



## **Ocean Acidification: The “Other” Carbon Problem and What We Can Do About It**

by Heir Elliot Johnston, age 12

### **Human Beings’ Subconscious Carbon Footprint**

Do you enjoy meat? If you have recently eaten a quarter pounder burger at McDonald's, you can think of it as having released 6.8 pounds of CO<sub>2</sub> into the atmosphere, just from that one hamburger<sup>1</sup>.

If you have eaten the same amount of lamb, even worse! You just emitted 9.8 pounds!

Vegetarian you say? Then what about the pound of cheese that you bought at the store? That released 13.5 pounds of CO<sub>2</sub>!

Oh, but you’re vegan. OK, then what about the desktop computer you have that is responsible for 610 pounds of CO<sub>2</sub>, and that’s just assuming that you have a 10 pound computer.

The chances are that you probably had no idea of the CO<sub>2</sub> “cost” of your human activity. This is a big problem. People are using these resources up so fast that soon we will be

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<sup>1</sup> Environmental Working Group, Meat Eater’s Guide. <http://www.ewg.org/meateatersguide/a-meat-eaters-guide-to-climate-change-health-what-you-eat-matters/climate-and-environmental-impacts/>

left with a planet with cities such as Miami underwater<sup>2</sup>, dramatic weather events, and a devastating reduction in fisheries which provide a primary source of protein for more than one billion of the poorest people on Earth<sup>3</sup>.

### **Ocean Acidification: Climate Change's "Evil Twin"**

One lesser known result of the excess human-produced CO<sub>2</sub> in our atmosphere is ocean acidification - global warming's "evil twin". Ocean acidification occurs when CO<sub>2</sub> is absorbed from our atmosphere into the water by diffusion. This increased CO<sub>2</sub> causes many problems, including a reduction of available carbonate in the regions of water where it is absorbed. This deficiency makes it much more difficult for many organisms to create shells, including very important microscopic phytoplankton. There are indications that several critical species may suffer large declines in their population as the result of ocean acidification<sup>4</sup>.

Another point that many people don't understand is that science suggests that there is significant lag between the time CO<sub>2</sub> is emitted and the time that the results are fully realized in our oceans. This fact reinforces the urgency of the need to reduce emissions -- nature takes time to heal, and we have been damaging the air and water for a long time. As the pH of our oceans has dropped from human-induced ocean acidification, it likely won't return to normal (e.g. pre-industrial revolution levels) for 100,000 years, and that's assuming we halt CO<sub>2</sub>

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<sup>2</sup> Elementa: Science of the Anthropocene; Effective inundation of continental United States communities with 21st century sea level rise; Kristina A. Dahl et al, July 12, 2017.

<https://www.elementascience.org/articles/10.1525/elementa.234/>

<sup>3</sup> Ocean-Based Food Security Threatened in a High CO<sub>2</sub> World A Ranking of Nations' Vulnerability to Climate Change and Ocean Acidification; Oceana; 2012. [http://oceana.org/sites/default/files/reports/Ocean-Based Food Security Threatened in a High CO<sub>2</sub> World.pdf](http://oceana.org/sites/default/files/reports/Ocean-Based%20Food%20Security%20Threatened%20in%20a%20High%20CO2%20World.pdf)

<sup>4</sup> Science Daily; "Acidification of oceans may contribute to global declines of shellfish", Stony Brook University; Oct 3, 2010. <https://www.sciencedaily.com/releases/2010/09/100928154754.htm>

emissions today<sup>5</sup>. This estimate represents the amount of time it would take for rocks in the sea to erode away under the higher acidity conditions, releasing basic elements that would ultimately stabilize the pH<sup>6</sup>.

## Scientists Confront the Evil Twin

This may make you feel like our planet might be too late to save. Every day scientists are awakened more and more to the massive extent of the problems of CO<sub>2</sub> in our air, and, subsequently, in our oceans. But thankfully, they are also researching new ways to help to reduce emissions. One promising technology comes from the company Blue Planet, LTD. This company focuses on ways to use and sequester CO<sub>2</sub> via the production of cement<sup>7</sup>. Their technology produces carbonate (CO<sub>3</sub>) from carbon dioxide (CO<sub>2</sub>) resulting in artificial limestone, a useful construction material. This has an additional benefit because normally the production

of cement actually emits a great deal of carbon. Some estimates indicate that concrete production accounts for 5% of total worldwide CO<sub>2</sub> emissions. In producing construction material from focused CO<sub>2</sub> emissions at their source, such as coal power plants, etc., this process is actually carbon



