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Station Biologique de Roscoff, FRANCE

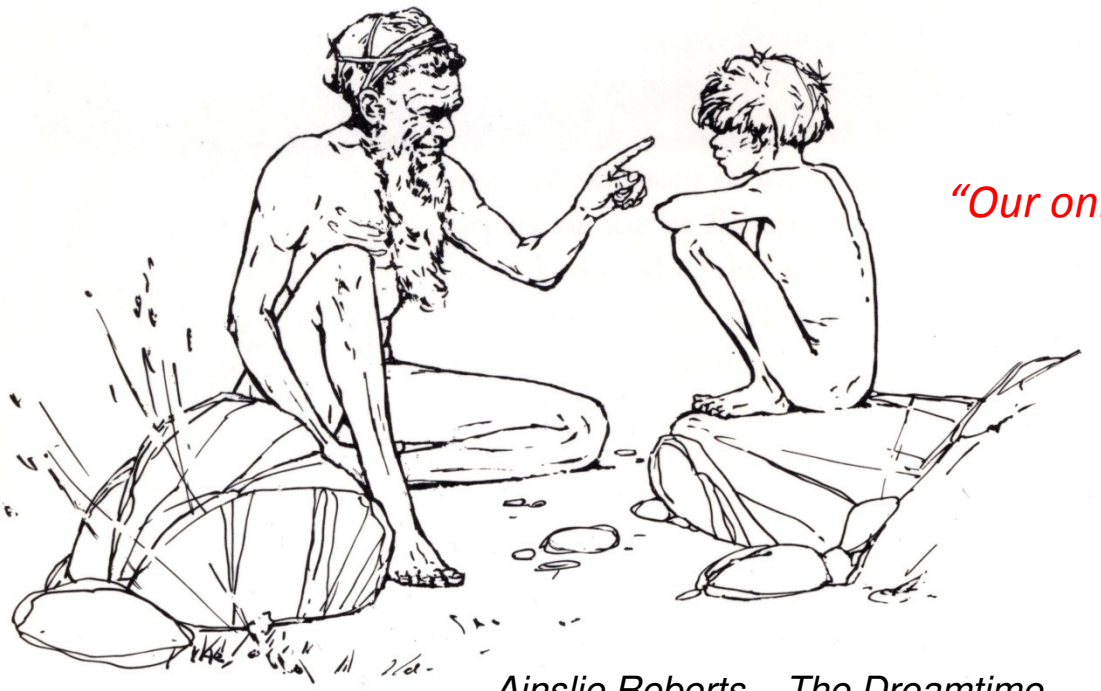
OMICS Group Conferences
Accelerating Scientific Discovery

2nd International Conference on
Oceanography
Las Vegas, USA July 21-23, 2014

THE EVOLUTION OF THE BIOSPHERE IN THE ANTHROPOCENE

Keynote Lecture, Monday July 21, 2014

"Ocean changes and its ecological impacts"



Ainslie Roberts – The Dreamtime

"Our only real heritage is passed on at birth"

PRACTICAL DEFINITIONS

PRACTICAL DEFINITIONS

BIOSPHERE

is the set of all life forms and of their metabolic products within the spatial confines necessary for their sustenance, development and evolution

