Link to speaker notes

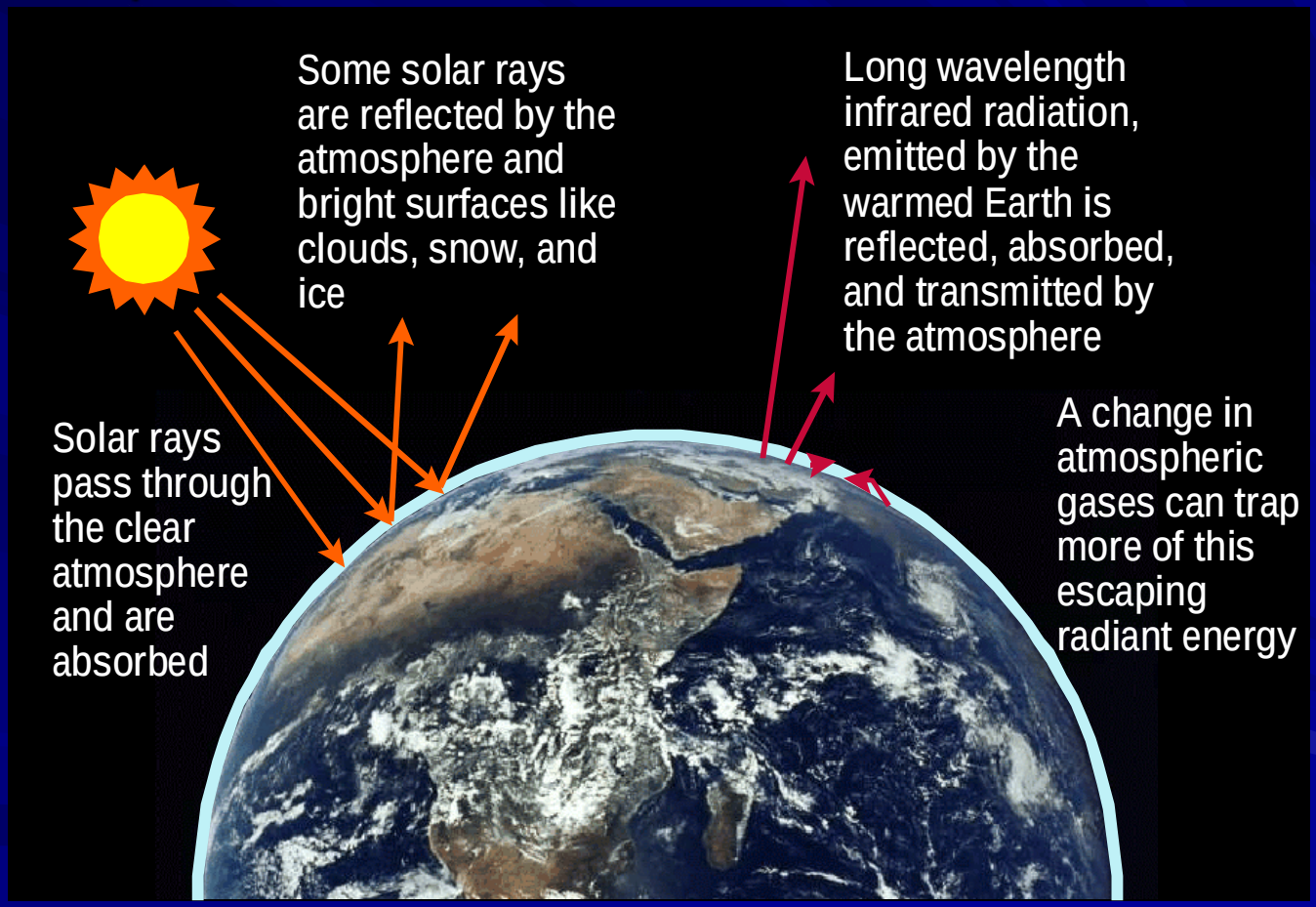
Global Warming: The Tip of the Iceberg

- Our Problems
- The Big Picture
- Action Strategies

Ross McCluney, Ph.D.
Cherokee Group
Tennessee Sierra Club
Chattanooga, TN

The Greenhouse Effect

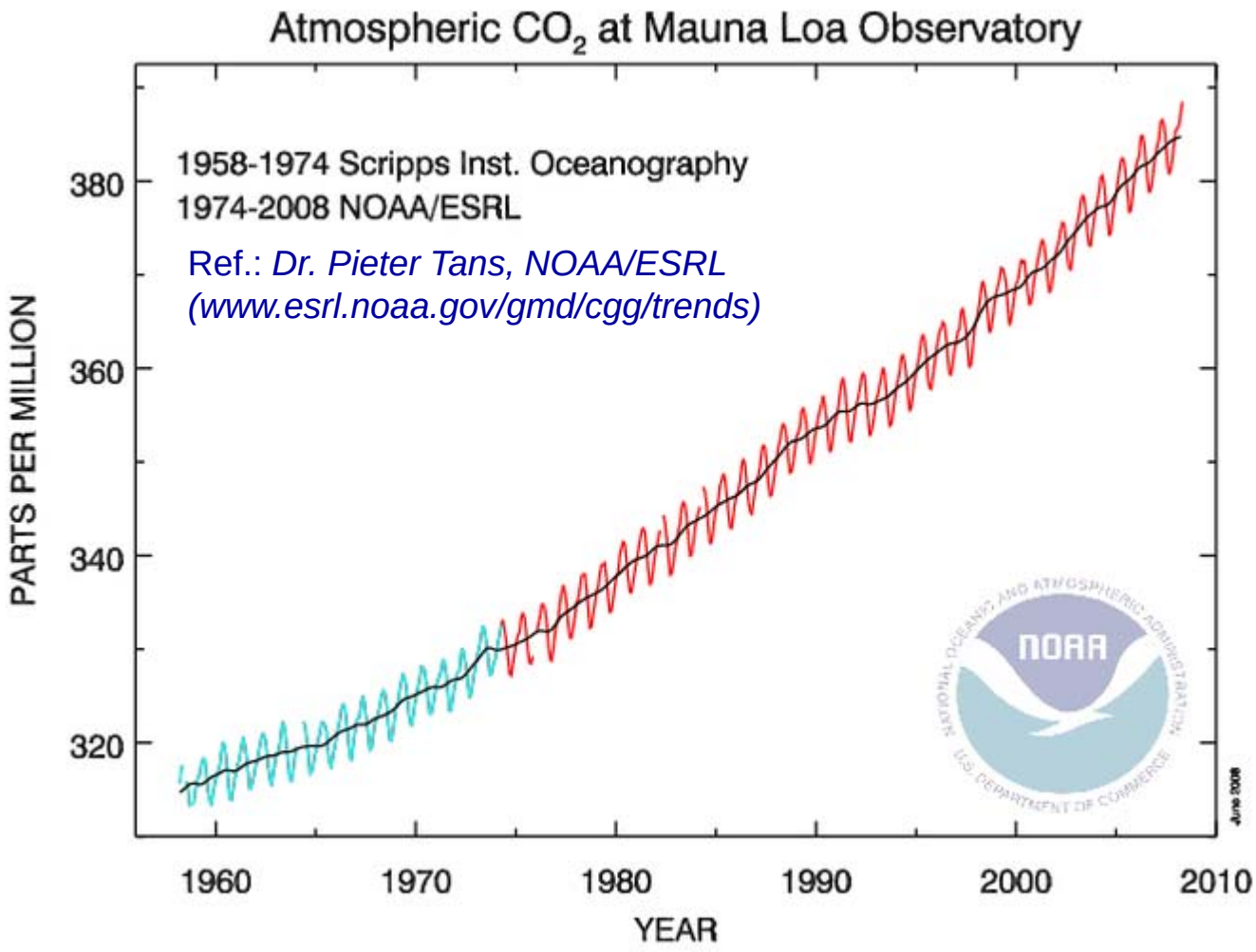
- Increases in “greenhouse gases” trap more solar heat in the atmosphere



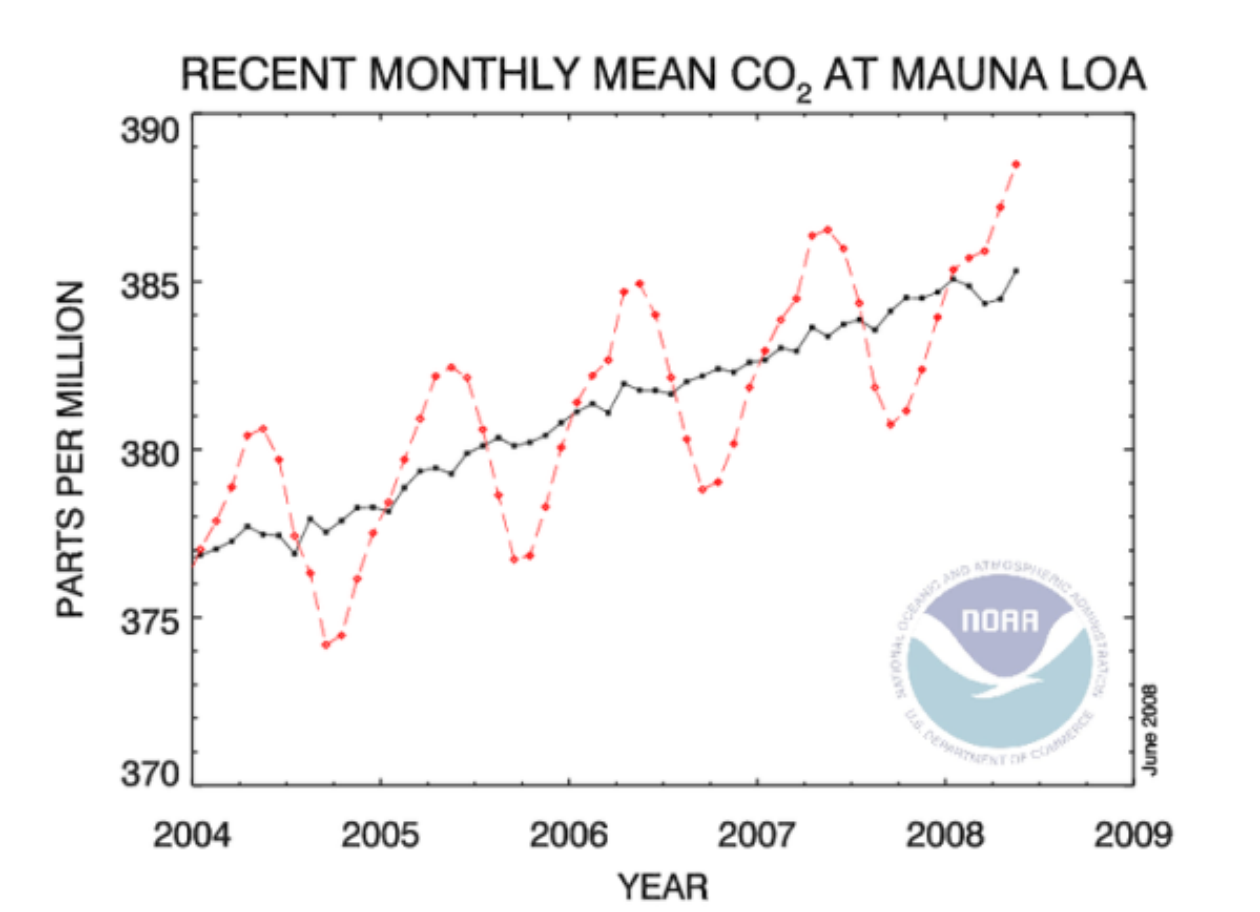
- As the solar heat is trapped inside, the Earth warms
- Serious physical and ecological consequences result

