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• Environmental Ethics and Land Management
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ENVR E-120

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Basic Concepts of Ecology

Timothy C. Weiskel

Session 2
28 September 2004

Harvard University Extension School
Fall Semester 2004

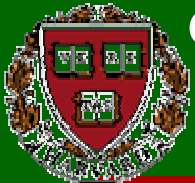


What this course is NOT

This course is NOT:

- An introduction to environmental studies
- A field or laboratory course in environmental science
- A course in environmental policy making.
- A course in the history of environmentalism
- A survey course in the literature of environmental ethics

In effect, it will help you place all these other kinds of courses in perspective.



This cannot and
will not
continue....

The
question is:

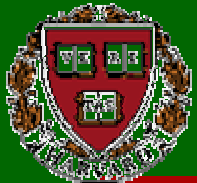
Can we
devise an
ethic in
the time
we have
remaining
to govern
human
behavior
and
preserve a
human
presence...



...in this
complex and
precious
ecosystem
we inhabit?

Who Should Take This Course?

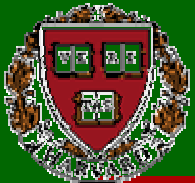
- Anyone with an interest in the survival of the human enterprise.



Who Should Take This Course?

- Anyone with an interest in the survival of the human enterprise.

What will be expected of you?

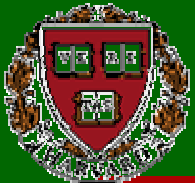


Who Should Take This Course?

- Anyone with an interest in the survival of the human enterprise.

What will be expected of you?

- Nothing less than the your total attention and complete devotion to the issues raised here for the rest of your life.



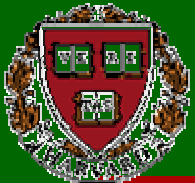
Who Should Take This Course?

- Anyone with an interest in the survival of the human enterprise.

What will be expected of you?

- Nothing less than the your total attention and complete devotion to the issues raised here for the rest of your life.

Will there be a test?



Who Should Take This Course?

- Anyone with an interest in the survival of the human enterprise.

What will be expected of you?

- Nothing less than the your total attention and complete devotion to the issues raised here for the rest of your life.

Will there be a test?

- You bet, but not one we will administer...



Who Should Take This Course?

- Anyone with an interest in the survival of the human enterprise.

What will be expected of you?

- Nothing less than the your total attention and complete devotion to the issues raised here for the rest of your life.

Will there be a test?

- You bet, but not one we will administer....
- You will have to live with the mind you furnish here for the remainder of your days. Take care...



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-
-

First and foremost we must remember that...

Environmental Ethics must cope with Vastly Different Scales of Time & Space

Cosmic time scales - the present to 10^9 - 10^{10} BP



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Environmental Ethics must cope with Vastly Different Scales of Time & Space

Cosmic time scales - the present to 10^9 - 10^{10} BP



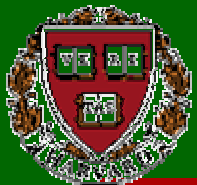
- What kinds of events occur in this time frame?



Environmental Ethics must cope with Vastly Different Scales of Time & Space

Cosmic time scales - the present to 10^9 - 10^{10} BP

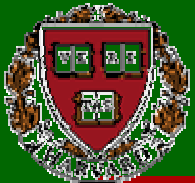
- What kinds of events occur in this time frame?
- Over what spacial ranges do these conditions apply?



Environmental Ethics must cope with Vastly Different Scales of Time & Space

Cosmic time scales - the present to 10^9 - 10^{10} BP

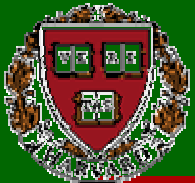
- What kinds of events occur in this time frame?
- Over what spacial ranges do these conditions apply?
- What -- if anything -- is the human significance of events that occur at cosmic time and spacial scales?



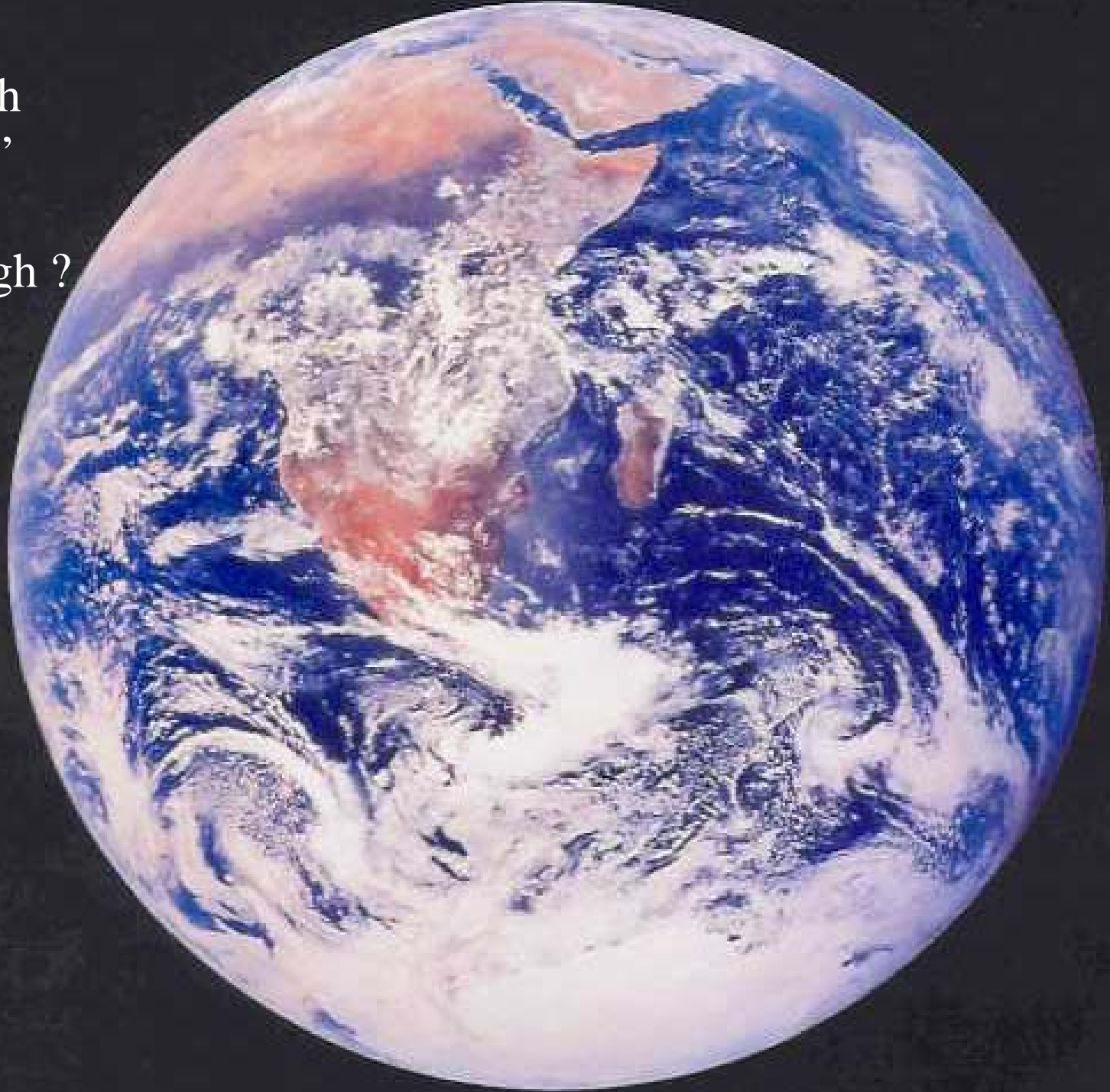
Environmental Ethics must cope with Vastly Different Scales of Time & Space

Cosmic time scales - the present to 10^9 - 10^{10} BP

- What kinds of events occur in this time frame?
- Over what spacial ranges do these conditions apply?
- What -- if anything -- is the human significance of events that occur at cosmic time and spacial scales?
- Do humans have any importance beyond very short temporal scales?



Is the
“Earth
scale”
large
enough ?





Not quite. If we look around a little bit we realize we have close neighbors in space. These neighbors have to be accounted for in any comprehensive moral system.





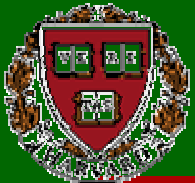
Where did our nearest space ‘neighbor’ come from?
Does its history have anything to do with ours?





The moon was “thrown” into orbit as debris from a major meteor impact with the earth -- a major celestial collision.

Tim Weiskel - 19



BBC News | Sci/Tech | Earth smash spawned Moon - Netscape

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Wednesday, March 17, 1999 Published at 16:56 GMT

Sci/Tech

Earth smash spawned Moon



The Earth and Moon were once one

By BBC News Online Science Editor Dr David Whitehouse

The Moon was blasted away from the early Earth by a massive interplanetary collision, according to an idea which has received strong new support.

Sci/Tech Contents

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Moon's orbit betrays its violent birth



The Earth was hit by a Mars-sized body

By BBC News Online science editor Dr David Whitehouse

The mysterious tilt of the Moon's orbit around the Earth is probably due to the satellite's violent origin, say scientists writing in the current issue of the journal *Nature*.

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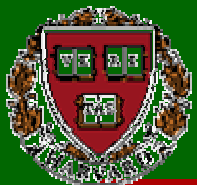
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Moon mission targets mystery
- ▶ [21 Jan 00 | Sci/Tech](#)
Moon glows red
- ▶ [22 Dec 99 | Sci/Tech](#)
Brightest Moon for decades

Internet links:

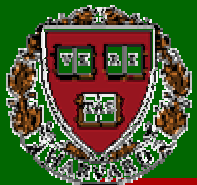
- ▶ [Nature](#)
- ▶ [NASA: Moon fact sheet](#)
- ▶ [Southwest Research Institute](#)

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Although “big events” like the cosmic encounter that produced the moon are very rare, other earth collisions with space debris are quite frequent, especially in the ‘asteroid belt.’



