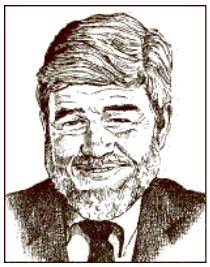
RESOURCES

John Martin's Role



Dr. John H. Martin, Director of the Moss Landing Marine Laboratories, is credited with formulating the "iron hypothesis", the concept that availability of iron controls primary production in much of the world's oceans and may be one of the primary factors controlling world climate.

Martin's role in developing, testing and publicizing the role of iron may be found at the web site "On the Shoulders of Giants" .

Because iron abundance reported in scientific literature had a very wide range, Martin and his colleagues surmised that sampling technique was flawed. He suggested one might find it difficult to measure super small iron concentrations at sea from and aboard an iron ship. He developed "ultraclean" laboratories and showed that indeed sampling error was rampant and that most open ocean water did not have enough iron to support photosynthesis.

Martin and colleagues conducted a series of "bottle experiments" proving that the addition of miniscule amounts of iron caused rapid growth of phytoplankton. Using dust and carbon dioxide captured in Antarctic ice cores as the primary evidence, Martin postulated that changes in the amounts of iron in windblown dust from Asia could trigger Ice Ages. He quipped a remark to this extent at a conference and the resulting cartoon has become a feature ever since in ocean science classes.

As early as the 1930's, the potential role of iron as a limiting factor in open ocean phytoplankton productivity was described. (Gran, 1931; Hart, 1934; Harvey, 1938).

In the late 1980's John Martin, director of the Moss Landing Marine Laboratory (MLML – Cal State University's), began to weave together several independent threads of evidence, revitalizing the early idea that iron plays a major regulatory role in phytoplankton productivity (Martin, 1992). The iron found in the ice core originated as terrestrial dust that settled out of the atmosphere. The CO2 is measured from trapped bubbles of air frozen in the ice and preserved for millennia.

Martin proposed that analyses of 7,000-foot deep Antarctic ice cores provided support for his premise. He made particular note of CO2 and iron concentrations found 18,000 and 160,000 years ago, about the time of earth's ice ages. (Studies of ice cores now extend this pattern to 700,000 years). Scientific controversy was unleashed with a quip that suggested an extreme interpretation of Martins work saying, “Give me a half-tanker of iron, and I'll give you an ice age." His intent , though overstated for effect, being to emphasize the power of iron stimulated plankton blooms at removing CO2 from the atmosphere.

Martin died in 1993, shortly before the first Iron experiment. This and many additional experiments have confirmed the truth and importance of his idea.

Rest in Peace John and thank you.

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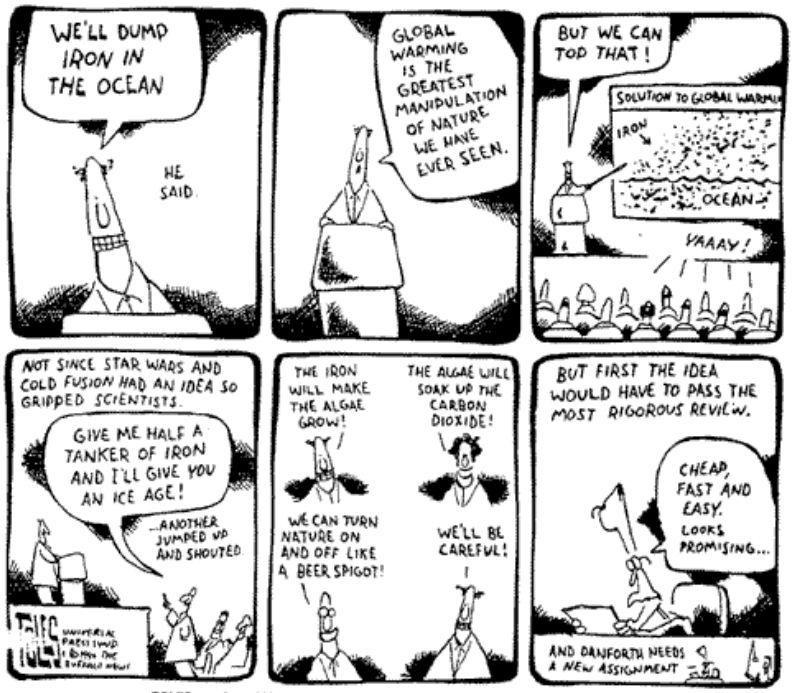

Remember! This is a cartoon (ps. That's the first President Bush in the last frame.)

Iron Experiments

1993, IronEx I - The National Science Foundation funded the first experiment which spread iron sulfate over a 64 square kilometer area due west of the Galapagos. A dramatic plankton bloom was stimulated, but the experiment was cut short.

1995 IronEx II - This experiment successfully triggered a bloom with tenfold increases in phytoplankton concentrations, by applying iron in the same general area as the IronEx I experiment. This "biblical" bloom changed the color of the water from blue to green and provided the most vivid proof of the validity of the iron hypothesis.

NSF Experiments Pause From 1995 to 2002 - Although the IronEx II results were widely considered very significant, no subsequent NSF cruises were undertaken for seven years. This delay, which chagrined oceanographers, illustrates how the expense and logistics of iron fertilization research strain limited budgets for oceanographic research.