The Driving Force

from NOAA's Earth System Research Laboratory

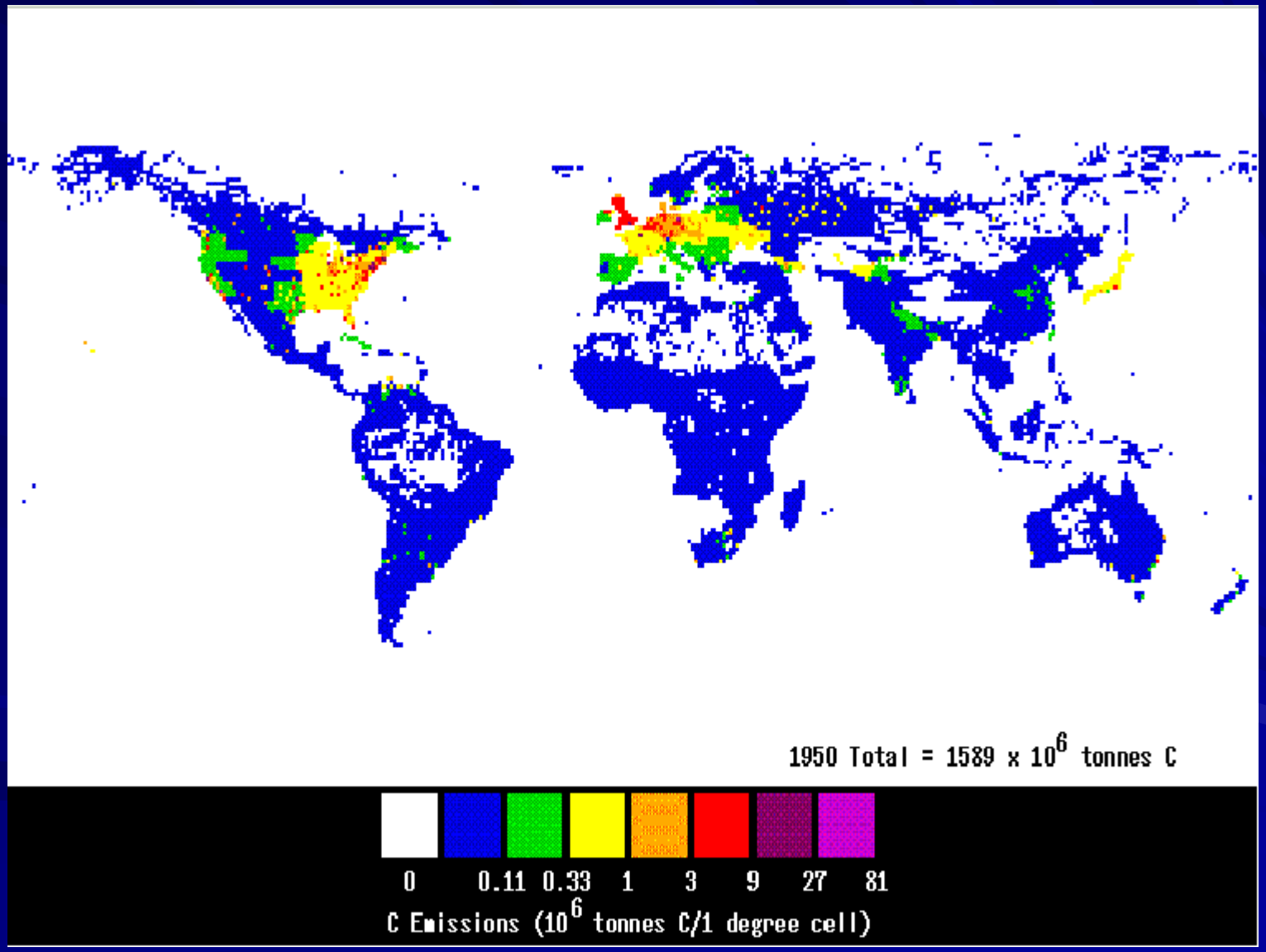


Recent Trends in Atmospheric Carbon Dioxide - Mauna Loa

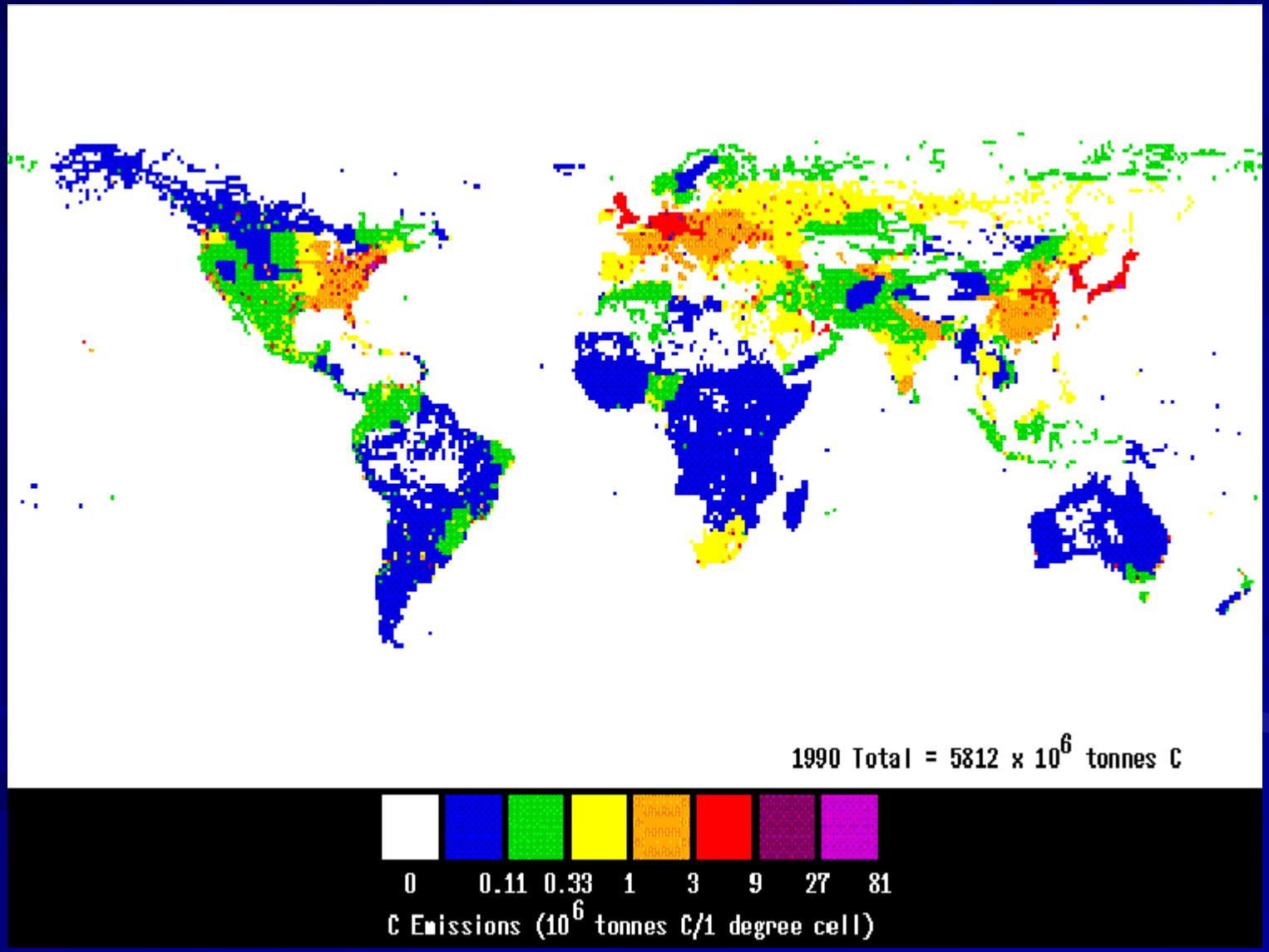


The graph shows recent monthly mean carbon dioxide measured at Mauna Loa Observatory, Hawaii.