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Encounters are ‘inevitable’ ...



BBC News | SCI/TECH | Comets could have seeded life on Earth - Netscape

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BBC NEWS

You are in: [Sci/Tech](#)
Thursday, 5 April, 2001, 15:08 GMT 16:08 UK

Comets could have seeded life on Earth



Impacts with comets and asteroids were common during the Earth's youth

By BBC News Online science editor Dr David Whitehouse

By simulating a high-velocity comet collision with the Earth, a team of scientists has shown that organic molecules hitch-hiking aboard a comet could have survived an impact and seeded life on Earth.

The results add weight to the theory that the raw materials for life came from space.

“ This is the beginning of a new field of science ”

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- 24 Sep 98 | Sci/Tech Clues to life's origins
- 16 Jun 00 | Sci/Tech Sugar in space sweetens chances of life
- 29 Jan 01 | Sci/Tech 'Cells' hint at life's origin

Internet links:

- American Chemical Society
- More: comets and life

The role of comets in the history of the earth is still being discovered.

Some suggest that life itself is extraterrestrial in origin....

What are the ethical implications, if any, of this?


National Museum of Natural History - Dinosaur Extinction - Microsoft Internet Explorer

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Address http://www.nmnh.si.edu/paleo/blast/asteroid_hyp.htm Go


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The Asteroid Hypothesis

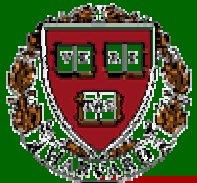


This conceptual sketch depicts the asteroid moments before impact, as it takes aim on Mexico's Yucatan coastline. Approaching at an angle from the southeast, it will send the main force of its impact northward in a fire storm over North America. The evidence has grown so overwhelming that few scientists dispute that an asteroid nearly 10 km (6 mi) wide slammed into what is now Mexico's Yucatan Peninsula.

The “Asteroid Hypothesis” is currently the leading explanation offered for the “extinction event” represented by the KT Boundary in the geological record. *

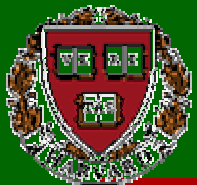


“Extinction events” are dramatic cases on cosmic intrusions into the history of life-forms on Earth, but smaller “events” have occurred as well...





How might cosmic events have shaped life's more recent history on Earth?



BBC News | SCI/TECH | Asteroids 'affected human evolution' - Netscape

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Thursday, 12 April, 2001, 10:36 GMT 11:36 UK

Asteroids 'affected human evolution'

Front Page World UK UK Politics Business **Sci/Tech** Health Education Entertainment Talking Point In Depth AudioVideo



A threat to our early ancestors?

By BBC News Online science editor Dr David Whitehouse

Impacts by asteroids may have affected the course of human evolution, according to two researchers studying how often the Earth has been struck in the past.

They say that rather than gradual and uninterrupted human evolution, the ascent of mankind could have been influenced by frequent cosmic catastrophes.

Their work, they say, explains one of the

“ It is sobering to

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- 26 Feb 01 | Sci/Tech UK asteroid response 'unsatisfactory'
- 04 Nov 00 | Sci/Tech Scientists revise asteroid warning
- 18 Sep 00 | Sci/Tech Call for asteroid defences

Internet links:

- John Moores University
- The Planetary Society
- Nasa: Asteroid impacts

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Some scientists are suggesting that cosmic events may well have directly affected the evolution of the *human* species. *

What if “we” emerged as a result of a cosmic event?

BBC News | SCI/TECH | No escaping asteroids - Netscape

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No escaping asteroids

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It hit the dinosaurs and it could hit us

By BBC News Online Science Editor Dr David Whitehouse

Whether an asteroid will hit the Earth is a question of when, not if.

Though it is an unlikely event, it will happen given enough time. We might be unlucky and it may occur next year, or we may have to wait a 100,000 years for a major impact.

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- 04 Jan 00 | Sci/Tech Saving the world from asteroids
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- 14 Apr 99 | Sci/Tech Earth set for close asteroid encounter
- 18 Nov 99 | Sci/Tech Fiery end for dinosaurs?

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Whatever their role in Earth's past, asteroids and meteors appear to be an ongoing "fact of life" on Earth. There is no "escaping" them. *

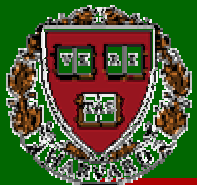
In fact there is a call for new defenses to cope with them. *



This is not just an idle
“theoretical” problem.



Consider what happened
in June 1908....





In 1908 the Earth experienced the largest explosion in “recorded history” ...

.... The trouble was that it wasn't *recorded* by many people at all.





Tunguska, Russia on
30 June 1908 -- (an
artist's impression).



BBC News | Sci/Tech | Return to Tunguska - Netscape

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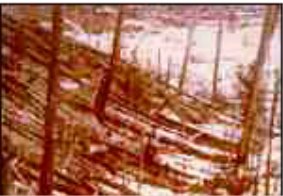
Return to Tunguska



Tunguska: 91 years after the impact

By BBC News Online Science Editor Dr David Whitehouse

Scientists hope to solve the mystery of the greatest cosmic impact of the century by undertaking an expedition to a remote region of Russia.



The impact happened on 30 June, 1908, at Tunguska in central Siberia. With no warning, a small comet or meteor hurtling through space collided with the Earth and exploded in the sky.

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There are now recent scientific expeditions to investigate what happened on June 30, 1908. *

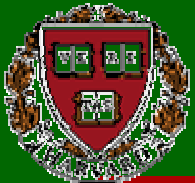
Consider recent Events

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We have other cosmic “issues”

But what of other cosmic “issues,” closer to home in both time and space?

What about our nearest neighbor beyond the moon -- upon which all life on Earth’s surface depends?



BBC News | Sci/Tech | Scientists to forecast sun eruptions - Netscape

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Front Page Tuesday, March 9, 1999 Published at 17:56 GMT

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Sci/Tech

Scientists to forecast sun eruptions



S-shaped swirls on the Sun's surface spell danger

Colossal solar storms which can destroy communication satellites and knock out power grids on Earth may be predictable.

Scientists have found that unusual

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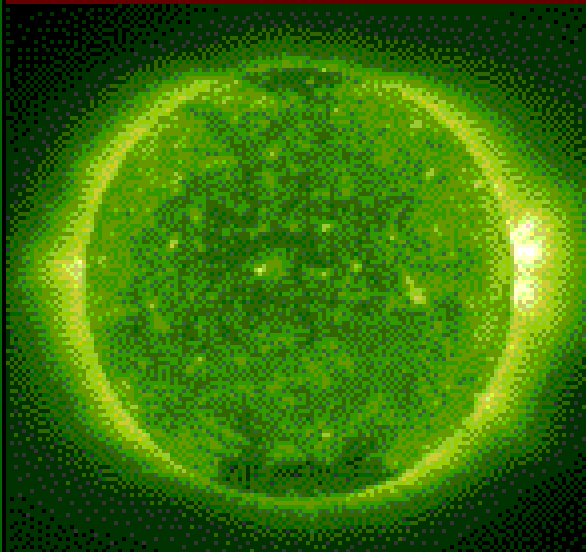
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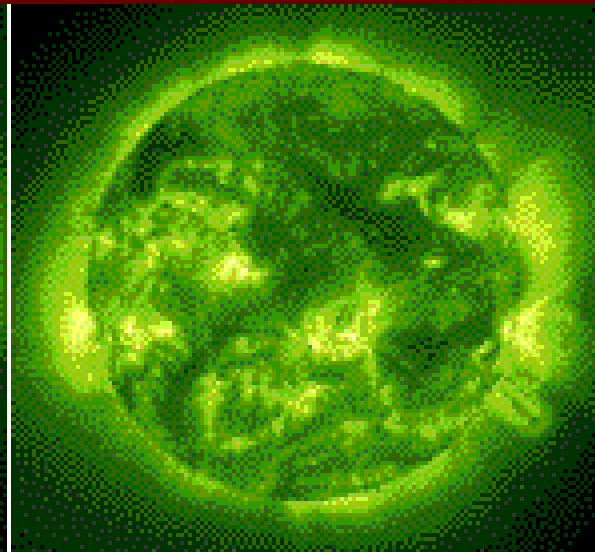
What are “sun eruptions”? Why should we care?