Photo credit: Oak Ridge National Laboratory

<sup>5</sup> Arstechnica. "Emit some CO<sub>2</sub>? Its warming influence should peak in about a decade" SCOTT K. JOHNSON - 12/11/2014. <https://arstechnica.com/science/2014/12/emit-some-co2-its-warming-influence-should-peak-in-about-a-decade/> Scott K. Johnson - 12/11/2014

<sup>6</sup> "Ancient Ocean Acidification Intimates Long Recovery from Climate Change", Scientific American, By David Biello on July 22, 2010.

<sup>7</sup> Conservation Magazine, University of Washington, Dec 8, 2010. <http://www.conservationmagazine.org/2010/12/cementing-the-future/>

negative. The company plans to open their first full-scale commercial plant this year in California.

In another example of solution technology, guanidine, a man-made compound, may prove very useful in cleaning up the atmosphere. In a recent accidental discovery, scientists at Oak Ridge National Laboratory found that a solution containing guanidine at room temperature can pull CO<sub>2</sub> from the air<sup>8</sup>! The guanidine reacts with the CO<sub>2</sub> creating crystals. These crystals can subsequently be easily re-evaporated in a controlled fashion, and the carbon may then be sequestered deep underground. It is particularly significant that this potential technology could remove CO<sub>2</sub> from “regular” air rather than requiring sources of concentrated CO<sub>2</sub>.

### **We Too Can Be Resolute In Making A Better Future!**

Everyone can help by making personal changes in their own lives, like reusing containers or eating less meat. We can help to mitigate our climate problem if everyone makes an effort in their personal lives to make our planet healthier. Schools can play a part in this solution by removing meat from school lunches! There are, in fact, school districts such as Oakland Unified that are taking meat out of lunches in order to reduce their carbon footprint<sup>9</sup>. If this were to happen on a country-wide or even worldwide scale, the effects on our global carbon footprint would be enormous. If we do something as simple as reducing meat consumption resulting in less meat production, then less CO<sub>2</sub> will be emitted into our atmosphere, and less

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<sup>8</sup>Oak Ridge Today. ORNL: “Crystallization method offers new option for carbon capture from air” January 9, 2017 <http://oakridgetoday.com/2017/01/09/ornl-crystallization-method-offers-new-option-carbon-capture-air/>

<sup>9</sup>The Daily Caller News: “California Schools Cut Meat, Cheese From Lunches To Fight Global Warming”; 2/15/2017. <http://dailycaller.com/2017/02/15/california-schools-cut-meat-cheese-from-lunches-to-fight-global-warming/>

would make its way into our oceans. This illustrates that we can all take steps to make a difference in reducing carbon emissions.

### **What Do I Think?**

It is ironic - We humans, having played with fossil fuel technology for far too long at a huge cost to the environment, may now have to rely upon newer technology to save our planet. However, this doesn't mean that we should stop buying hybrid and electric cars, nor should we stop advocating for climate policy changes, nor should we stop taking any of the steps that we take to save our planet. In fact, it means more than anything that we need to continue to do our part in saving the environment to mitigate the problems that we're facing until we have a safe technology in a practical form that is certain to help. One of the worst things we can do now is to say that we have all the solutions in place, because the truth is that we do not yet. Depending solely on new technology could lead people to be complacent in their daily lives.

As someone who is inheriting this planet in its current state, I think that we should all be doing what we can to reduce our personal sources of carbon until we eventually actually have technology in place that can reduce industrial CO<sub>2</sub> output. For now I am reducing my meat consumption dramatically, and I'm encouraging my family to do the same. I am meeting with



Dr. Tessa Hill: University of California, Davis  
Professor Dept of Earth & Planetary Sciences and the Bodega Marine  
Laboratory

scientists like Dr. Tessa Hill from UC Davis to learn how I can help to educate others about the problem of ocean acidification, and the actions we can take to help reduce CO<sub>2</sub> emissions. And I'm working with my fellow Heirs to educate

others about ocean acidification and climate change and their effects on our oceans' natural resources. I am also studying science. Perhaps I will someday be the scientist or engineer who develops a technology that can be put into practice to reduce or eliminate CO<sub>2</sub> emissions from our atmosphere!

**Heirs to Our Oceans is inspiring the next generation of environmental leaders.**



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