1950


1950 Total = 1589 x 10^6 tonnes C
0
0.11
0.33
1
3
9
27
81
C Emissions (10^6 tonnes C/1 degree cell)

1990


1990 Total = 5812 x 10^6 tonnes C
0
0.11
0.33
1
3
9
27
81
C Emissions (10^6 tonnes C/1 degree cell)

Methane is Also Important

NATIONAL GEOGRAPHIC NEWS
REPORTING YOUR WORLD DAILY

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Global Warming Feedback Loop Caused by Methane, Scientists Say

Elizabeth Svoboda
for National Geographic News
August 29, 2006

In the ongoing debate over glo
dangerous of the atmosphere'

But methane, a greenhouse gas 2

Enlarge Photo

Email to a Friend

RELATED

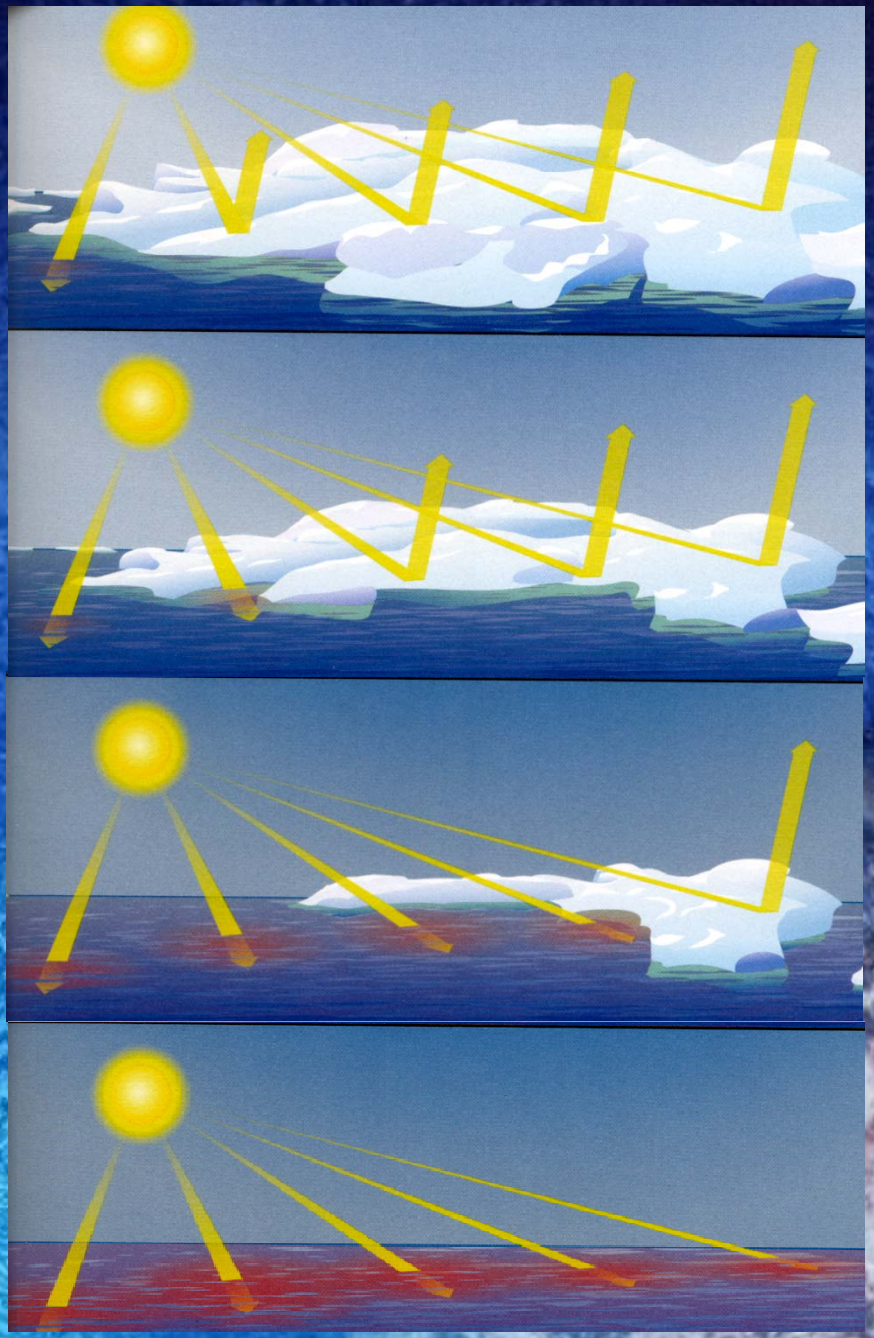
- **"But methane, a greenhouse gas 20 times more potent than carbon dioxide, might be even more problematic [than CO_2]. …**
- **"More methane is released into the atmosphere from ocean deposits during periods of warming than previously thought.**
- **"This expelled methane increases temperatures and releases more methane, creating a positive feedback loop."**

The Permafrost Effect

- In many areas of the world, methane is trapped on the land
- In frozen soil for eons of time
- A warming Earth melts the permafrost, releases the methane into the atmosphere
- Other deposits of methane are similarly released as the globe continues warming

Arctic Sea Ice

- The ice is about 60% reflective, 40% absorbing
- The dark blue sea is about 6% reflective, 94% absorbing
- As the ice melts, more solar is absorbed, warming the water and melting more sea ice



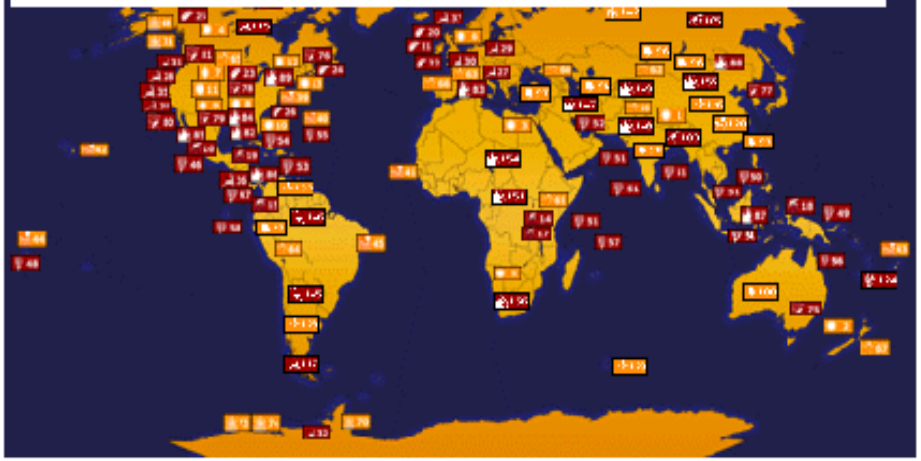
Acceleration

- Melting permafrost and melting sea ice increase the rate of warming
- The warmer it is, the greater the release of global warming gases
- The greater the rate of ice melting
- These are called positive feedback loops
- Scientists are alarmed that the rate of change today is faster than expected a decade ago

GLOBAL WARMING: Early Warning Signs

"An increasing body of observations gives a collective picture of a warming world and other changes in the climate system."

Intergovernmental Panel on Climate Change (IPCC), 2001



This map illustrates the local consequences of global warming.

NEW POINTS!

PHOTOS!

- Home
- About the map
- Regions
  - Africa
  - Antarctica
  - Asia
  - Central America
  - Europe and Russia
  - North America
  - Oceania
  - South America
- Fingerprints
- Harbingers
- Selection Criteria
- References
- Organizations
- Get a copy of the map
- Contact us

Tip of the Iceberg

- The metaphor is apt
- Global warming, while serious and dangerous, is but the tip of a much larger iceberg
- We are systematically taking apart the life-support system for humanity

Report on Global Ecosystems Calls for Radical Changes

Earth's Sustainability Is Not Guaranteed Unless Action Is Taken to Protect Resources, Experts Say

By Shankar Vedantam
Washington Post Staff Writer
Wednesday, March 30, 2005; Page A02

Many of the world's ecosystems are in dange
generations unless radical measures are implem
them, according to the most comprehensive analysis ever conducted of how the world's oceans, dry lands, forests and species interact and depend on one another.

Many of the world's ecosystems are in danger and might not support future generations….

Global Ecosystem Report, cont.

- About 60 percent of the planet's "ecosystem services" .... are being degraded or used unsustainably...
- The report warns of ***dangerous environmental surprises***:
  - the sudden collapse of fisheries
  - the appearance of "dead zones" in coastal waters
  - outbreaks of new and reemerging diseases like SARS
  - regional shifts in climate
- "There is no simple fix to these problems" the report said.
- “Radical measures” will be needed.

RANDOM SAMPLES

Edited by Jocelyn Kaiser

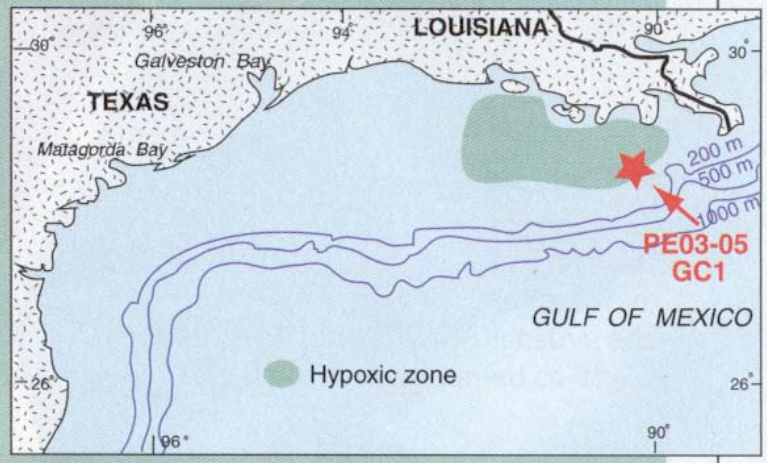
Gulf's Dead Zone Worse in Recent Decades

A seasonal dead zone in the northern Gulf of Mexico developed occasionally in the 1800s, according to a new study. But its data suggest that the zone has become more intense in the last few decades as farmers cranked up fertilizer use.

Coastal bottom waters off Louisiana now become depleted of oxygen almost every summer when nutrient-rich Mississippi River water causes populations of tiny marine plants called phytoplankton to explode. When they die, their decomposition sucks oxygen from the bottom waters. Fish and other animals then flee the area.

Most scientists believe that chemical fertilizer is a major cause of the seasonal dead zone, but the fertilizer industry and a few scientists are skeptical (*Science*, 9 February 2001, p. 968). To probe past conditions, a team led by micropaleontologist Lisa Osterman of the U.S. Geological Survey in Reston, Virginia, took sediment cores from the consistently hypoxic zone. They dated cross sections and counted three species of tiny animals called foraminifers that tolerate low-oxygen waters.