*

The sun appraoching solar maximum

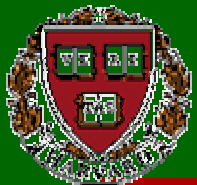


Early 1997



Late 1999

SOURCE: SOHO/ESA/NASA



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GLOBAL CLIMATE CHANGE

Thursday, 16 November, 2000, 17:43 GMT

Viewpoint: The Sun and climate change

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The sun approaching solar maximum



Early 1997 Late 1999
SOURCE: SOHO/ESA/NASA

Satellites now monitor solar activity constantly

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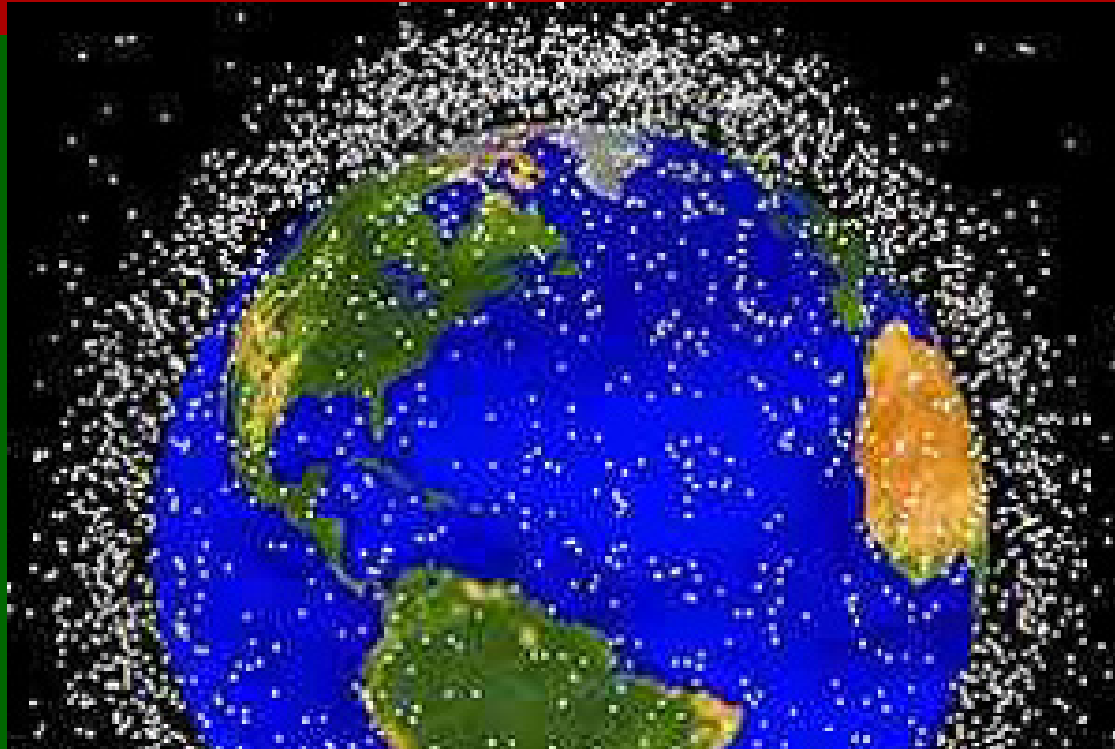
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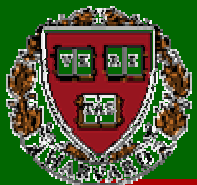
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The sun most certainly affects climate -- in ways we do not fully understand.



The sun's "weather" also affects us quite directly in terms of how we communicate and "protect" ourselves on earth.

Tim Weiskel - 39



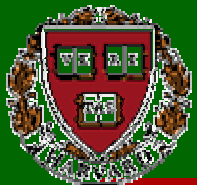
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Vastly Different Scales of Time & Space

Cosmic time scales - 10^{10} - 10^9 BP to present



Geologic time scales - 10^9 BP to present

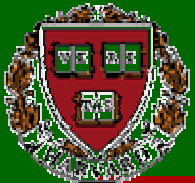


Vastly Different Scales of Time & Space

Cosmic time scales – 10^{10} and 10^9 BP - present

Geologic time scales - 10^9 BP to present

As with “cosmic” time scales and events, so too, we must consider “geological time” scales and events in developing an effective environmental ethic.



What are “geological events?”

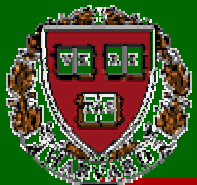


Courtesy Isaac Newton Group of Telescopes

Volcanoes
happen...

Volcanoes often
happen near
inhabited areas,
but have wide-
spread and
sometimes global
impacts. *

Tim Weiskel - 42



Distant and Invisible Volcanoes...

BBC News | SCI/TECH | Giant wave could threaten US - Microsoft Internet Explorer

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BBC NEWS

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Wednesday, 4 October, 2000, 18:06 GMT 19:06 UK

Giant wave could threaten US



The wave would sweep up to 20 km inland

A collapsing volcano in the Atlantic could unleash a giant wave of water that would swamp the Caribbean and much of the eastern seaboard of the United States, a scientist has claimed.

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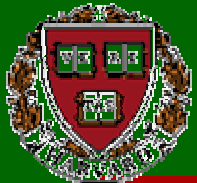
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- The Geological

javascript: void request_launch();

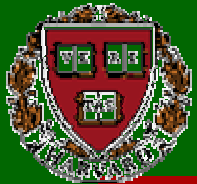
Internet

Tsumanis - giant waves or “walls of water” -- can be triggered by submarine volcanoes or earth slides provoked by volcanoes.

Some of these have received recent publicity. *







Vastly Different Scales of Time & Space

Cosmic time scales - 10^{10} - 10^9 - BP

Geologic time scales - 10^9 BP - present

Bioevolutionary time scales - 10^9 BP - present



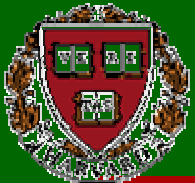
Vastly Different Scales of Time & Space

Cosmic time scales - 10^{10} - 10^9 - BP

Geologic time scales - 10^9 BP - present

Bioevolutionary time scales - 10^9 BP - present

Hominid time scales - 10^6 BP - present



Vastly Different Scales of Time & Space

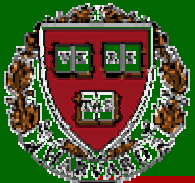
Cosmic time scales - 10^{10} - 10^9 - BP

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Hominid time scales - 10^6 BP - present

Cultural-Evolutionary time scales - 10^5 - 10^4



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Cosmic time scales - 10^{10} - 10^9 - BP

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Cultural-Evolutionary time scales - 10^5 - 10^4

Civilization time scales - 10^3



Vastly Different Scales of Time & Space

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Geologic time scales - 10^9 BP - present