ECOSYSTEM

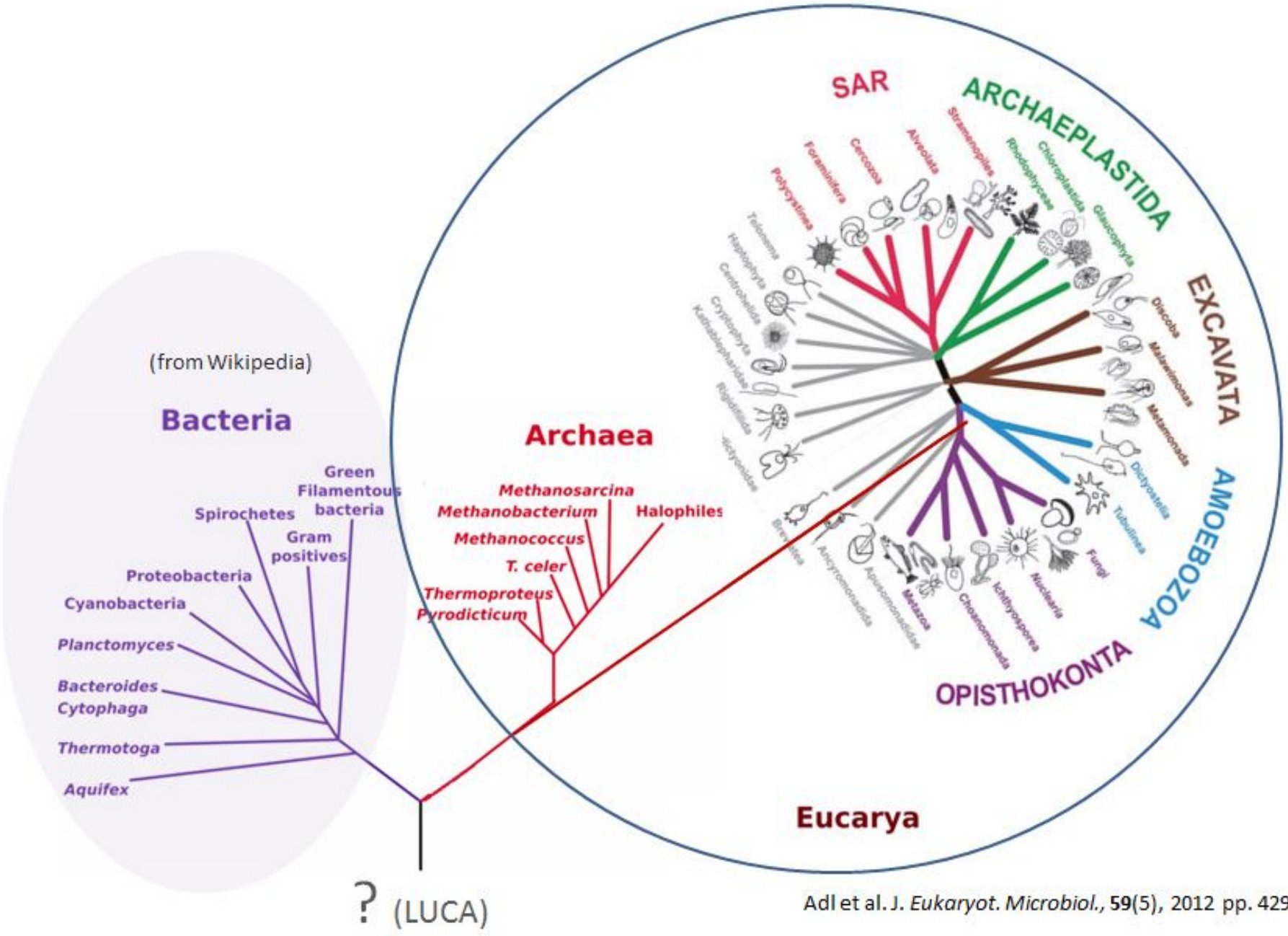
is a distinct community of living organisms (eukaryotes and prokaryotes) in dynamic interaction between them and with the non-living elements of their environment

BIODIVERSITY

is the variation of life forms expressed in a given biological system.

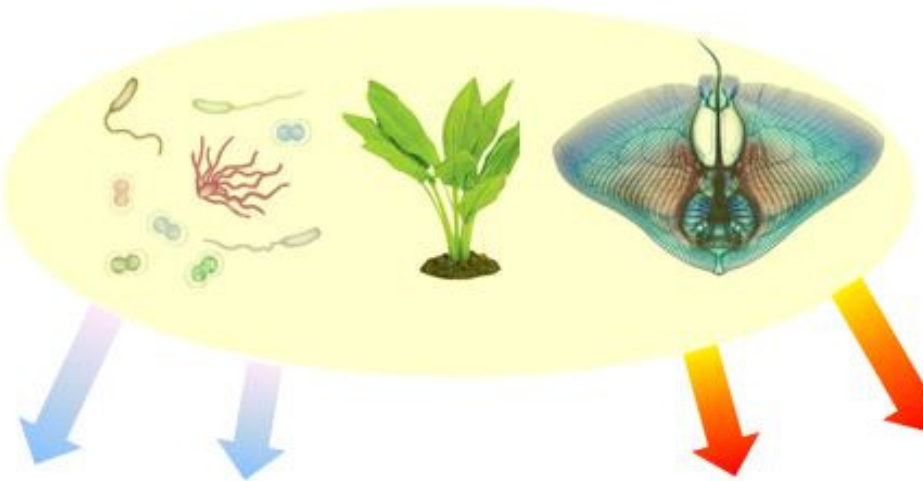
Hotspots localities combine high levels of endemism and diversity per sq. unit.

BIOSPHERE: (i) all existing life forms



Adl et al. J. *Eukaryot. Microbiol.*, **59**(5), 2012 pp. 429–493

BIOSPHERE (ii) … and of their metabolic products



SEMIOCHEMICALS

¤ PHEROMOMONES
(trails, scents)
¤ ALLOMONES
(toxins, emetics, poisons)

DISJECTA, SECRETIONS

¤ NUTRIENTS
(C, N, S, P cycling)
¤ AEROSOLS
(S, halogens, hydrocarbons)

ORGANIC MASS

¤ FOOD
(predators)

