SC/Biol 2010
Photosynthesis

An Introduction...

artwork by Michael Hagelberg

1700........
EXPANSION OF THE HUMAN POPULATION
1700


1800........
EXPANSION OF THE HUMAN POPULATION
1800


1900........
EXPANSION OF THE HUMAN POPULATION
1900

MAN, n. An animal so lost in rapturous contemplation of what he thinks he is as to overlook what he indubitably ought to be. His chief occupation is extermination of other animals and his own species, which, however, multiplies with such insistent rapidity as to infest the whole habitable earth and Canada.

Bierce
Devil’s Dictionary

What is a Weed?
Homo sapiens is perhaps the weediest of all species, and the more he dominates the landscape, the more he seems to thrive. If we confine the concept of weeds to species adapted to human disturbance, then man is by definition the first and primary weed under whose influence all other weeds have evolved.

[...]
If man does succeed in controlling his own population size, we shall have an example of a weed becoming domesticated.

Jack R. Harlan (1992)
Crops and Man, 2d edition
(page 87)
Croplands at Risk of Degradation, 1999

Soil Degradation of Drylands, 1990's

Want to Eat?
Want a Clean Source of Energy?
Want Oxygen?
Want to Remove Excess Carbon Dioxide?

Try Photosynthesis

The PS10 concentrates sunlight from a field of heliostats on a central tower.
A solar cell made from a monocrystalline silicon wafer

Phthalocyanine: Building block for photoelectricity

Synechocystis sp PCC6803 has been genetically transformed to produce ethanol as a byproduct of photosynthesis.


Genes encoding pyruvate decarboxylase (to convert pyruvate to acetaldehyde) and alcohol dehydrogenase (to convert acetaldehyde to ethanol) were all that were required.

Then, the cyanobacteria (or eukaryotic algae) can be grown in transparent tubing networks — photosynthetic bioreactors.


Bioengineering: Fuel Production

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Lavoisier, A. L. Traite elementaire de Chimie. 1789

Photosynthesis

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LIGHT and OXYGEN
Although life had begun in the form of anaerobic bacteria early in the Archean Eon, photosynthetic bacteria did not appear until the middle Archean and were not abundant until the start of the Proterozoic. The bacteria emitted oxygen. The atmosphere changed. The oceans changed. The oceans had been rich in dissolved ferrous iron, in large part put into the seas by the extruding lavas of two billion years. Now with the added oxygen, the iron became ferric, insoluble and dense. Precipitating out, it sank to the bottom as ferric sludge, where it joined the lime muds and silica muds and other seafloor sediments to form worldwide, the banded-iron formations that were destined to become rivets, motorcars, and cannons. This was the iron of the Mesabi Range, the Australian iron of the Hamersley Basin, the iron of Michigan, Wisconsin, Brazil. More than ninety percent of the iron ever mined in the world has come from Precambrian banded-iron formations. Their ages date broadly from two-thousand-five-hundred to two-thousand million years before the present. The transition that produced them—from a reducing to an oxidizing atmosphere and the associated radical changes in the chemistry of the oceans—would be unique. It would never repeat itself. The earth would not go through that experience twice.

John McPhee. *Annals of the Former World*
Croplands at Risk of Degradation, 1999

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