Bioevolutionary time scales - 10^9 BP - present

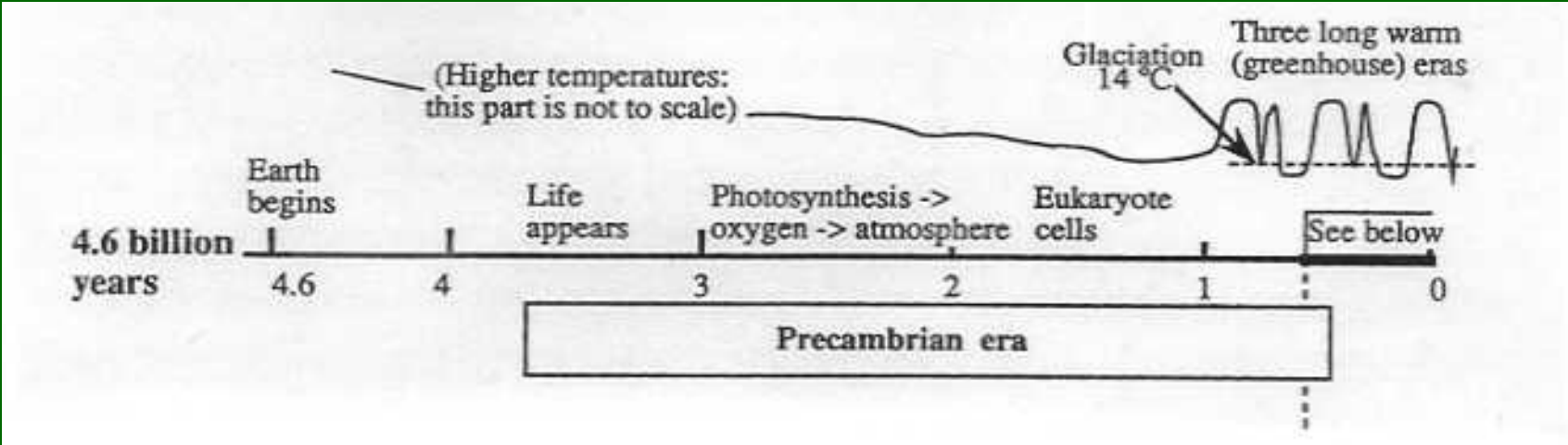
Hominid time scales - 10^6 BP - present

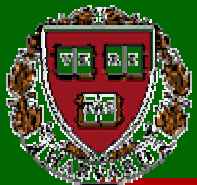
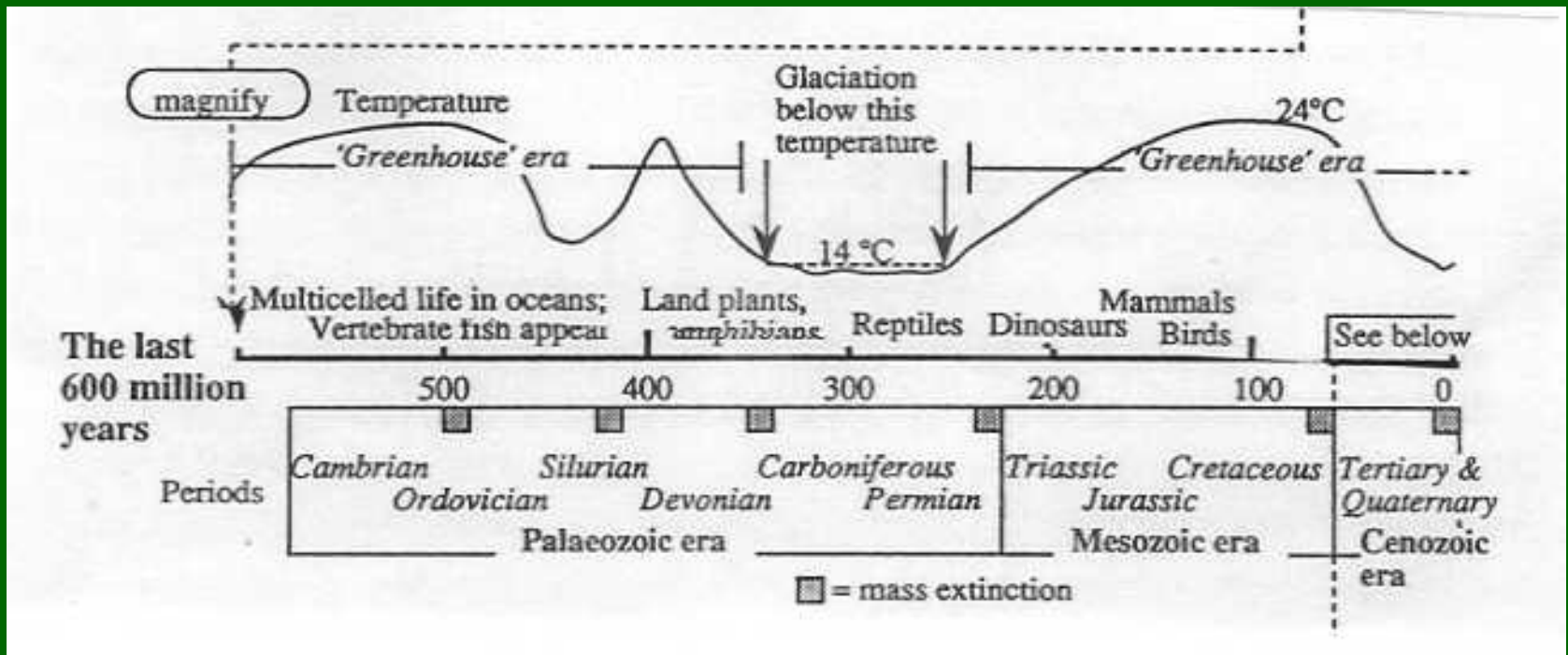
Cultural-Evolutionary time scales - 10^5 - 10^4