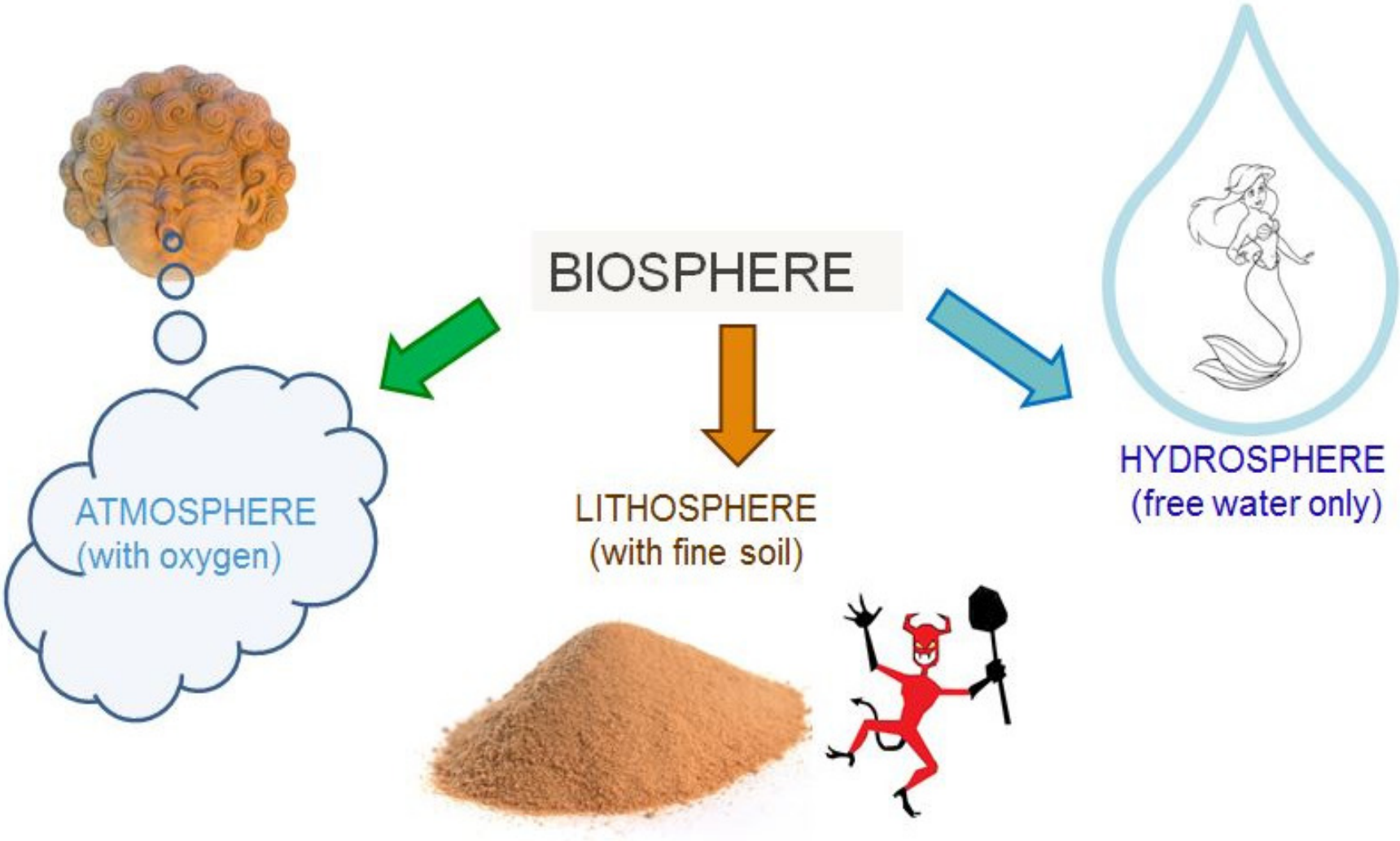
¤ NUTRIENTS
(C, N, S, P cycling)

BIOMINERALS

¤ BONES, SHELLS,
CONCRETIONS,

BIOSPHERE (iii) … within the spatial confines…

The interface between land, sea and air that has the right chemistry to support life



