough estimate of the lifetime of a carbon dioxide molecule in the atmosphere by dividing the total mass of carbon in the atmosphere by the mass that is absorbed in photosynthesis by land vegetation each year. I do not know the exact numbers. Roughly, the total atmospheric carbon is eight hundred gigatons and photosynthesis absorbs seventy gigatons of carbon per year, giving a lifetime of about twelve years. This is the average time that a carbon dioxide molecule spends in the atmosphere before it is absorbed by a land plant. I used this lifetime to estimate how long it would take for a major change in the land vegetation to produce a major change in the atmosphere.

This calculation completely ignores the ocean. In reality the flow of carbon dioxide into the ocean is about twice as large as the flow into land vegetation. So the lifetime of a carbon dioxide molecule in the atmosphere is really only about five years. Between two jumps into the land vegetation, an average molecule jumps twice into and out of the ocean. I ignored the ocean in my estimate because I was considering only land management and not ocean management as a way of controlling carbon dioxide in the atmosphere. It is possible that ocean management may turn out to be technically more effective, but land management is politically easier because each country owns its own land.

© 1963-2015 NYREV, Inc. All rights reserved.