As far back as 1823, the hardy foraminifers thrived during Mississippi River flood years, suggesting that nutrients in floodwaters can



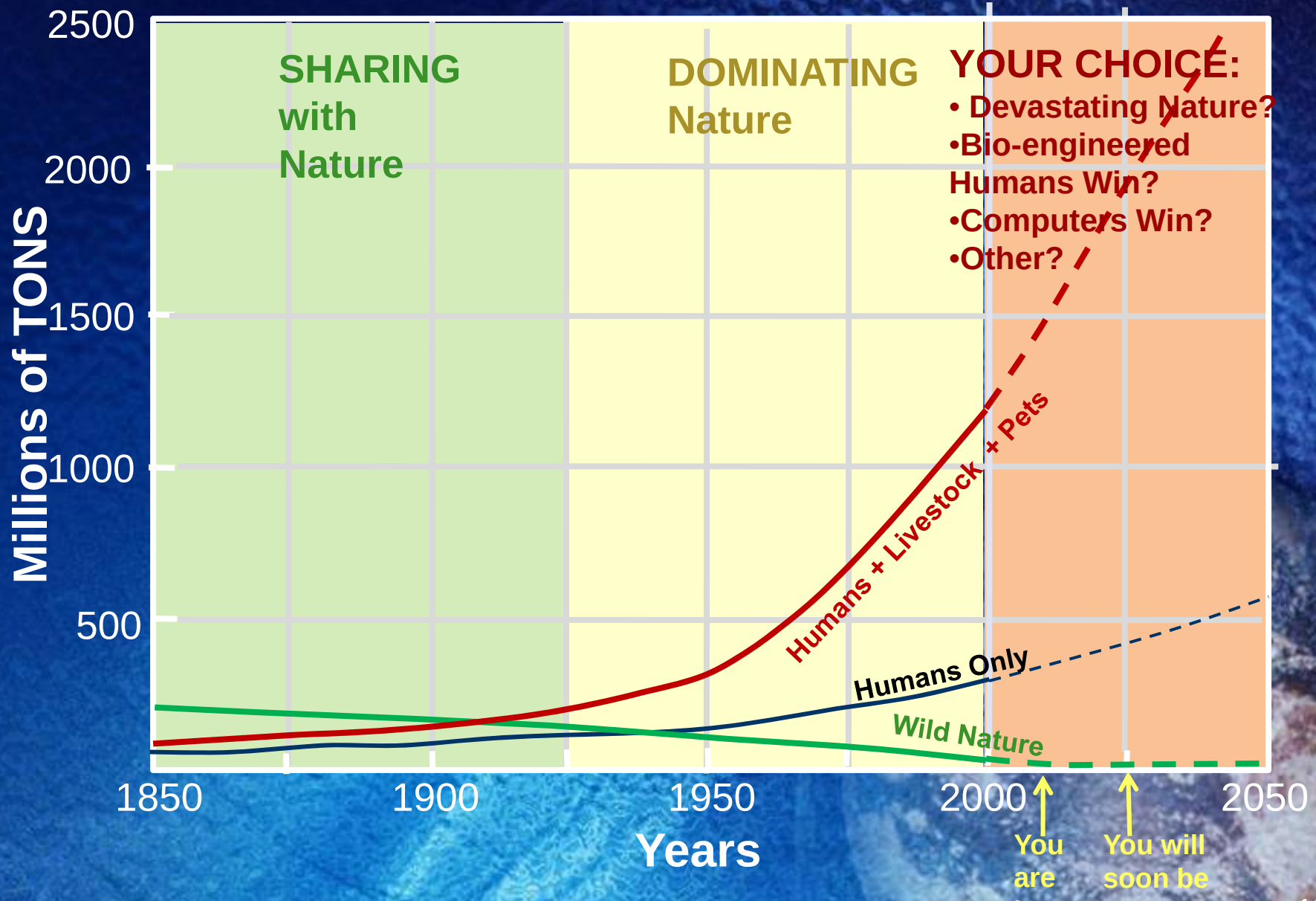
Coring spot.

Paul MacReady

- Dr. MacReady was an award-winning physicist and aeronautic engineer.
- In 1977, his Gossamer Condor won an award for the first sustained, controlled human-powered flight.
- Early on, he developed a powerful concern for the human-altering of our life-support system
- Summarized in the following chart

Nature vs. Humans by Paul MacReady

(Weight of all air and land vertebrates)



Daniel Quinn

- Teamed with ecologist Alan Thornhill
- Made a video on Food & Population
- Concluded:

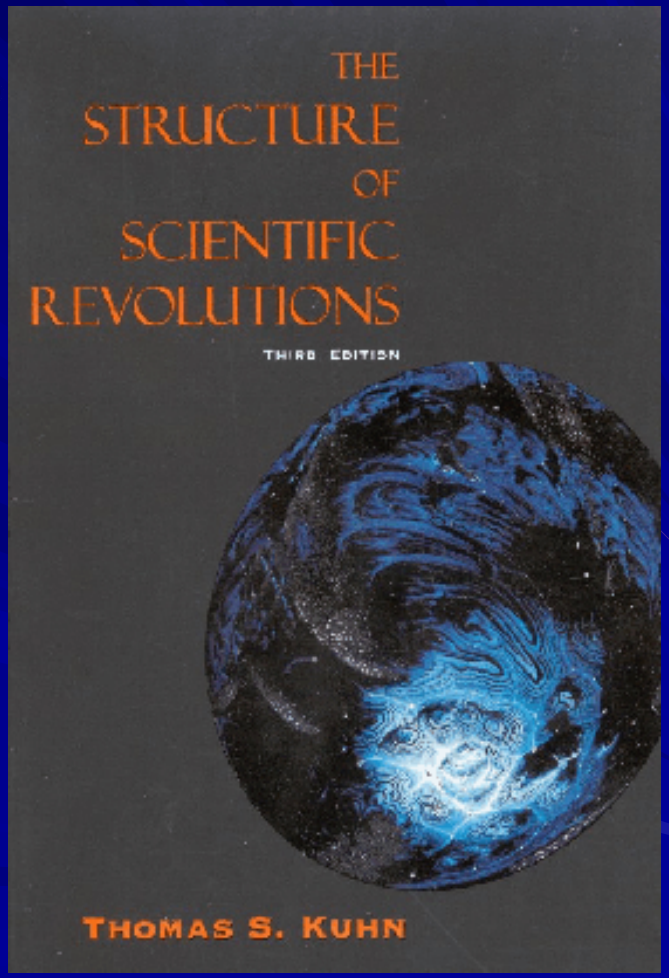
Humanity is systematically replacing nonhuman biomass with human biomass

Symptoms of a Larger Disease

- **The illness:** A faulty paradigm for society
- The very structure of our industrialized world is damaging the Earth and its ecosystems
- Apollo program showed us:
  - Our huge planet is but a tiny speck in the vastness of space
- The ecosystems of Spaceship Earth are our life-support system.
- If the **societal paradigm** is wrong, how do we fix it?

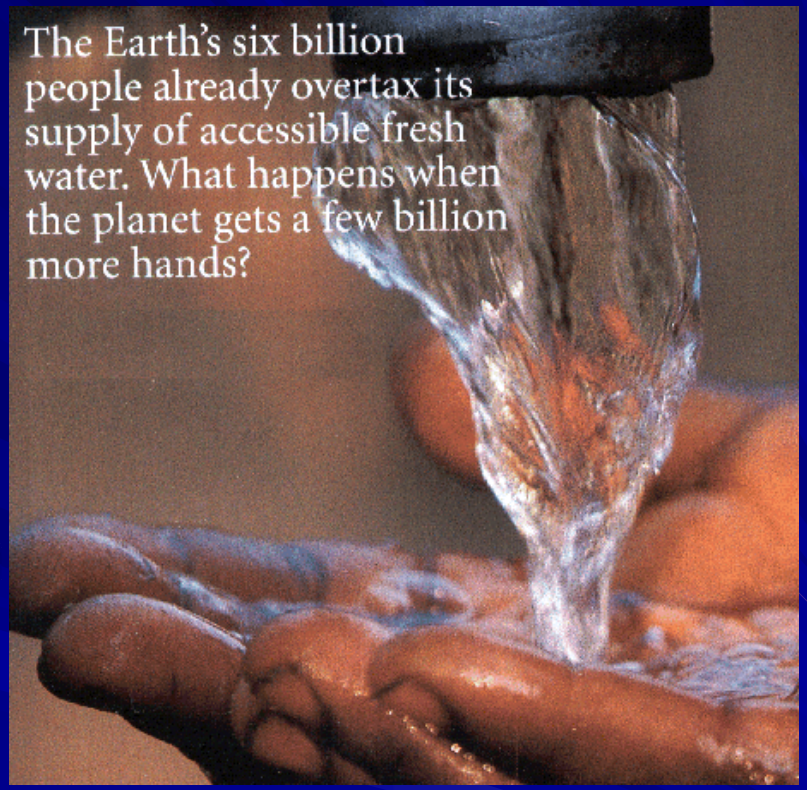
Paradigm Shifts

- Thomas Kuhn wrote *The Structure of Scientific Revolutions*.
- In it he says:
- What ultimately causes a paradigm to change is the accumulation of anomalies:
  - observations that do not fit into and cannot be explained by the prevailing paradigm.
- The anomalies have to be presented over and over because there is a social determination not to see them.



Our Anomalies

- Global Warming and its consequences:
  - sea level rising
  - ice sheets melting
  - more extreme weather
  - spreading deserts
  - extinctions at mountaintops
- Stratospheric Ozone depletion
- Oil depletion and the severe political and economic turmoil certain to result
- Toxic chemicals injected into the global biosphere
- Declining fresh drinking water



The list goes on and on and on….