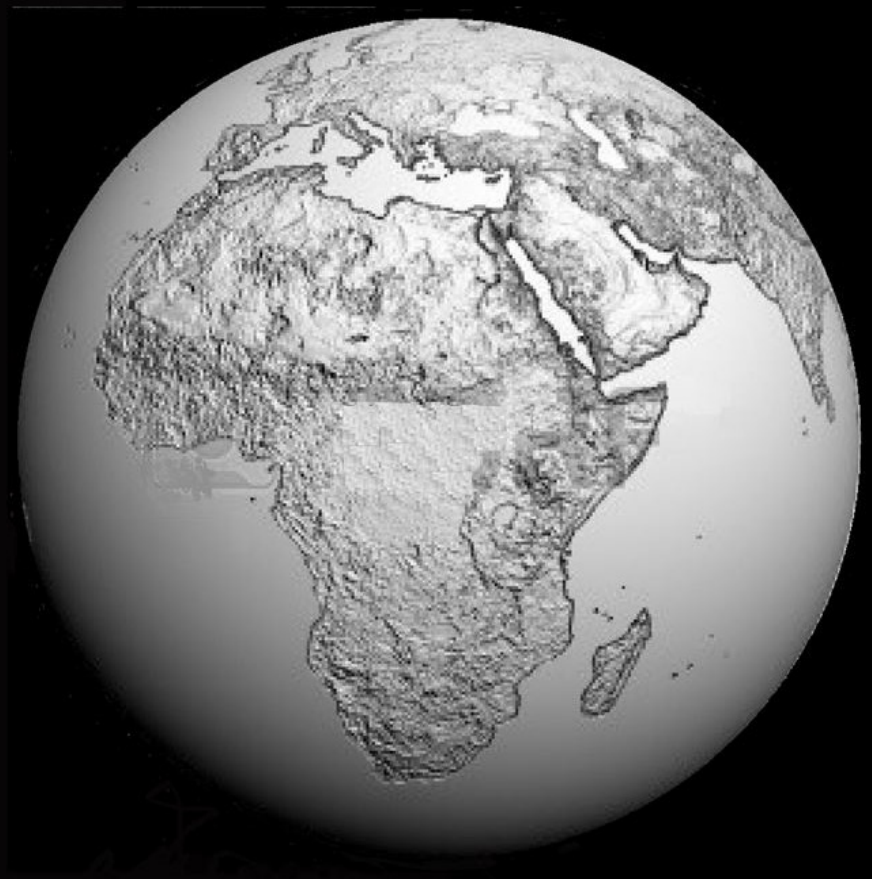
ATMOSPHERE

Under constant motion

The air we breathe on our planet

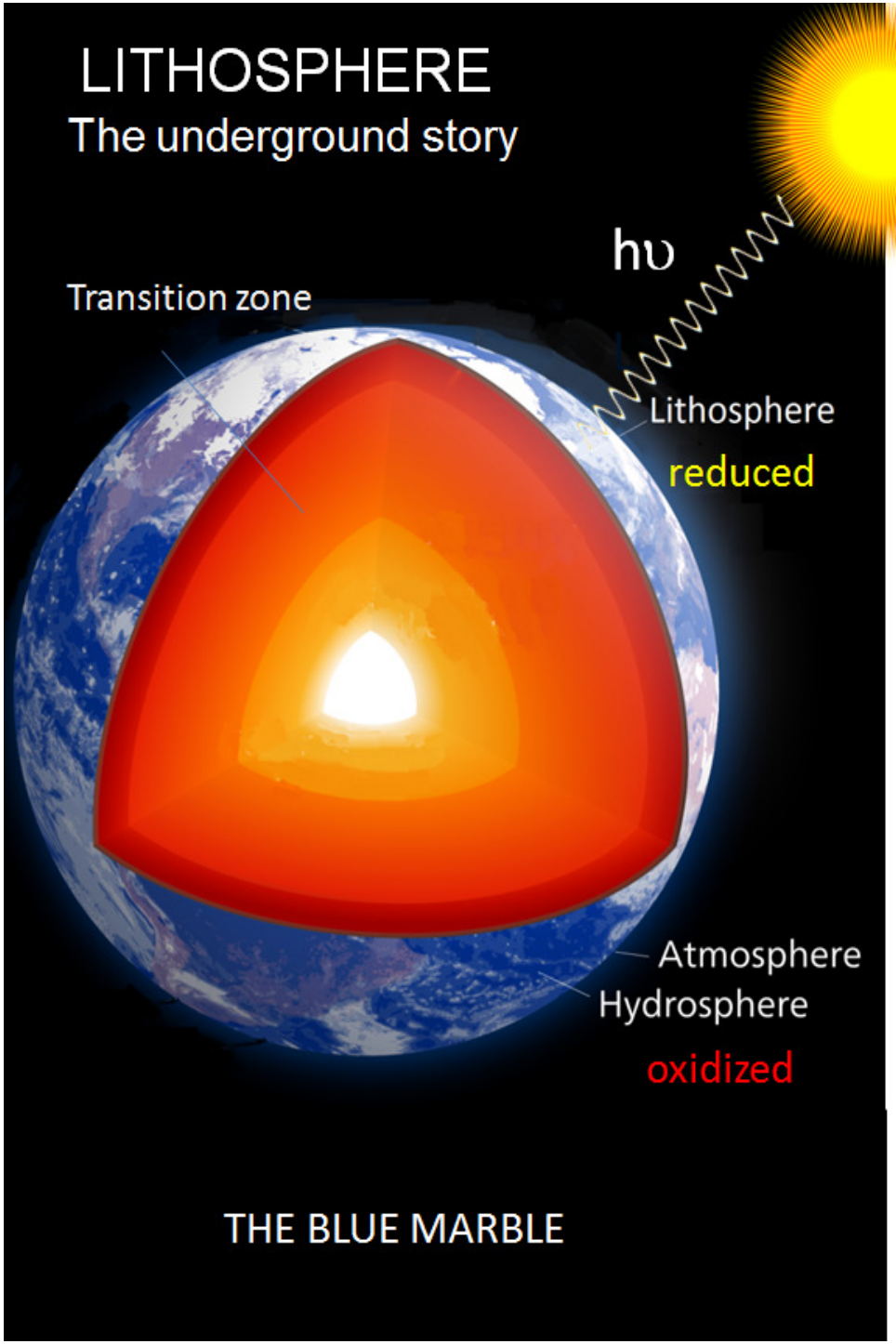
The ***Blue Marble***, 2012, NASA

HYDROSPHERE Water on our planet

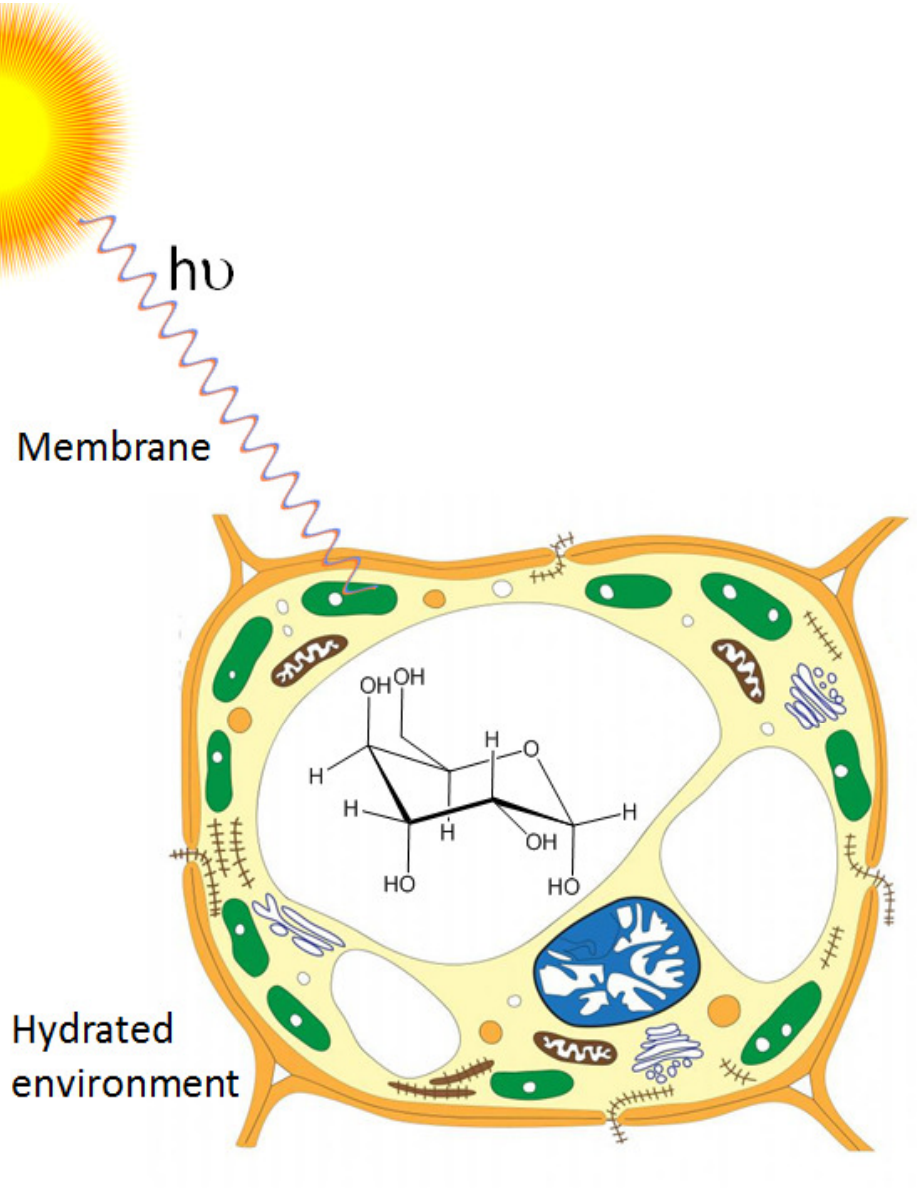


LITHOSPHERE

The underground story



THE BLUE MARBLE



THE PHOTOSYNTHETIC CELL

PRACTICAL DEFINITIONS

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is the set of all life forms and of their metabolic products within the spatial confines necessary for their sustenance, development and evolution