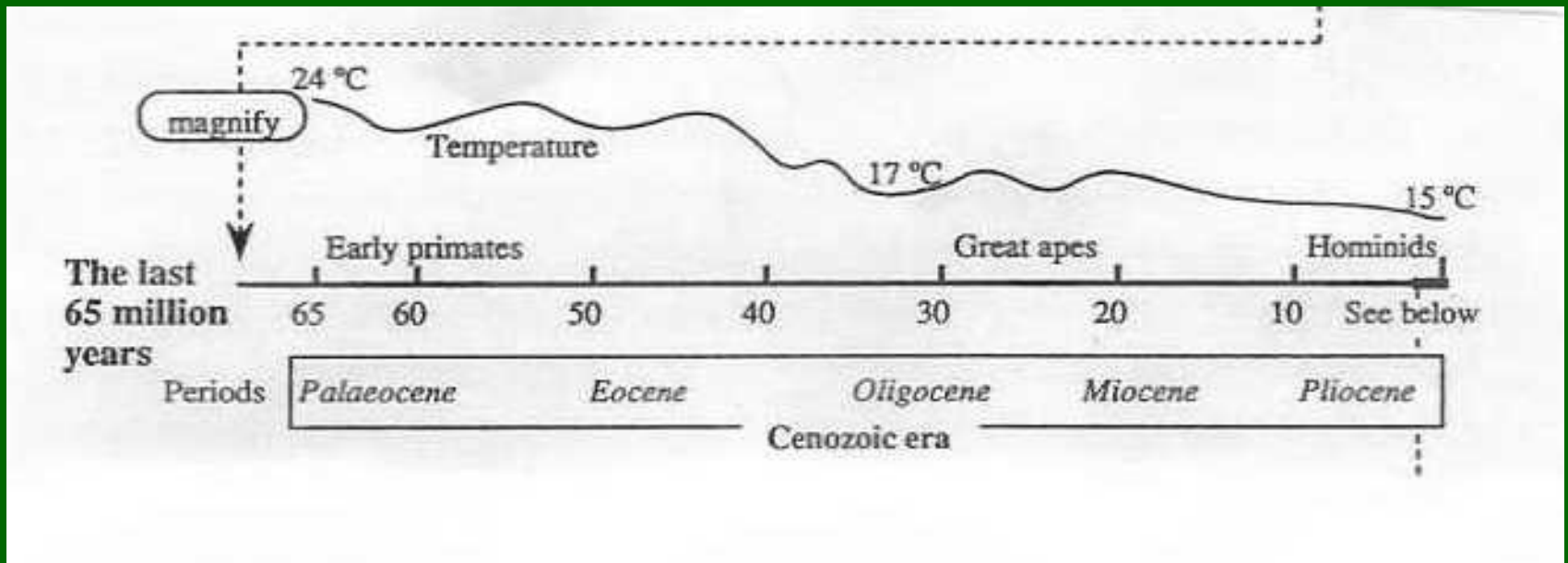
Civilization time scales - 10^3

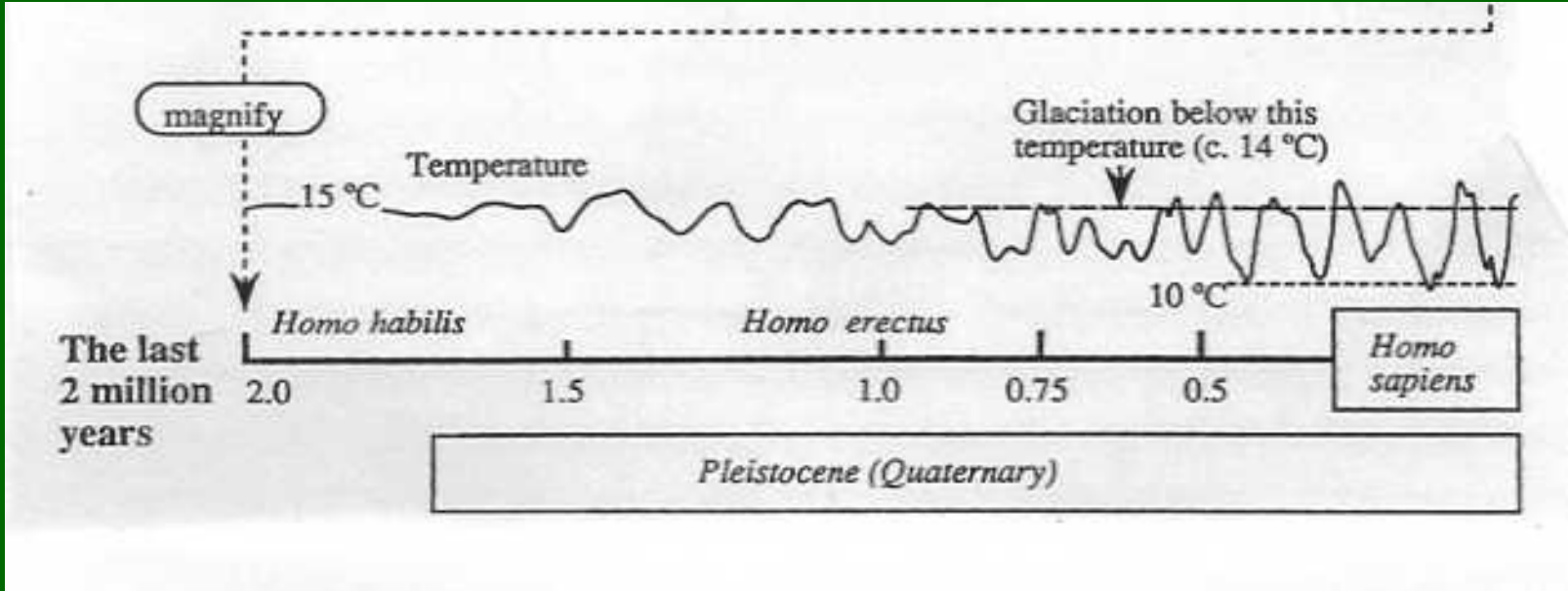
Historical time scales - 10^2 - 10





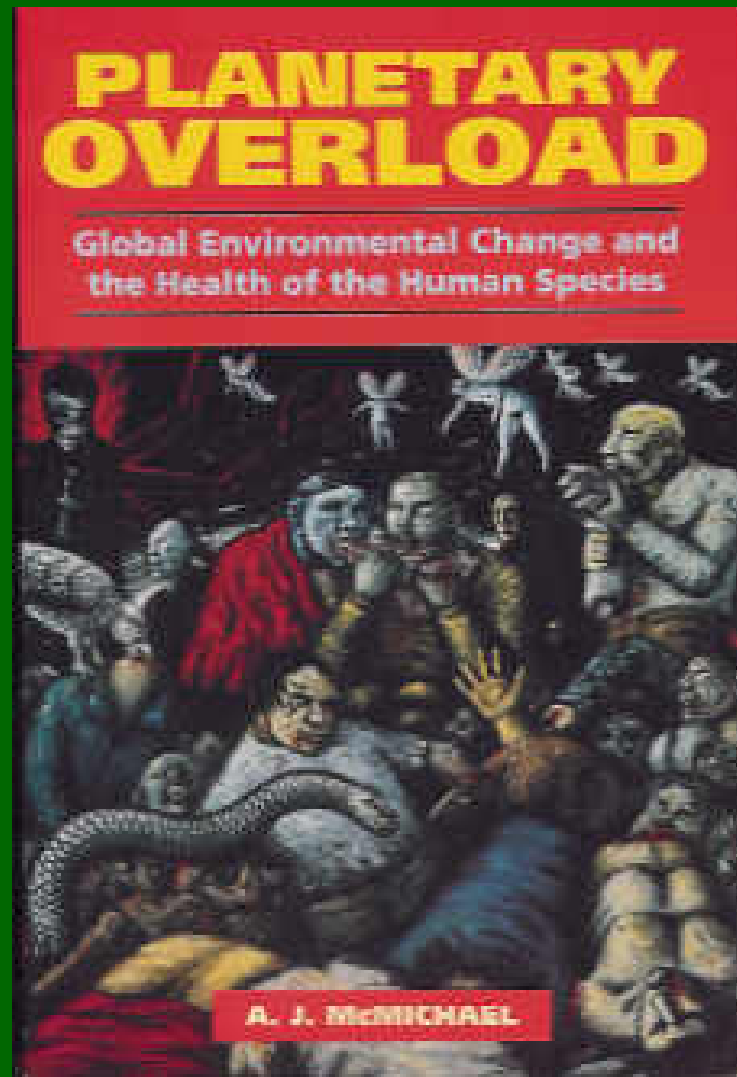


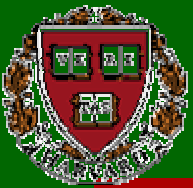
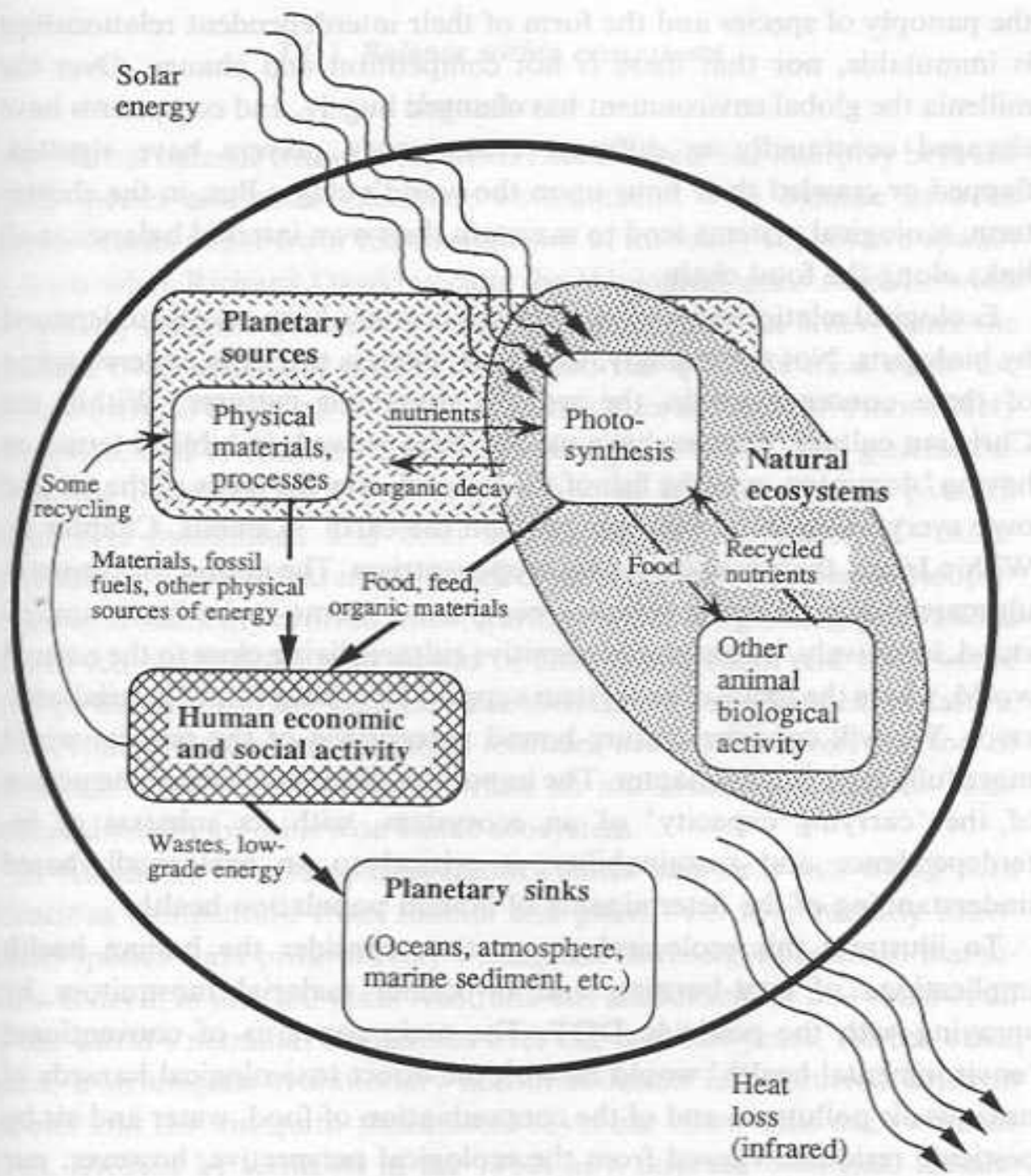




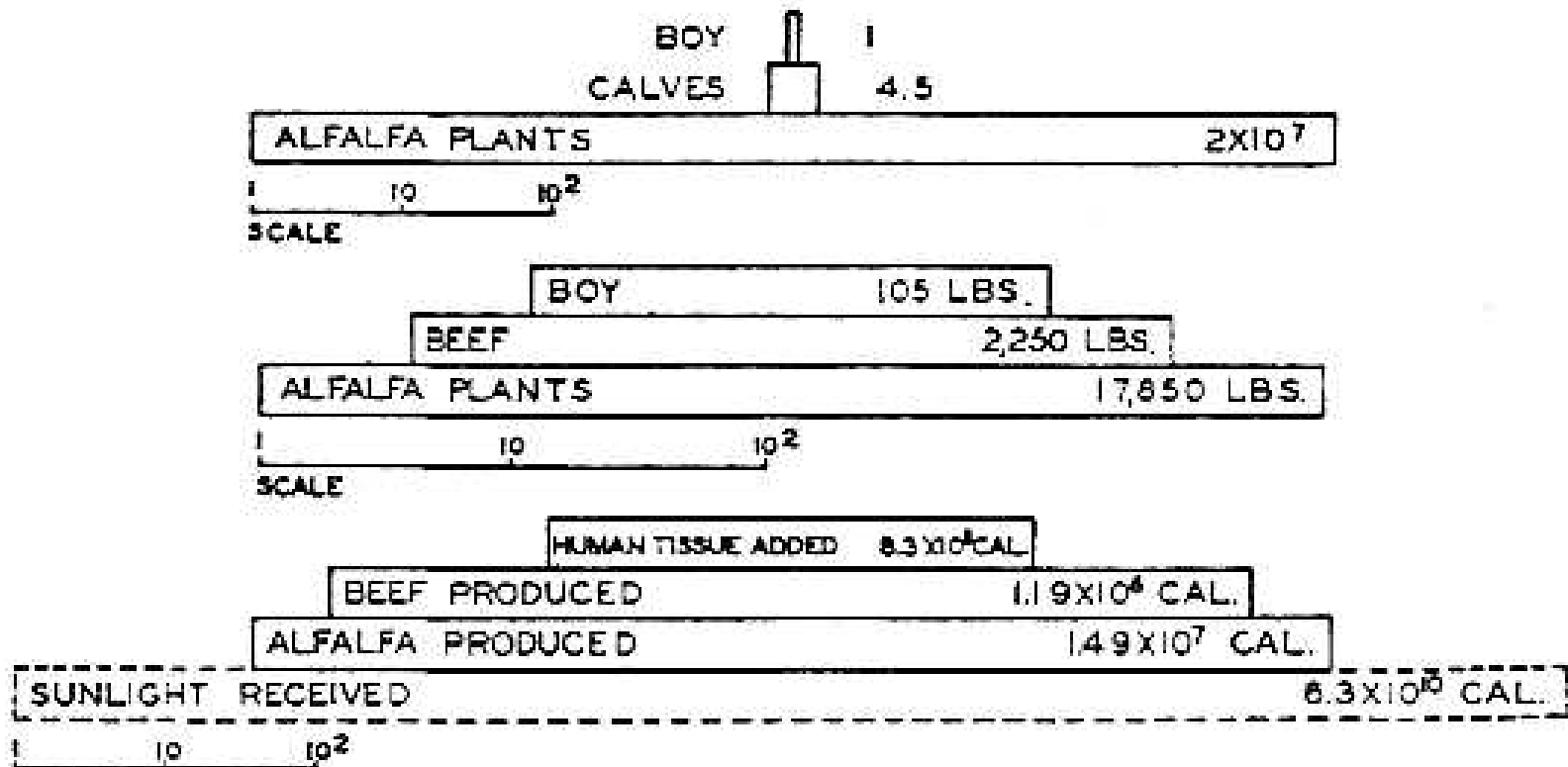
With all the shocks the earth system has experienced, what could a title like “*Planetary Overload*” possibly mean?

Is the planet overloaded? In what sense?