- Freshwater shortages commonplace around the globe
- Depleting fisheries
- Species extinction at the rate of 200 per day
- Losses of wilderness area
- Degradation of national parks

MEXICO CITY'S LEAKY SINK
Population booming as water pipes crumble, Mexico City must truck water to many residents. Once called the Venice of the

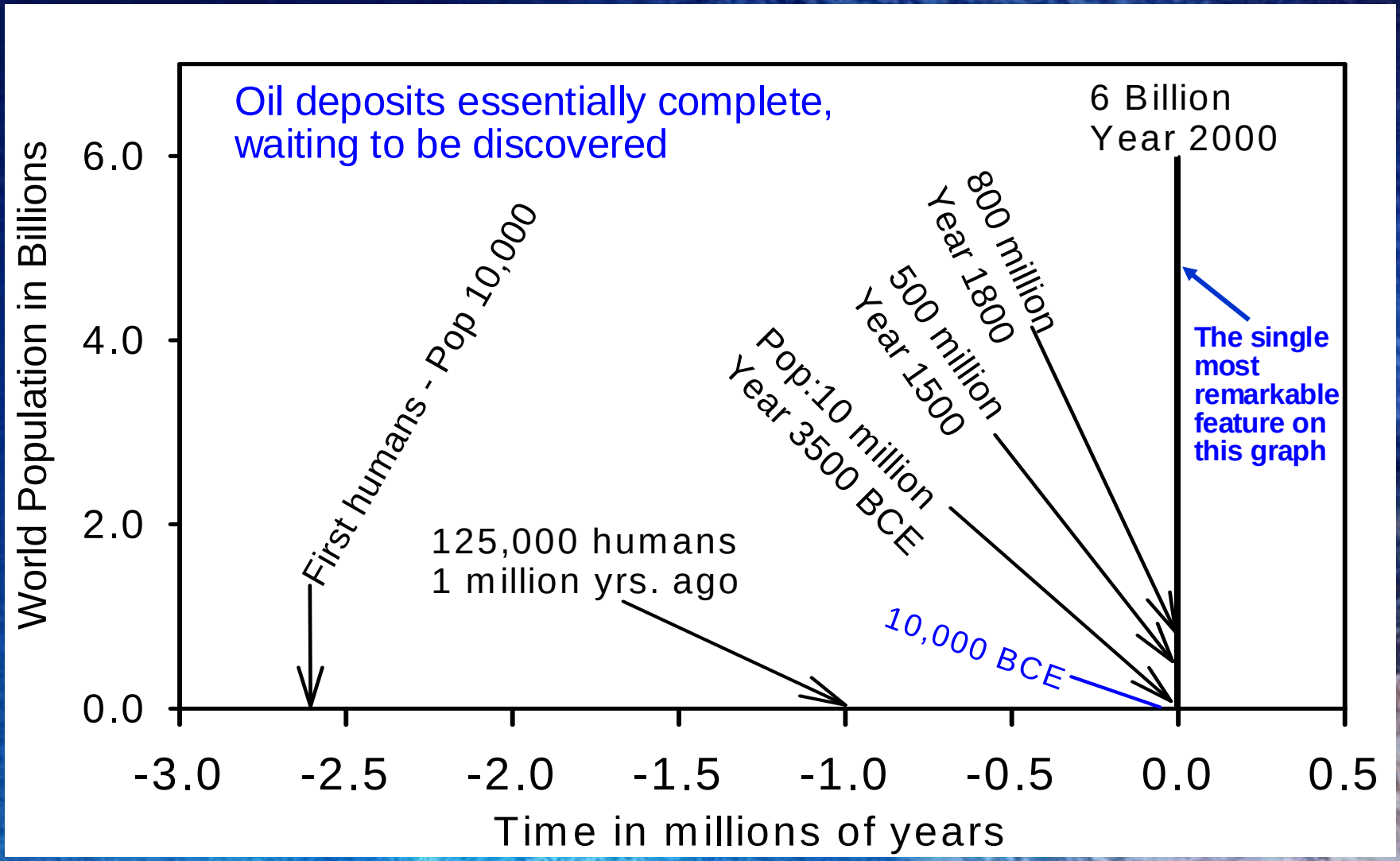
These "anomalies" are the symptoms of a faulty paradigm — an Industrial Growth Society gone wrong.

Problem Summary

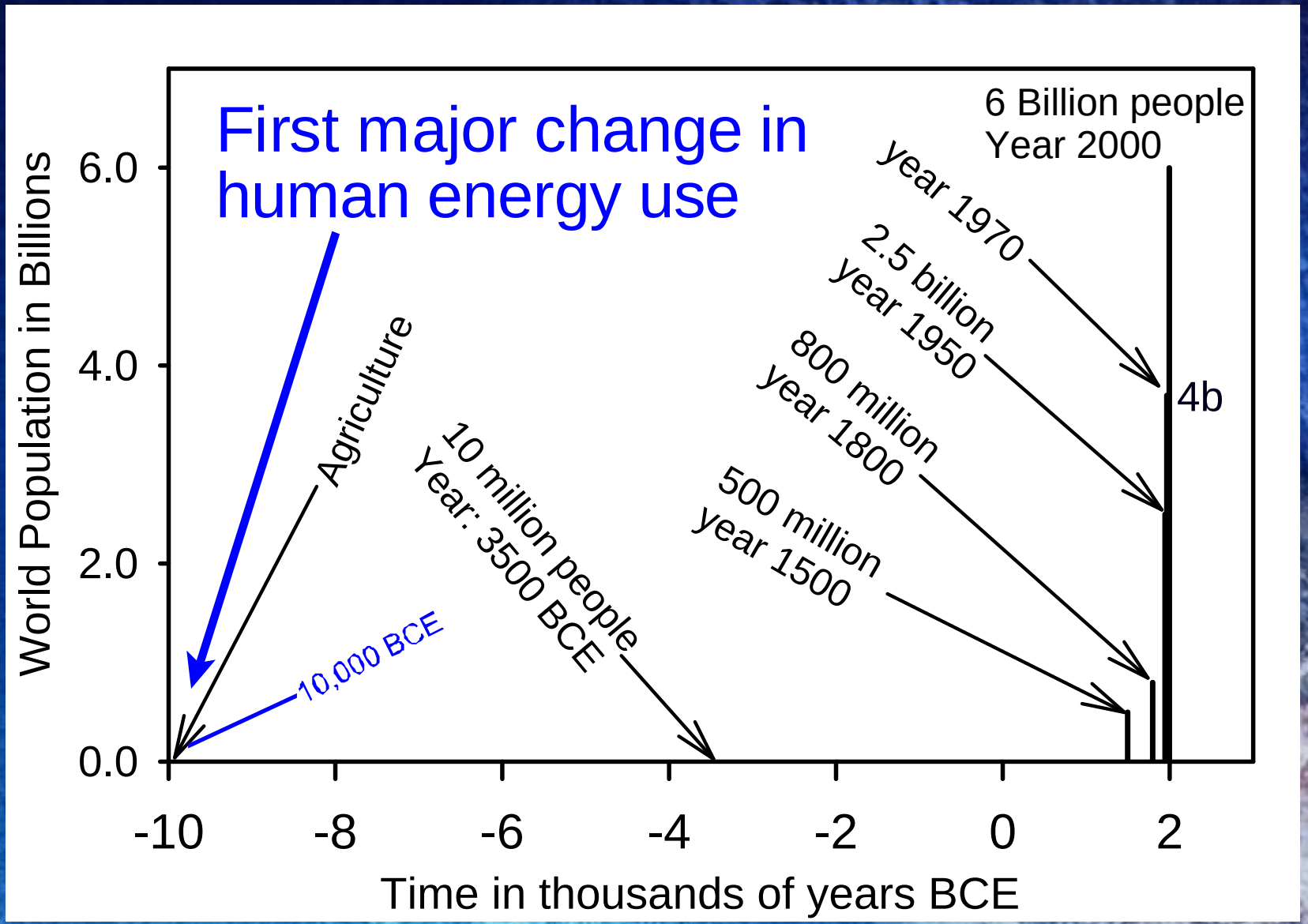
- **We are systematically taking apart the life-support systems of the planet:**
- Increasing human population means:
- Expanding needs for food, leading to:
- Conversion of diverse ecosystems to crop monocultures and human habitats. The result:
- Biodiversity is declining – human biomass expanding.