ECOSYSTEM

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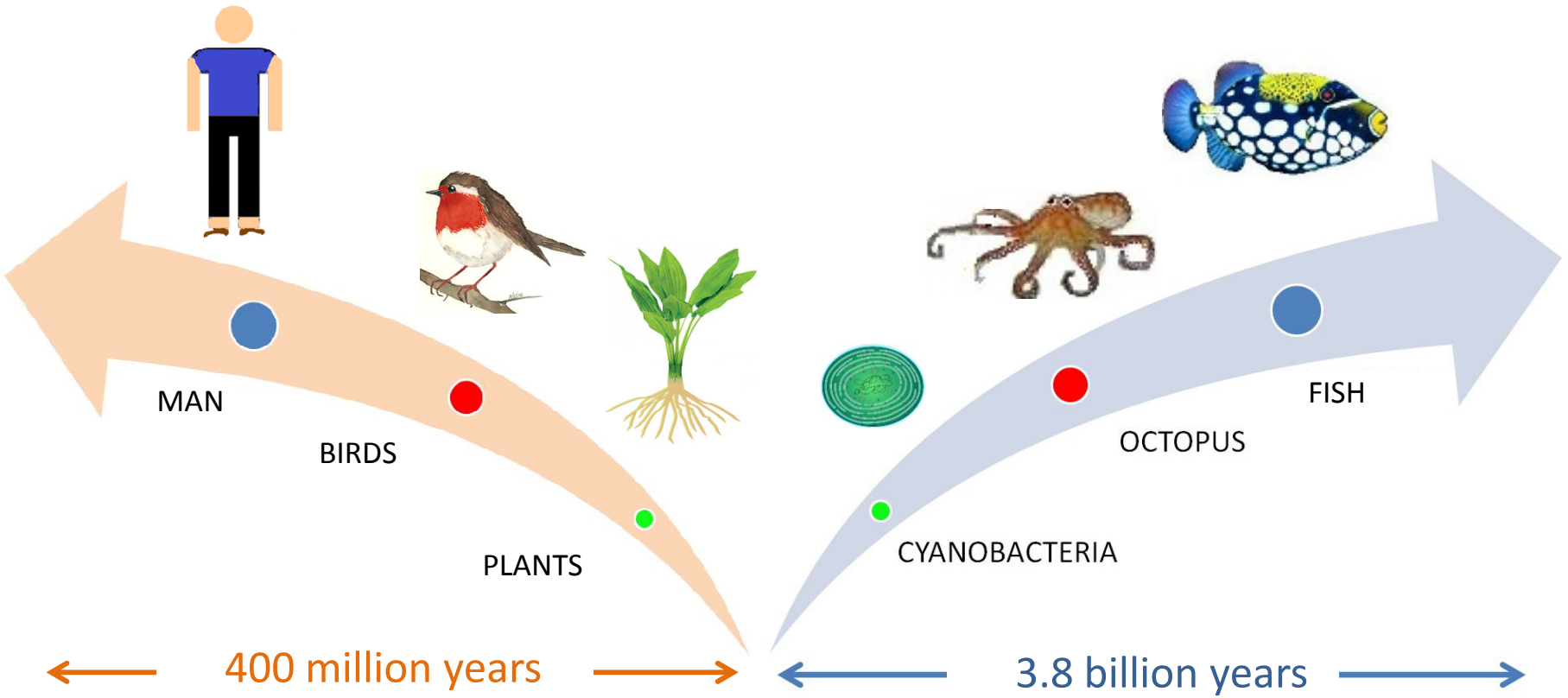
BIODIVERSITY

is the variation of life forms expressed in a given biological system.

Hotspots localities combine high levels of endemism and diversity per sq. unit.

ECOSYSTEMS

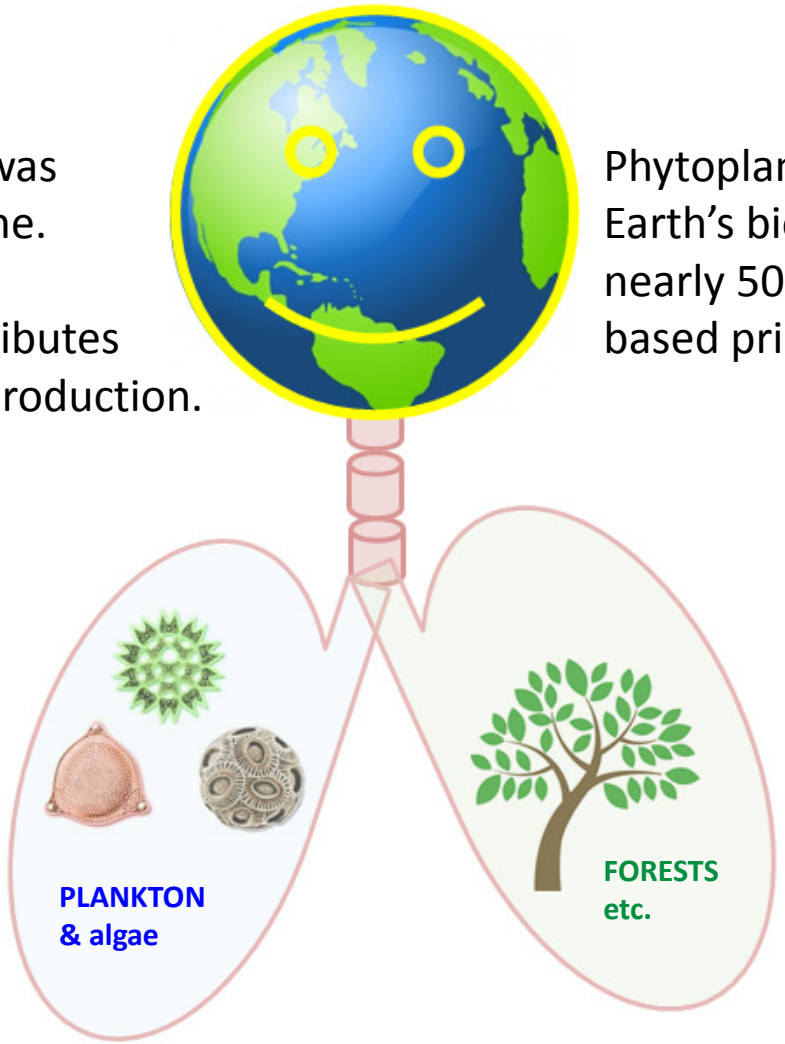
Terrestrial ecosystems and marine ecosystems



OXYGEN AND CARBON PRODUCTION: MARINE vs. TERRESTRIAL

Oxygenic photosynthesis was originally exclusively marine.