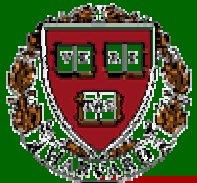
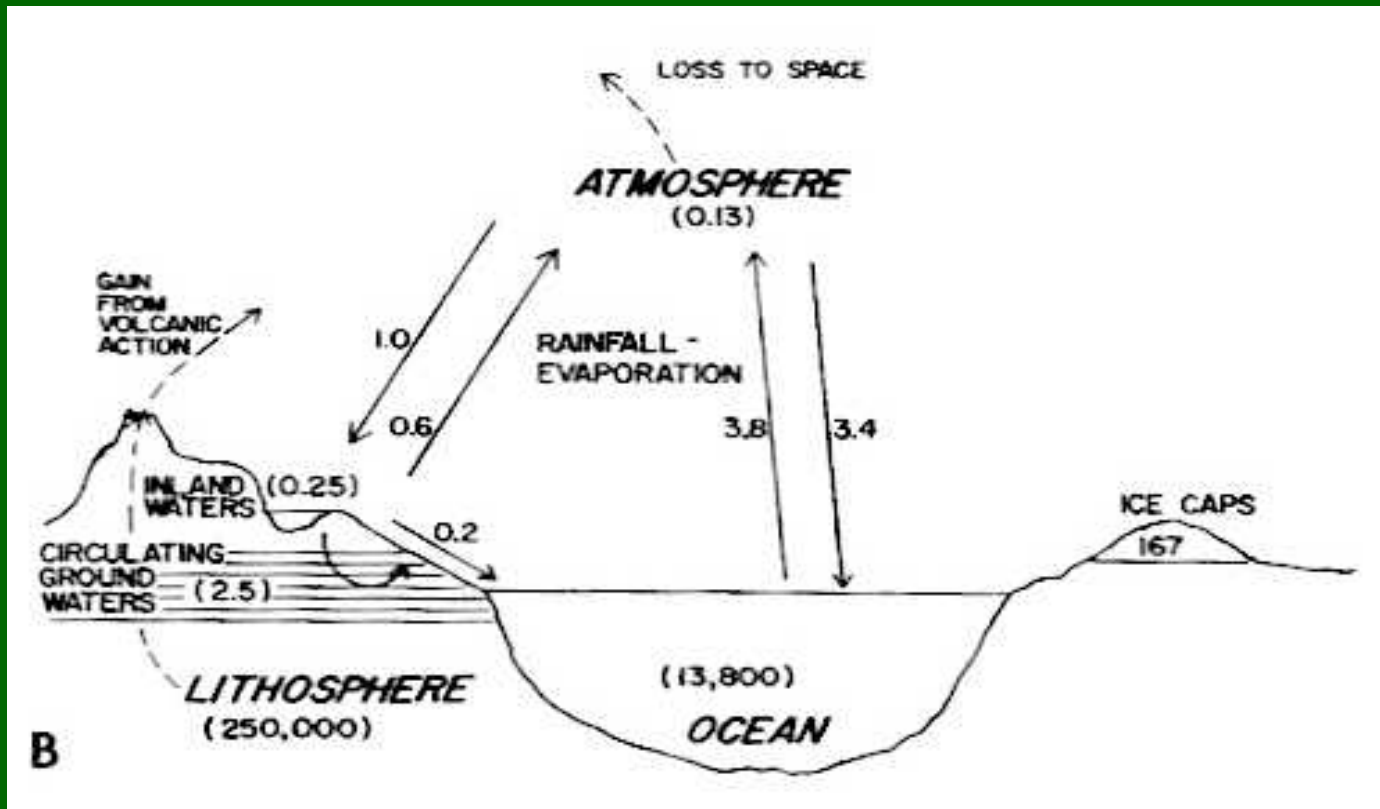




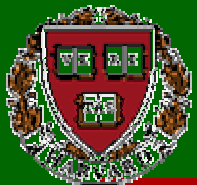
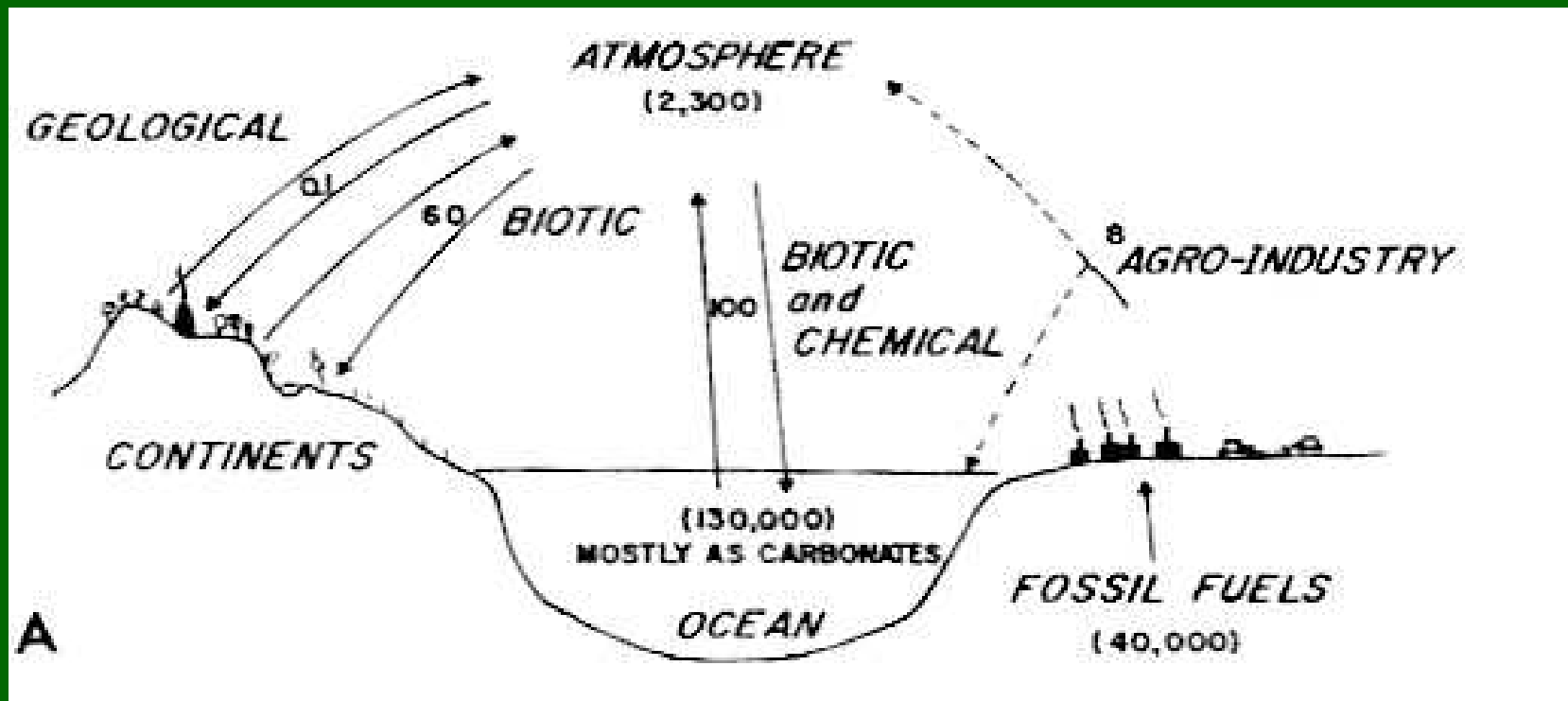
Energy Flow Can Be Measured