How It All Happened

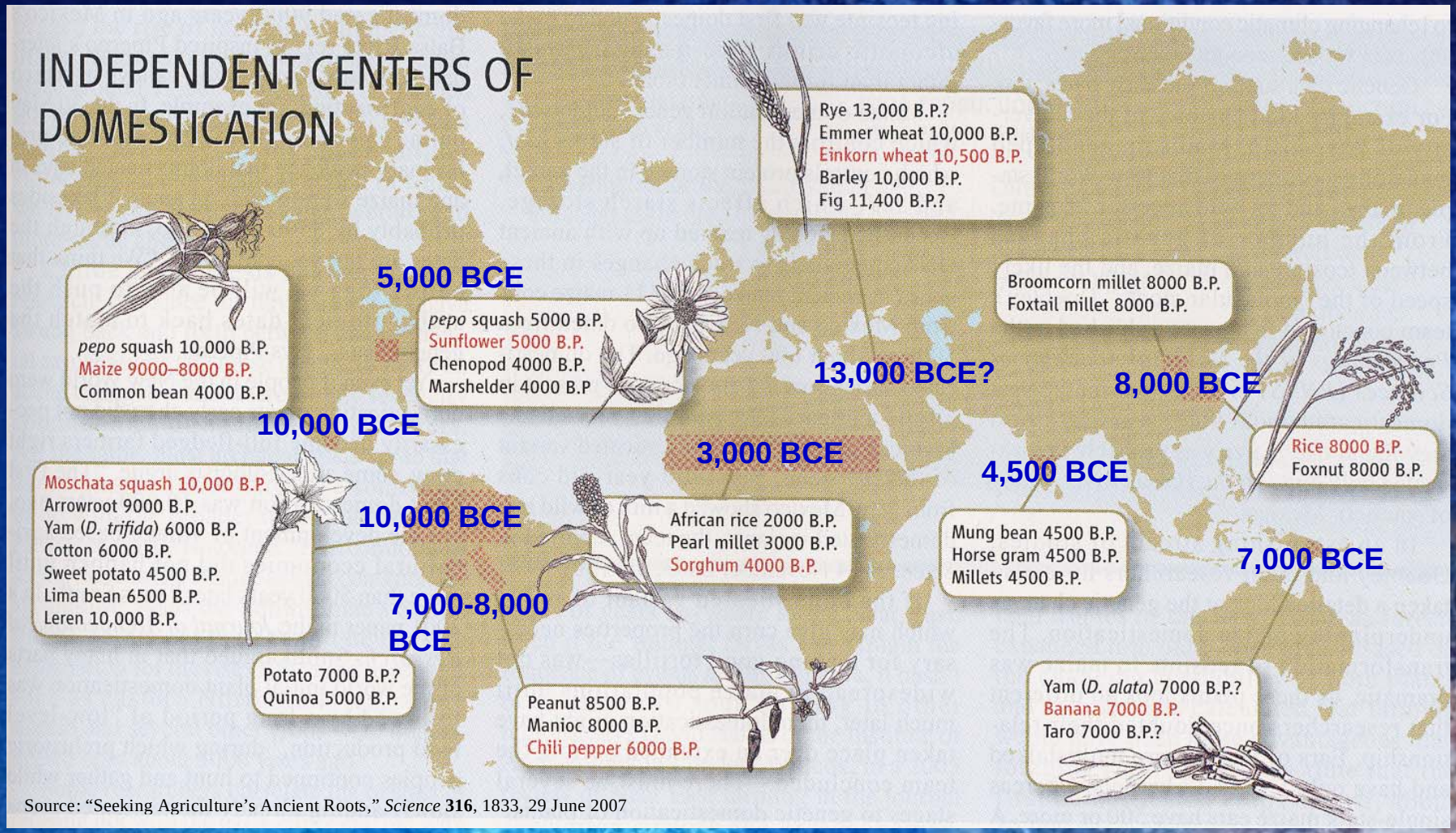
Human History = Hunters & Gatherers



Civilization History



Origination of Cultivated Crops

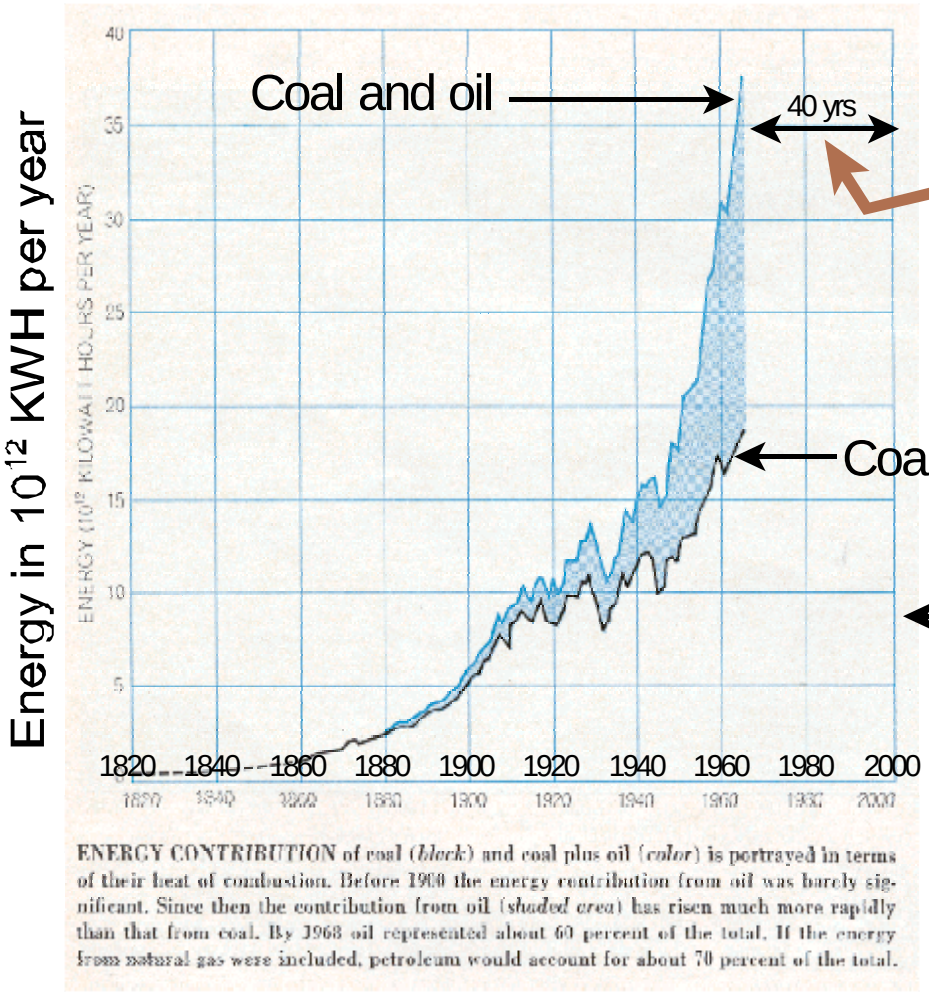


Source: "Seeking Agriculture's Ancient Roots," *Science* **316**, 1833, 29 June 2007

An important feature of civilization: Appetite for energy is insatiable & growing

- Agriculture
- Burning wood
- Increasing use of fossil fuels.
- Energy use has paralleled an amazing growth in human population.
- When the fossil energy starts declining, what will happen to population?

Exponential Growth of Coal and Oil



What do you think happened in the next 40 years?

And what will happen 40 years after that?

M. King Hubbert, "The Energy Resources of the Earth," *Scientific American*, September 1971, pp. 60-70.

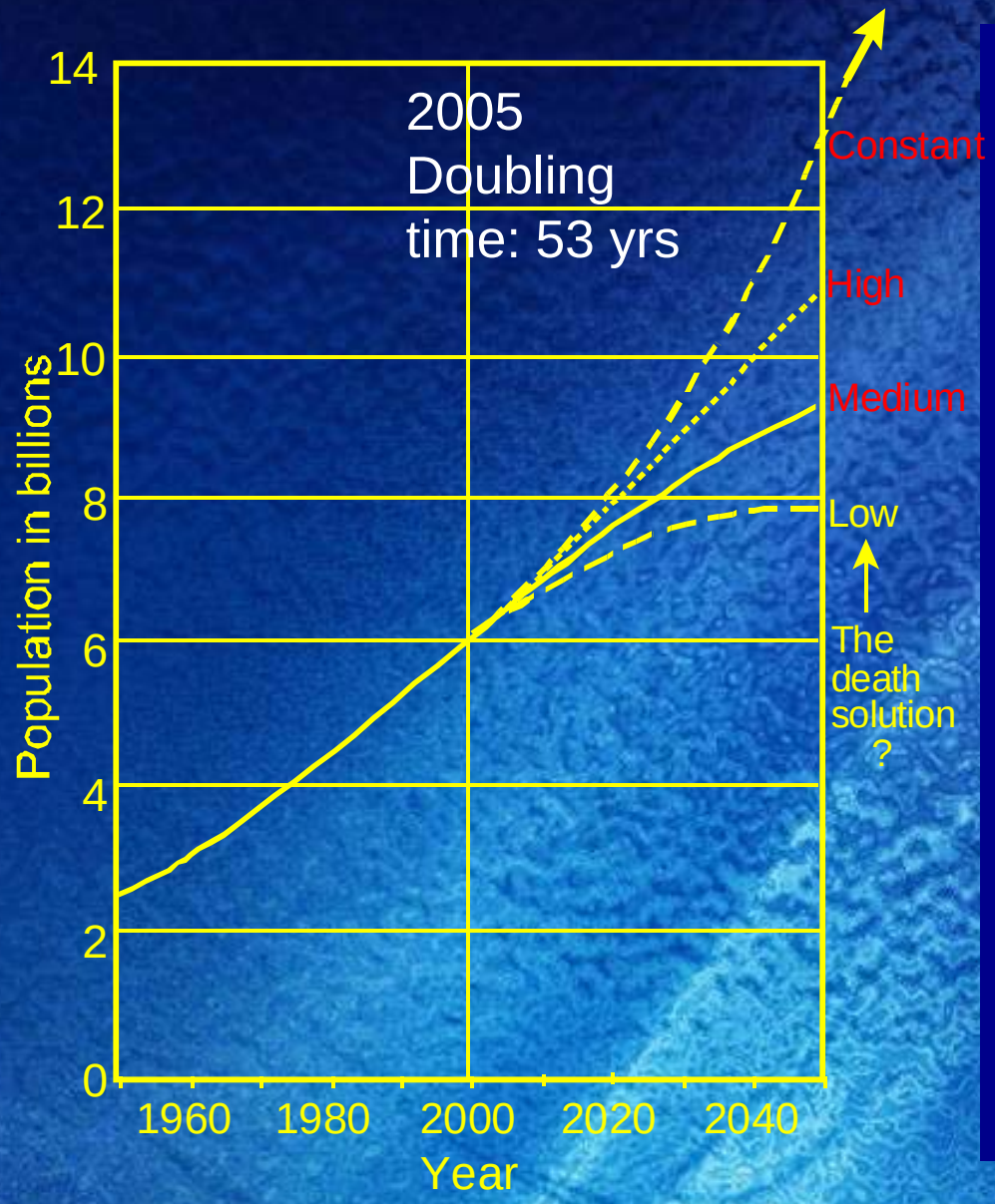
Future Growth in World Oil Demand

- Petroleum powers most transportation. It supplies the petrochemical industry.

- Total Demand for Oil =
  Per capita demand X World Population

- Future growth depends on both of these

UN: World Population Growth Projection



The projection uses four assumptions about average future fertility rates.

The "constant" rate is the fertility in the year 2000.

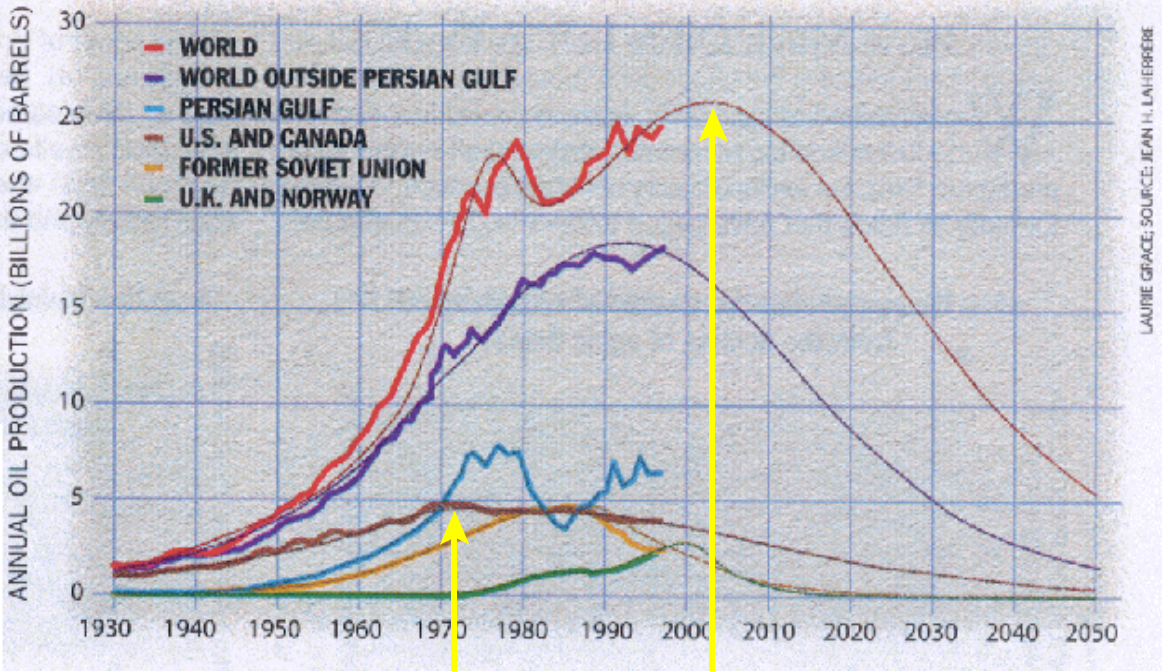
With modest effort, some believe that the "High" rate is possible, a doubling to 11 billion by the middle of the century.