Now phytoplankton contributes 50-85% to global oxygen production.



Phytoplankton account for <1% of the Earth's biomass but is responsible for nearly 50% of global annual carbon-based primary productivity

PRACTICAL DEFINITIONS

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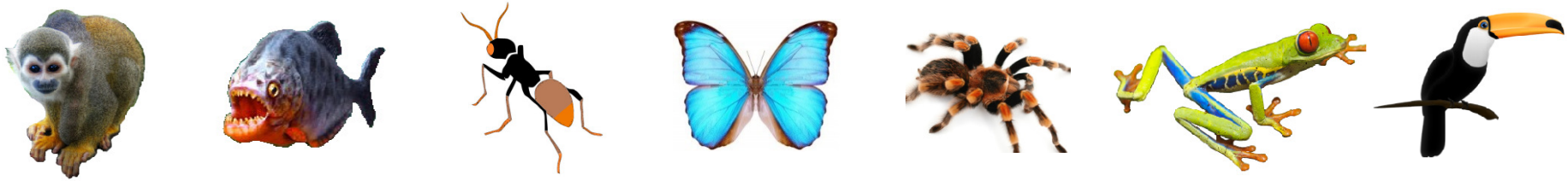
BIODIVERSITY

is the variation of life forms expressed in a given locality.

Hotspots localities combine high levels of endemism and diversity/area

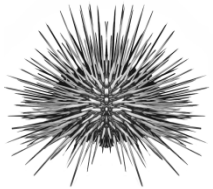
Rainforest Ecosystems



"Although tropical forests cover less than 7% of the earth's surface they are home to approximately 50% of all living things on earth."

Rainforest Foundation US, http://www.rainforestfoundation.org/

Coral Reef Ecosystems



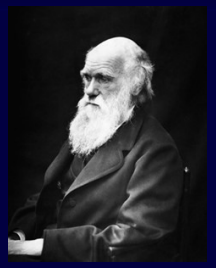
« Coral reefs contain at least one quarter, perhaps as much as one third, of all the diversity in the ocean.

This is an amazing statistic when you consider that reefs occupy less than 0.2 percent of the ocean's surface »

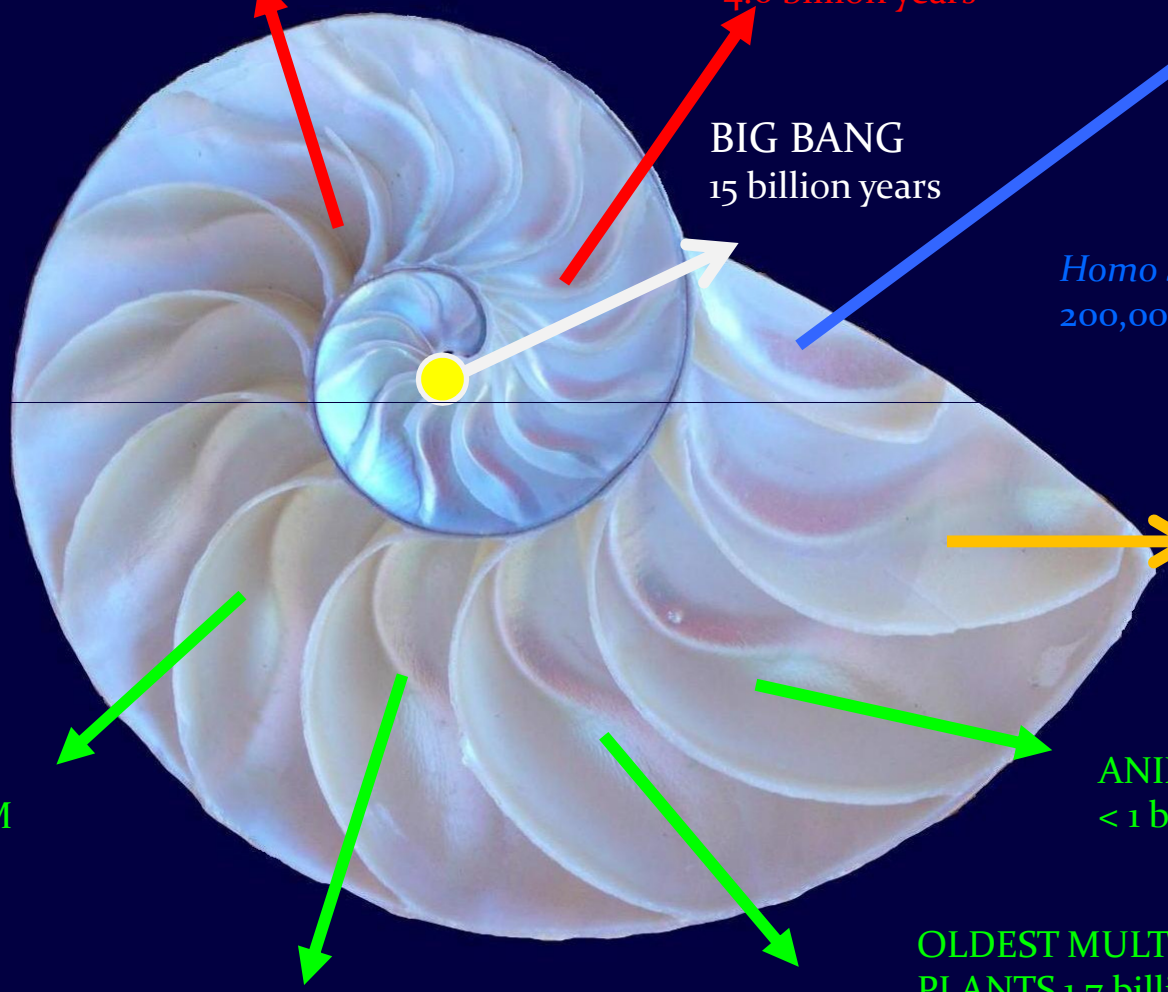
Nancy Knowlton, Professor of Marine Science, Smithsonian Institution