Water Circulation Can be Measured

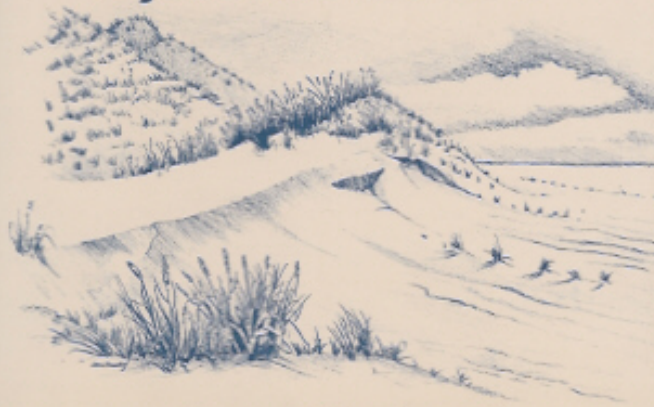


Carbon Circulation Can Be Measured



Life as a Geological Force

Dynamics of the Earth

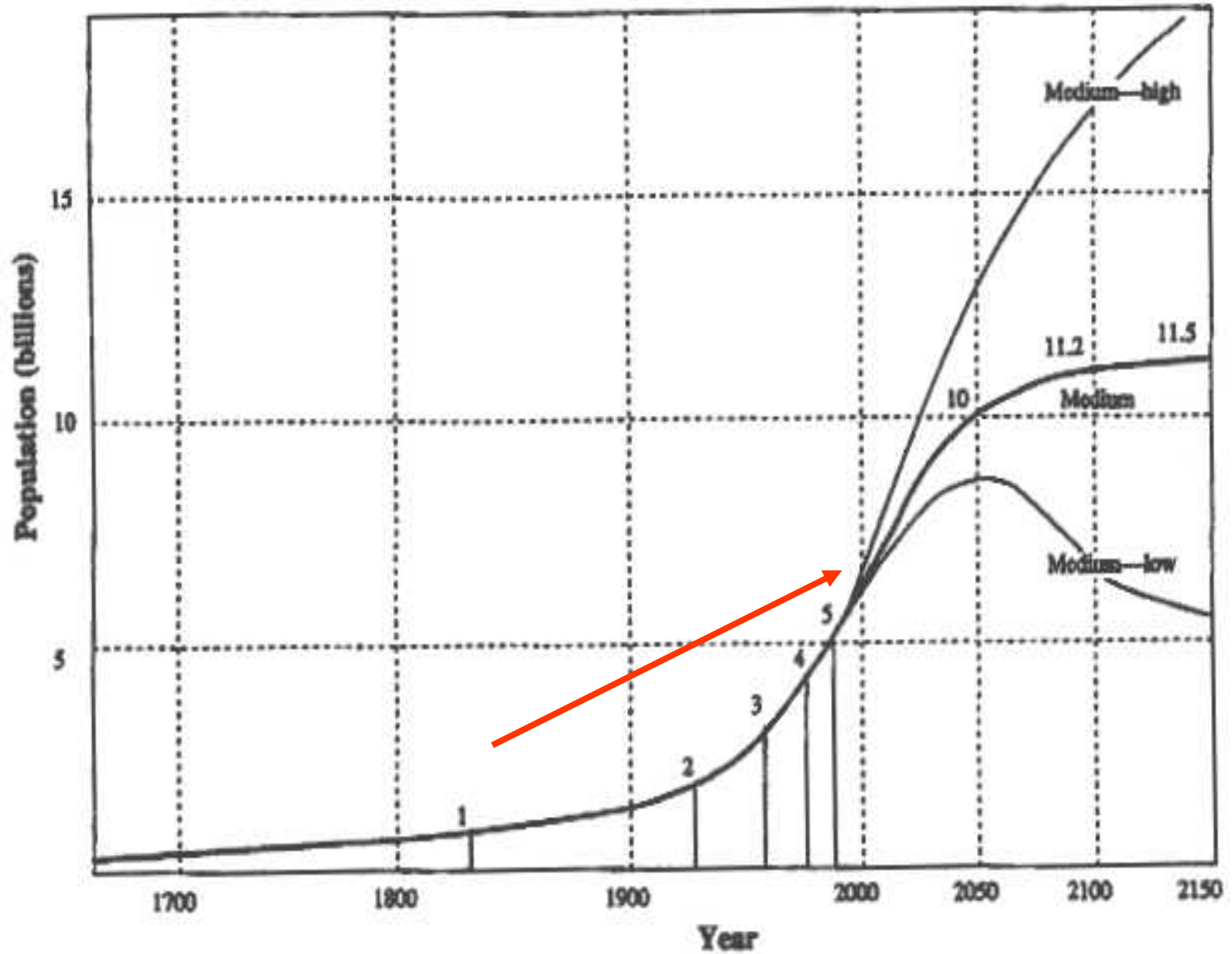


Peter Westbroek

Life has been a “geological force” on Earth for far longer than humans have been part of the biosphere -- the full “committee of life forms.”

We live in a highly improbable atmosphere made possible by everything from “farting ants” to anaerobic bacteria alive for eons before we emerged.

In one respect, however, things are different now that humans have emerged in such massive numbers.



Historians have observed...

In his study, *Plagues and Peoples*, historian William McNeill has observed...(p. 16)

“...modern science and technology, by tapping inorganic sources of energy, enormously enlarged human capabilities for changing natural balances among competing life forms. The apparent conquest of infectious diseases...was assuredly one of the most drastic disturbances of older ecological balances ever achieved by human beings.”



Historians have observed...

He goes on (p. 16):

“Nonetheless...we remain caught in the web of life – permanently and irretrievably – no matter how clever we are at altering what we do not like, or how successful we become at displacing other species.”

This, then, is our ethical dilemma. We are embedded in the ecosystem, which we cannot escape and cannot control. Extinction is the ultimate sanction that the ecosystem imposes upon those species that don't observe its rules. We must devise an ethic to curb our collective behavior to assure the continuity of our species within the enduring ecosystem.



Environmental Ethics = our last, best chance of survival..

We are still assessing the ecological impact of the Viet Nam war and the war in Kuwait a decade ago, and the prognosis is not encouraging.

Question is: *Can we survive our own propensity and skill in killing and destroying life support systems?*

Answer: **Not without a new environmental ethic.**



Environmental
Legacy in Kuwait



An Environmental Assessment Of Kuwait

Seven Years After the Gulf War

Final Report - August 1998

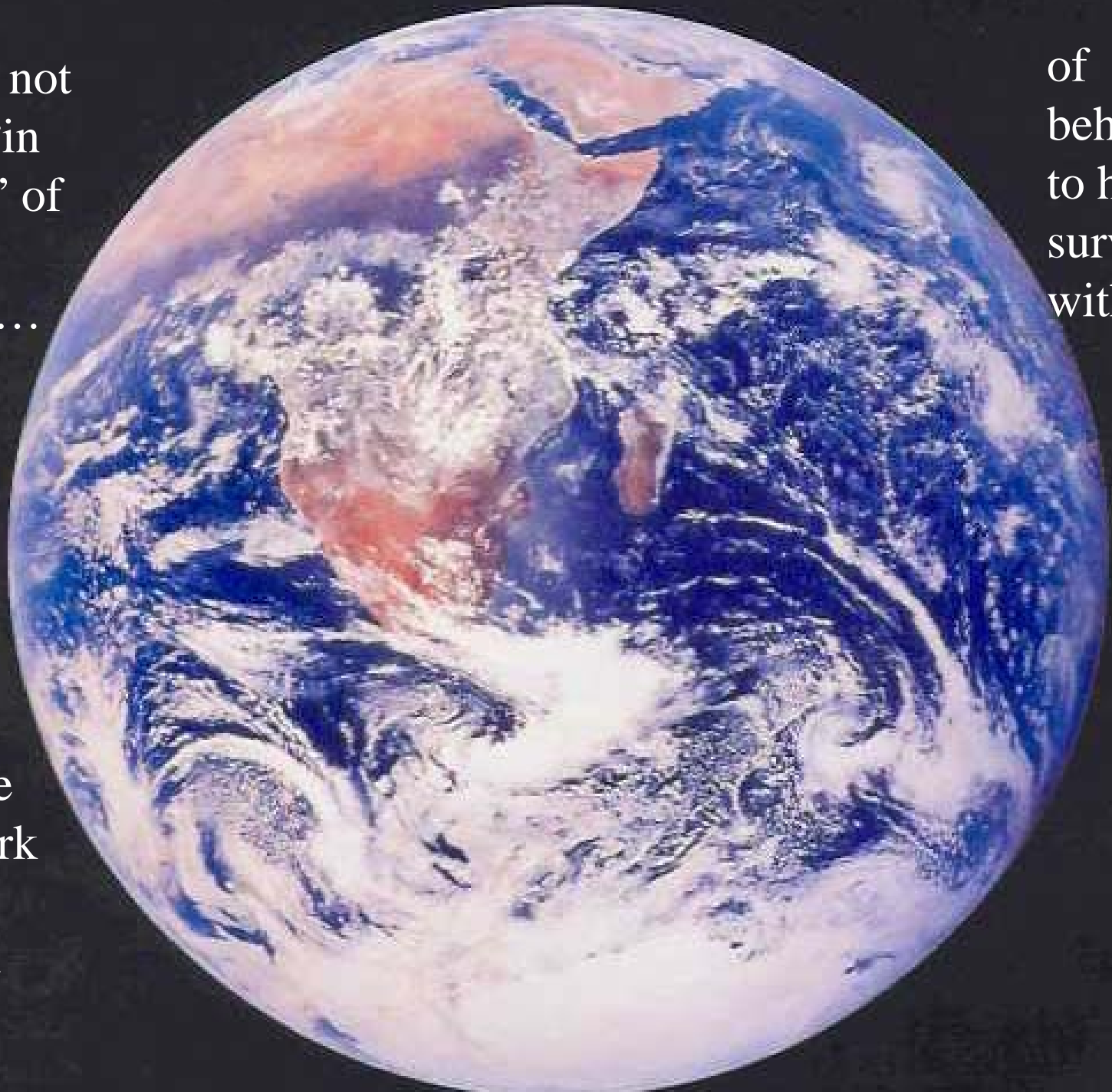
FOREWORD

On August 2, 1990, Kuwait was invaded by Iraqi troops. This sudden attack was followed by a period of intense diplomatic negotiations. The international community was and remains particularly concerned by the situation in the Gulf, because economic and political stability of the whole region is critical to the world.