To achieve the "medium" rate will require considerable extra effort toward family planning and birth control around the world.

Peaking and Decline of World Oil

1998 Projection by Campbell and Laherrere

GLOBAL PRODUCTION OF OIL, both conventional and unconventional (*red*), recovered after falling in 1973 and 1979. But a more permanent decline is less than 10 years away, according to the authors' model, based in part on multiple Hubbert curves (*lighter lines*). U.S. and Canadian oil (*brown*) topped out in 1972; production in the former Soviet Union (*yellow*) has fallen 45 percent since 1987. A crest in the oil produced outside the Persian Gulf region (*purple*) now appears imminent.



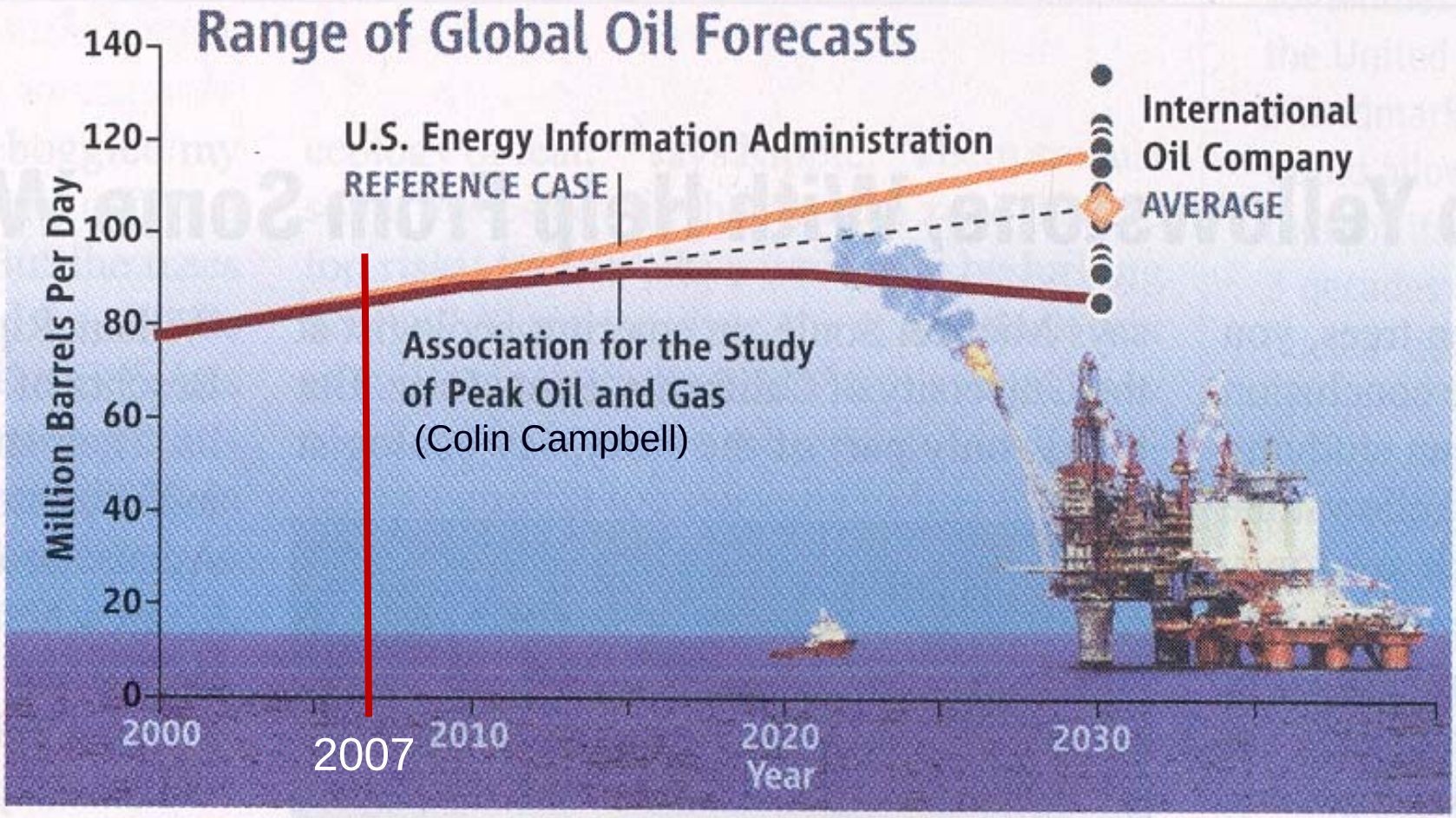
U. S. production peaked in 1972, only 3 years after 1969, the year Hubbert predicted (in 1956) it would happen.

C. J. Campbell and J. H. Laherrere, "The End of Cheap Oil," *Scientific American*, March 1998, pp. 78-83.

U. S.+ Canada peak

World peak

Current Prospects for Peak Oil



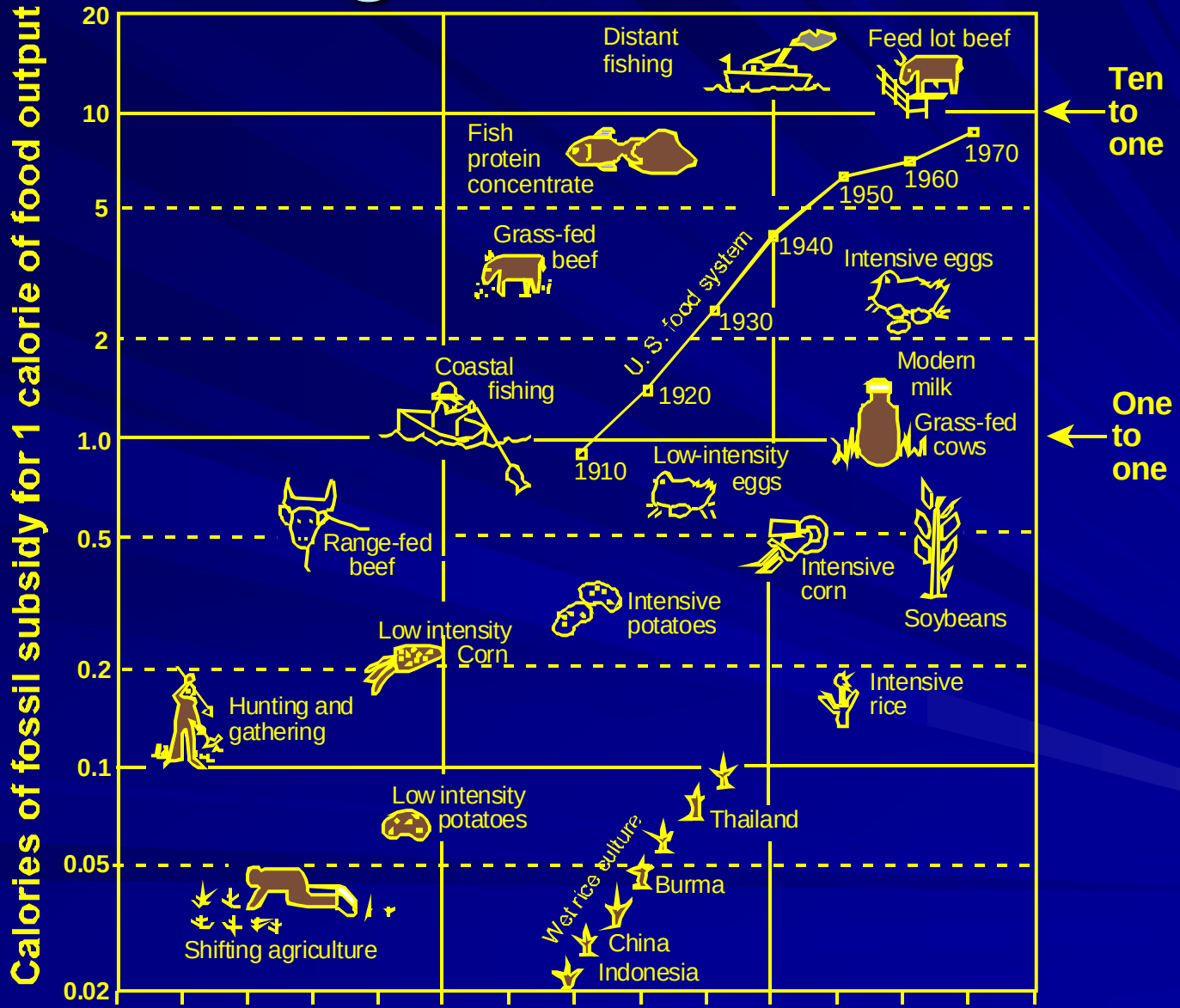
Lower expectations. Oil companies tend to forecast that oil production in 2030 will be below the official U.S. forecast but above pessimists' prediction.

SCIENCE **317**, 437, 27 JUL 07

Human Uses of Petroleum

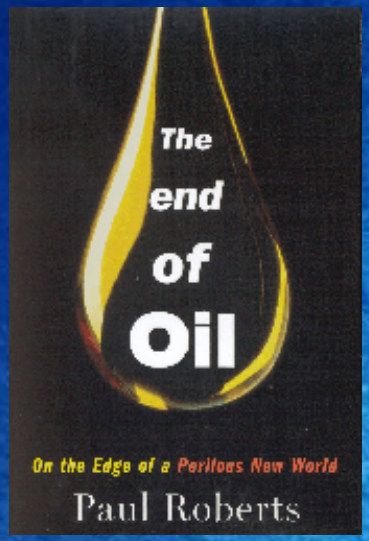
- Fuel
- Plastics
- Textiles
- Pharmaceuticals
- Fertilizer
- Pesticides & herbicides
- Chemical industry feedstocks
- Fossil fuel subsidy to food production
- When these cost a lot more, what happens to economic growth?