February 1999, Southern Ocean Seeded By Southern Ocean Iron Release Enrichment Experiment (SOIREE). This was the first of the perturbation experiments in the Southern Ocean. The consortium led by a New Zealand Oceanographic institute, essentially duplicated the IronEx II experiment in the Southern Ocean. SOIREE did manage to produce a bloom within their patch, but adverse weather conditions did not allow tracking of the patch.

January-March 2002, the Southern Ocean Iron Fertilization Experiment (SOFeX) Conducts First Clearly Successful Iron Experiments in the Southern Ocean. This series, described at http://www.mbari.org/education/cruises/

SOFeX2002/index.htm was able to cultivate and track two patches in the Southern Ocean and disproved a theory which, if true, would diminish the potential significance of the "iron hypothesis".

June-July 2002 - Planktos Foundation Experiments

This experiment is the first private sector experiment aimed at gaining an understanding of materials, engineering, and management requirements for future development. It also has allowed for the testing of the acceptability and suitability of ocean forest carbon in the global carbon emission trading market.

Dust might drop

Model forecasts health benefits and global warming risk.
NATURE 26 September 2003 BETSY MASON

The world could be a lot less dusty in the future, predicts a new model1. This would bring health benefits for some but might also exacerbate global warming.

The model is based on how much of the Earth's surface is covered by deserts, how much wind is around to pick up dust, and rainfall. Natalie Mahowald and Chao Luo of the National Center for Atmospheric Research in Boulder, Colorado, who developed the model, used six different scenarios for future climate, vegetation cover and land use to come up with their estimates.

By 2090 up to 60% less dust will be loose in the Earth's atmosphere, they calculate. The most realistic scenario - it takes

into account the potential for a rise in atmospheric carbon dioxide to increase plant growth and reduce exposed soil - results in the biggest dust reduction. But even holding available dust sources constant leads to a 20% decrease in dust.

"Anything that reduces the amount of dust in the atmosphere will probably result in warming," says climate scientist Ron Miller of the NASA Goddard Institute for Space Studies in New York. Dust reflects some energy back into space and absorbs some, trapping it near the top of the atmosphere, which cools the surface, he explains.

Less dust could also affect the ocean, says Mahowald. Dust supplies plankton with iron. Less iron means fewer plankton to photosynthesize carbon dioxide. "It's possible the oceans won't be able to take up as much carbon dioxide," she says.

References

1. Mahowald, N. M. & Luo, C. A less dusty future? *Geophysical Research Letter*, published online, doi:10.1029/2003GL017880, (2003).

Africa's deserts are in "spectacular" retreat

Fred Pearce From New Scientist Online News 19:00 18 September 02

The southern Saharan desert is in retreat, making farming viable again in what were some of the most arid parts of Africa.

Burkina Faso, one of the West African countries devastated by drought and advancing deserts 20 years ago, is growing so much greener than families who fled to wetter coastal regions are starting to go home.

New research confirming this remarkable environmental turnaround is to be presented to Burkina Faso's ministers and international aid agencies in November. And it is not just Burkina Faso.

New Scientist has learned that a separate analysis of satellite images completed this summer reveals that dunes are retreating right across the Sahel region on the southern edge of the Sahara desert. Vegetation is ousting sand across a swathe of land stretching from Mauritania on the shores of the Atlantic to Eritrea 6000 kilometres away on the Red Sea coast.

Nor is it just a short-term trend. Analysts say the gradual greening has been happening since the mid-1980s, though has gone largely unnoticed. Only now is the evidence being pieced together.

Aerial photographs taken in June show "quite spectacular regeneration of vegetation", in northern Burkina Faso, according to Chris Reij of the Free University, Amsterdam.
There are more trees for firewood and more grassland for livestock. And a survey
among farmers shows a 70 per cent increase in yields of local cereals such as sorghum and millet in one province in recent years. The survey, which Reij is collating, was paid for by Dutch, German and American overseas aid agencies.

Meanwhile, Kjeld Rasmussen of the University of Copenhagen has been looking in detail at sand dunes in the same area. Once they seemed to be marching south. But since the 1980s, he says, there has been a "steady reduction in bare ground" with "vegetation cover, including bushes and trees, on the increase on the dunes". Rising rainfall

Desertification is still often viewed as an irreversible process triggered by a deadly combination of declining rainfall and destructive farming methods. In August, the UN Environment Programme told the World Summit in Johannesburg that over 45 per cent of Africa is in the grip of desertification, with the Sahel worst affected.

But a team of geographers from Britain, Sweden and Denmark has spent the summer re-examining archive satellite images taken across the Sahel. Andrew Warren of University College London told New Scientist that the unpublished analysis shows that "vegetation seems to have increased significantly" in the past 15 years, with major regrowth in southern Mauritania, northern Burkina Faso, north-western Niger, central Chad, much of Sudan and parts of Eritrea.

But there is confusion over why the Sahel is becoming green. Rasmussen believes the main reason is increased rainfall since the great droughts of the early 1970s and 1980s. But farmers have also been adopting better methods of keeping soil and water on their land.

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