Dumping Iron

Ecohacker Michael Markels claims he has a megafix for global warming: Supercharge the growth of ocean plankton with vitamin Fe and let a zillion CO₂ scrubbers bloom.

By Charles Graeber – Wired Magazine – 8.11 November 2000

In October 1993, the Columbus Iselin, a ship loaded with 23 scientists from 15 international research institutes, left Panama on a mission to study one of the great riddles of oceanography. The mystery involved a dark, relatively lifeless stretch of the equatorial Pacific, a huge patch of water 250 miles southwest of the Galapagos Islands that 19th-century mapmakers called the Desolate Zone. The zone is desolate because it's short on phytoplankton, the tiny, floating surface algae that perform 50 percent of Earth's photosynthesis. Although it is rich in most of the nutrients required for plant life (phosphorous, nitrogen, silicon), the area has very little phytoplankton, a condition that scientists call "high nutrient/low chlorophyll," or HNLC. Twenty percent of the world's ocean water is HNLC, and for 70 years nobody could figure out why.

The Columbus Iselin set out to test a hypothesis that emerged in 1989, when an oceanographer named John Martin published a startling new theory in Nature. Martin believed HNLC ocean water was missing a vital ingredient: iron. Plants require minute quantities of iron to produce chlorophyll, and Martin was convinced that HNLC zones were, essentially, anemic. Sprinkle iron in the waters, he said, and they would bloom like Eden. Martin also theorized that if you grew enough phytoplankton in HNLC zones worldwide, you could lock up billions of pounds of carbon dioxide - phytoplankton converts CO₂ gas to solid carbon mass, which is effectively removed from the system when the dead plants sink to the deep ocean floor into a kind of permanent cold storage. In other words, you could potentially redirect the earth's climate.

Strange though this sounds, it's possible. Scientists have long recognized that Earth's average temperature is altered by the atmospheric concentration of CO₂, a V-shaped molecule that traps heat in the lower atmosphere like glass traps heat in a greenhouse. At the end of the last ice age, roughly 18,000 years ago, atmospheric CO₂ levels were only 180 parts per million, less than half the current (and rising) level of 366 ppm. Martin argued that huge blooms of phytoplankton were responsible for the lower CO₂ levels in that period; they reduced the earth's insulation and lowered the global temperature. With more and more of the earth's water tied up in expanding glaciers, he reasoned, winds pushed iron-rich dust from the continents' parched surfaces, creating new phytoplankton blooms and freezing even more water - a positive feedback loop for global cooling. Martin believed that if this effect were triggered again on a smaller scale, it might even counteract the contemporary problem of global warming. "Give me half a tanker of iron," he joked, "and I'll give you the next ice age."

Martin, a charismatic, polio-stricken oceanographer whom the media called Iron Man and Johnny Ironseed, found himself at the center of a blistering controversy because of these views. Oceanography is conventionally dedicated to studying the ocean, not changing it. Martin's peers warned that his "Geritol solution" could screw up the very system he was
trying to study, that too little was known about oceanic dynamics to simply start casting iron on the waves.

**In two weeks, 1,000 pounds of iron produced the biomass equivalent of 100 full-grown redwoods, sucking 2,500 tons of CO₂ from the sky.**

Martin died of prostate cancer in 1993 at the age of 56, a few months before a research mission he'd planned, called IronEx I, set off to test iron's impact on the Desolate Zone. Two oceanography colleagues ran the experiment in his place: Richard Barber of Duke University and Ken Johnson of Moss Landing Marine Labs, a public research center affiliated with San Jose State University. For two days, while the **Columbus Iselin** traversed a 25-square-mile grid of HNLC ocean, Barber's team dumped 1,000 pounds of granular iron sulfate, dissolved in a weak acid solution, into the ship's wake. Lasers from a NASA P-3 Orion airborne optical lab zapped the waters from above, scanning for new chlorophyll.

The results were promising but mixed: IronEx I produced phytoplankton, but it yielded four times less biomass than Martin's team had predicted. In 1995, a project led by Kenneth Coale (now the acting director of Moss Landing Marine Labs) tried to increase the yield in a follow-up expedition called IronEx II. This time scientists ladled out the thousand-pound iron payload in three separate servings. And this time the dead seas sprang dramatically to life. Overnight, the HNLC waters clouded green. Fish were attracted by the harvest, and within days sharks and turtles were chasing the new food supply. By the end of two weeks, IronEx II had produced the biomass equivalent of 100 full-grown redwoods - touch-of-life results that inspired Johnson to rave about "a phytoplankton explosion of almost biblical proportions." The experimenters calculated that they had pulled 2,500 tons of CO₂ out of the atmosphere, and claimed they could do it again in desolate zones all over the world.

Michael Markels is not an oceanographer. He's a chemical engineer with a doctorate from Columbia University and an inventor who, in the 1960s, designed noncombustible atmospheres for proposed space stations and helped solve heat-transfer problems in early nuclear reactors.

Nearly half a century later, Markels is 74 and semiretired after a career in environmental engineering that made him rich. He has a new wife, a new home, a gas-guzzling Buick Park Avenue, and a big goal. He wants to put Martin's ideas into practice on a planetary scale, using iron to essentially hack a solution to the greenhouse effect. Ignoring the continuing objections of ocean scientists, Markels has created a company, Ocean Farming Inc., devoted to this prospect.

His motivation? A mix of profit and principle. Markels is an outspoken contrarian who doesn't believe global warming is much of a threat, but he's happy to sell his services to people who think otherwise. He knows that in the years ahead, nations and corporations all over the world will pay dearly for methods that allow them to meet the CO₂ emissions cutbacks established in 1997 at the United Nations Framework Convention on Climate Change in Kyoto, Japan. He figures most nations won't find the will to cut back on their fossil fuel-burning ways, so they'll have to meet the new standards by buying pollution "credits" from those that do, or from individuals who figure out ways to lock up large amounts of CO₂. He'll be in the second camp, the man with the plan to switch on the worldwide air conditioner.