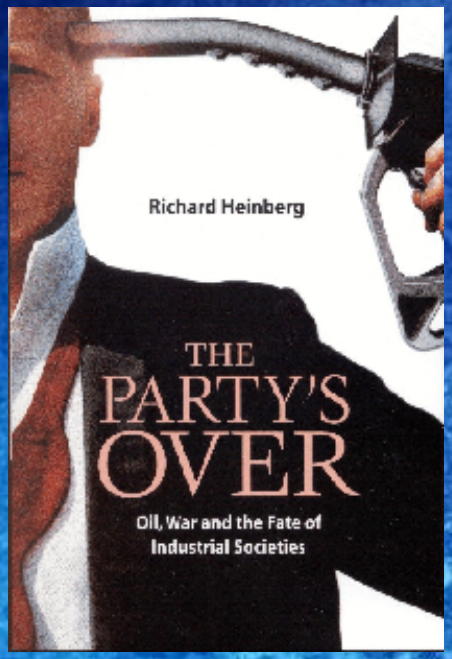
We're eating oil, not solar energy

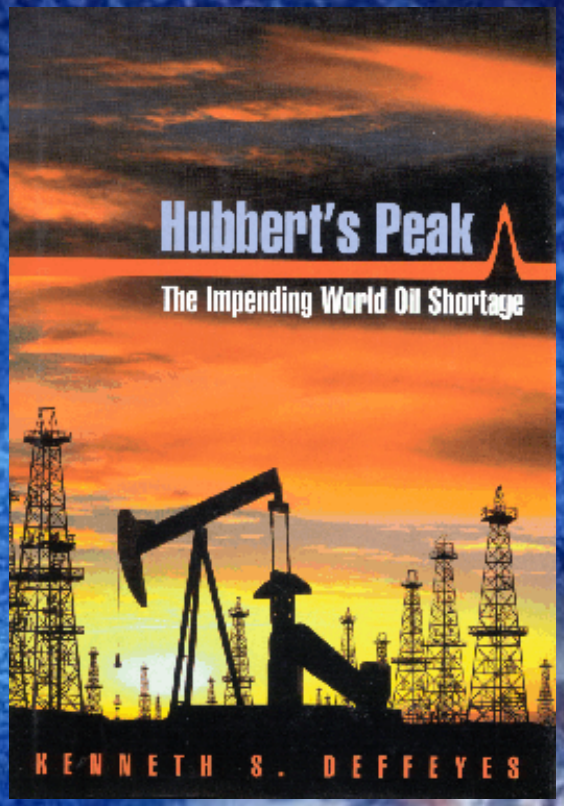


Source: Steinhart and Steinhart (1974). *The Fires of Culture: Energy Yesterday and Tomorrow*. Wadsworth Publishing.

It's not like we haven't been warned!





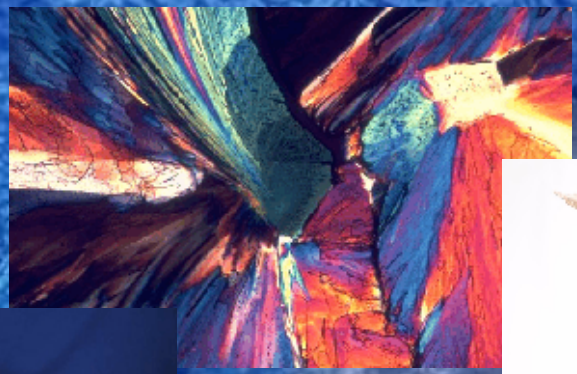


Discussions about "Peak oil" are all over the internet

Civilization has been good to us







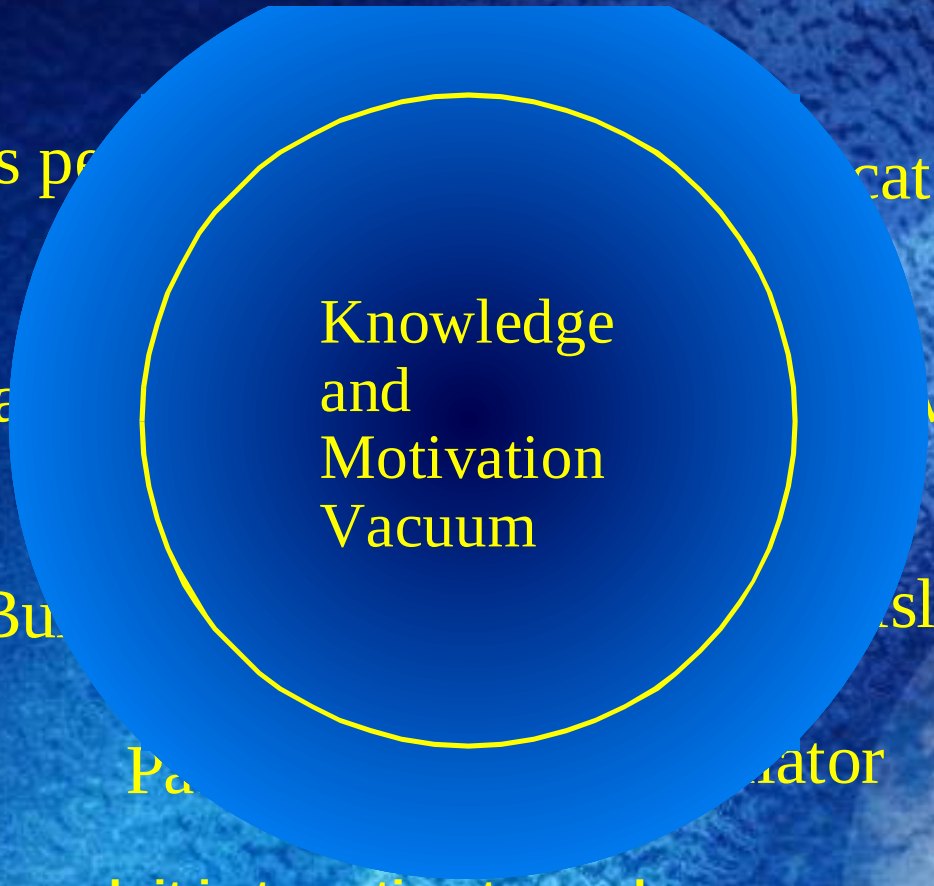


Great works of art, music, sculpture, architecture, dance, science, technology, knowledge, communication

But we need to re-examine our assumptions and our directions

- We're killing our world
- How can we stop the degradation while still living well?
- We need global and local discussions of the problems and the solutions

The Circular Chain of Inaction



Though it is tempting to work on one link in the chain, *all* must be addressed.

The kinds of change needed

- Stop the driving force: world population growth
- Protect habitats, reduce species extinctions
- We need strong and steady increases in the price of fossil fuels.
  - Though some price rises will come from market forces, these will be too slow and weak
  - We'll also need vigorous government action
  - Green taxes are widely used in Europe.
  - Revenues can go to energy conservation and renewable energy development
- Radical energy conservation and recycling

The kinds of change needed, continued

- Radical conversion to renewable energy
- Rethinking our values and approaches
  - solar is not just another form of oil. It has its own environmental impacts.
- We need massive public education and public discussion on future directions and policy

- Do you see much on this in the media?

Policy Coupled to Action

- First we need the correct policies
- Then we need implementation plans
- Leaders to show the way and manage the effort are critical
- Once we get our direction right
- Individual action will be essential

A Powerful Guiding Principle

Energy Self-Sufficiency

For the Nation **For the State** **For the County**

Here's something you can really sink your teeth into:

No energy imported into Tennessee at all !!

- **BENEFITS:**
- **Increase employment locally**
- **No longer dependent on foreign countries**
- **Improve balance of payments**
- **Improve economic growth locally**
- **Cleaner air and water**
- **Reduce global warming**

The Media Are Critical

- The greatest mechanism for mass public education the world has ever known
- It is pervasive and effective
- What is it teaching us?
  - Materialism
  - Unlimited growth
  - Consume, consume, consume
- Do you see much Earth education?
- Or discussions of the huge crises facing us?
- Why not?
- Who owns the media?

We need massive public education on a variety of topics:

- Earth's environmental history
- Civilization's environmental history
- How the Earth operates
- Energy and where it comes from
- Likely consequences of declining fossil fuels
- What carrying capacity is and what true sustainability means
- etc.

Government action is crucial

- The role of government is to protect the general welfare
- The “free market” has little interest in the general welfare
- Government rules and regulations therefore are necessary to mitigate the excesses of the free market
- That’s why we have speed limits and stop signs.
  It’s why thieves go to jail.

Political Action

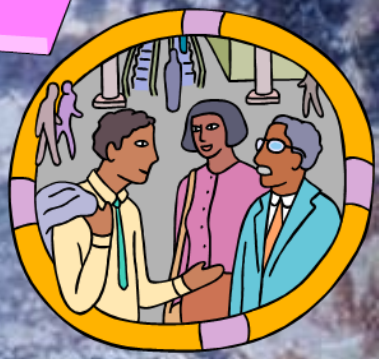
- Voluntary reforms are good, but the restructuring of society requires more than that.
- We need an informed, effective and long range public policy
  - toward real sustainability.
- GOOD, EFFECTIVE LEADERSHIP IS CRITICAL

Finally, What Can YOU Do? Begin with the obvious:

- Fuel-efficient vehicles, more walking, bicycling
- Replace light bulbs with Compact Fluorescent Lamps
- Become vegetarian, join community supported agriculture
- Recycle to the max
- Insulate your home
- Explain what you are doing to your neighbors & encourage them to do the same
- **Get politically active**





Then Spread Your Action Outward

- Join an environmental organization
- Talk to your teachers and administrators about more getting more Earth education
- Join a political party and green it
- Write letters to the editor
- Take a small group to give briefings to editorial boards
- Picket news organizations to give more coverage of these issues
- Write, phone, visit elected officials

Together We Can Make a Difference