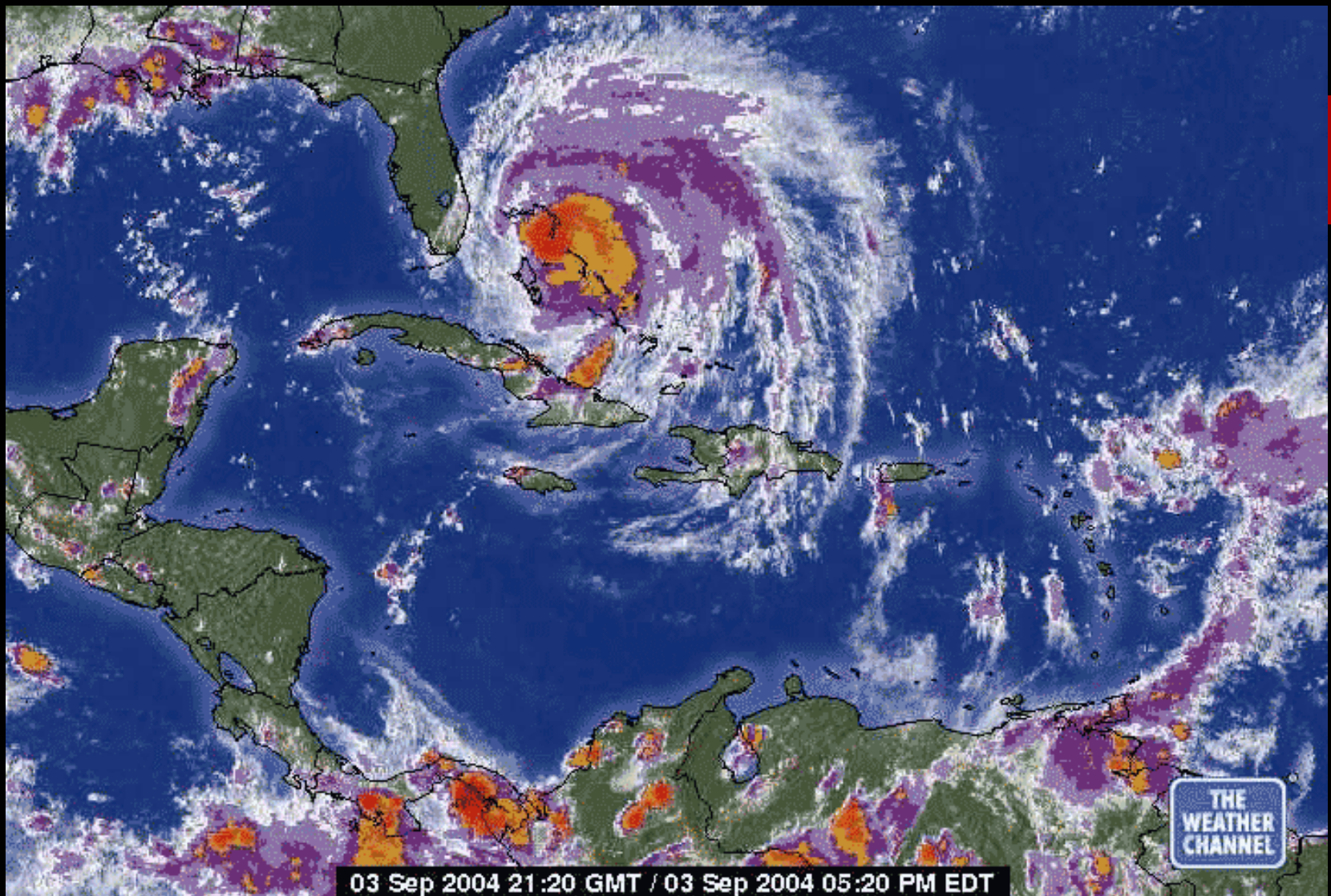
Tim Weiskel - 66

We are not
really “in
charge” of
this
system...

If we
work
hard we
can work
out an
ethic &
rules...

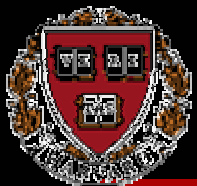


of
behavior
to help us
survive
within it.



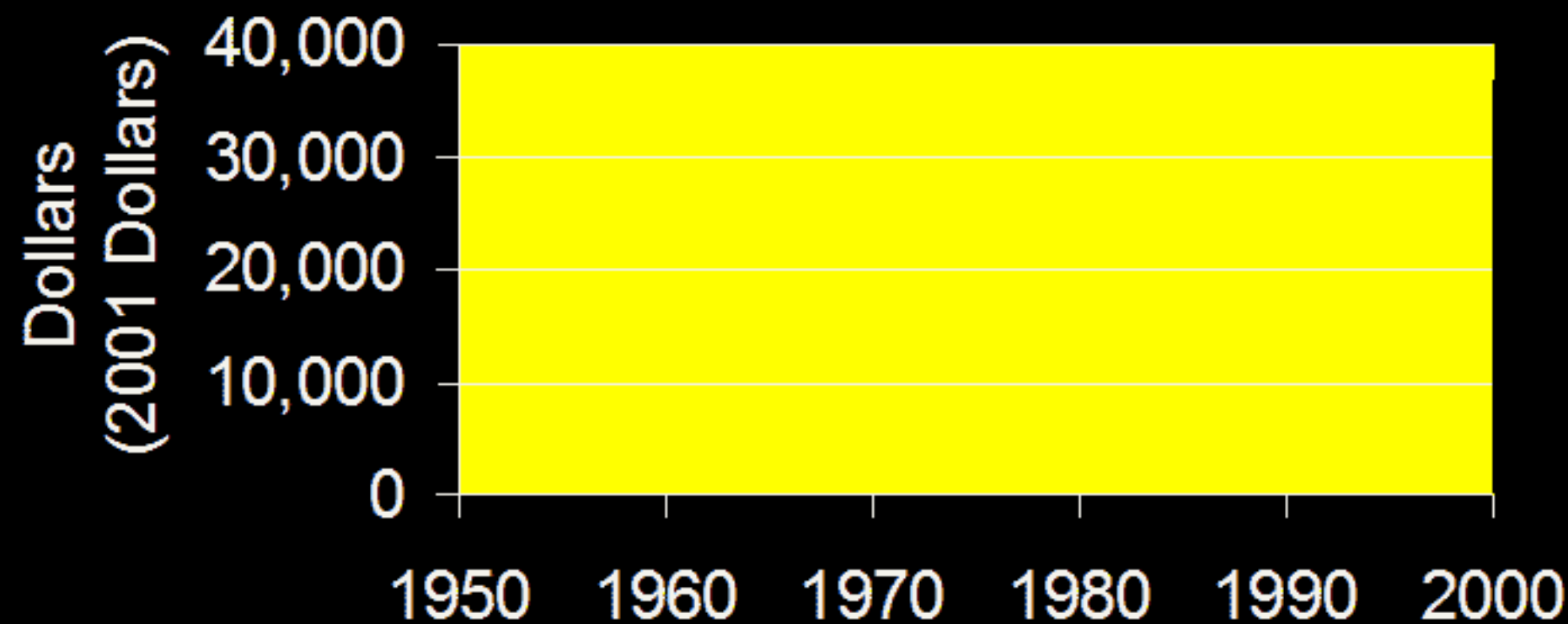
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THE
WEATHER
CHANNEL



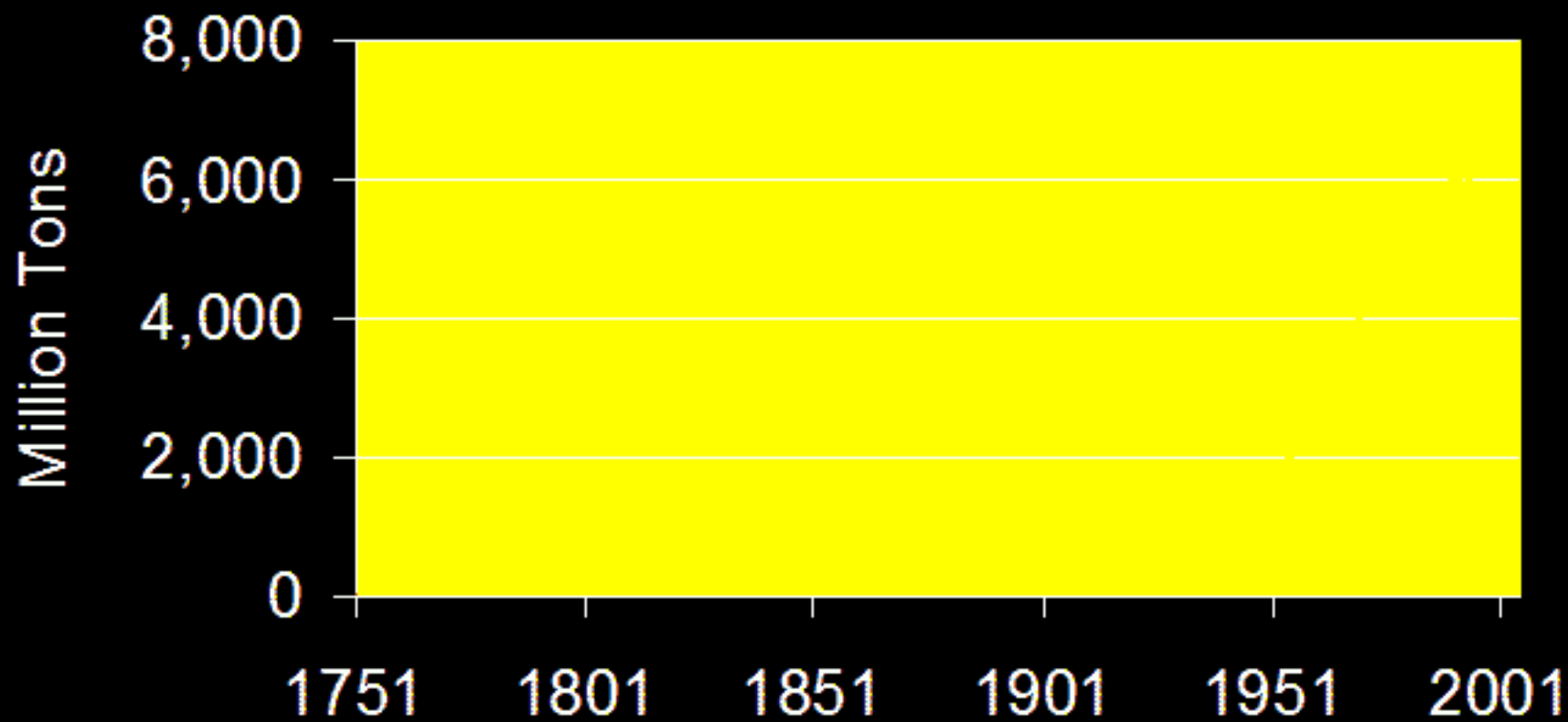
Those who think we can control it suffer from serious delusions.... We should not make that mistake. Tim Weiskel - 68

Gross Domestic Product and Genuine Progress Indicator Per Person, United States, 1950-2000



Source: Redefining Progress

Global Carbon Emissions from Fossil Fuel Burning, 1751-2002



Source: ORNL, BP

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• Environmental Ethics and Land Management
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ENVR E-120

<http://courses.dce.harvard.edu/~envre120>
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Basic Concepts of Ecology

Timothy C. Weiskel

Session 2
28 September 2004

Harvard University Extension School
Fall Semester 2004