THE ANTHROPOCENE: MAN-MADE IMPACTS

MAN IS A NEWBORN BABY, A LITTLE RESTLESS…



Darwin
200 years



LIQUID WATER

EARTH
4.6 billion years

BIG BANG
15 billion years

Homo sapiens
200,000 years

TERRESTRIAL LIFE
400 million years

ANIMALS, MACROALGAE
< 1 billion years

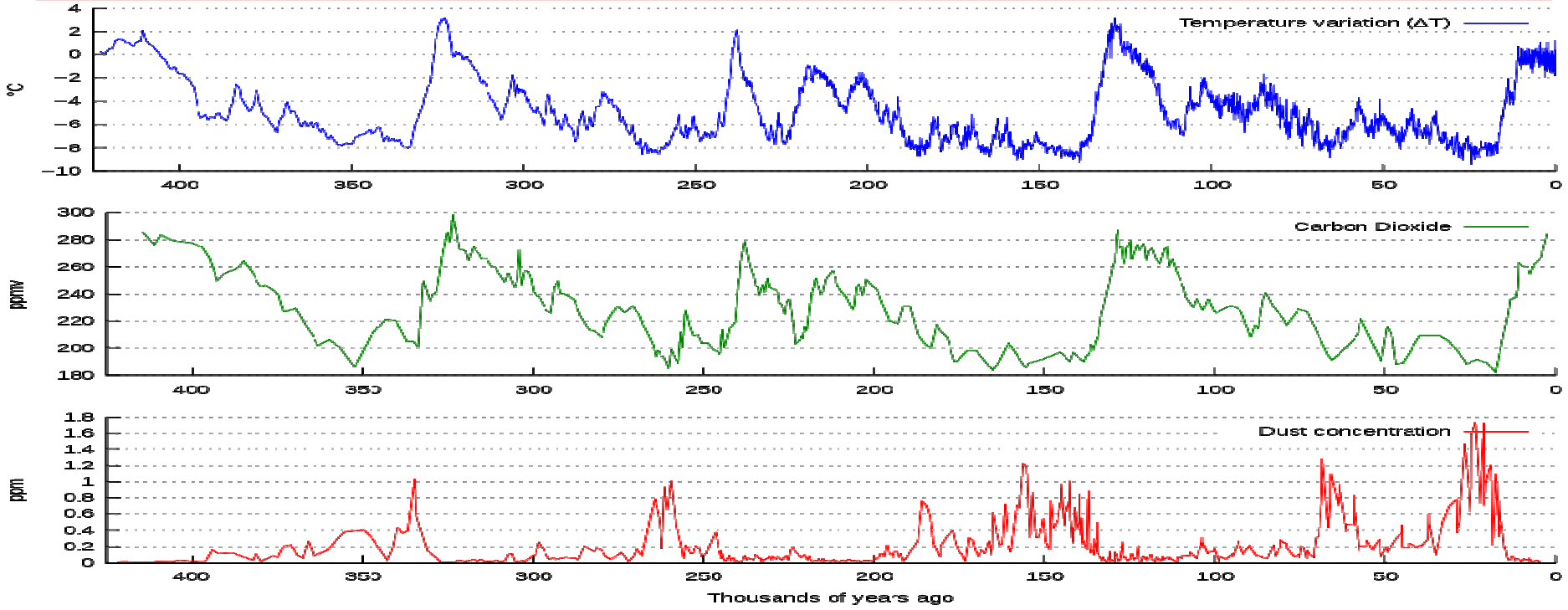
OLDEST MULTICELLULAR
PLANTS 1,7 billion years

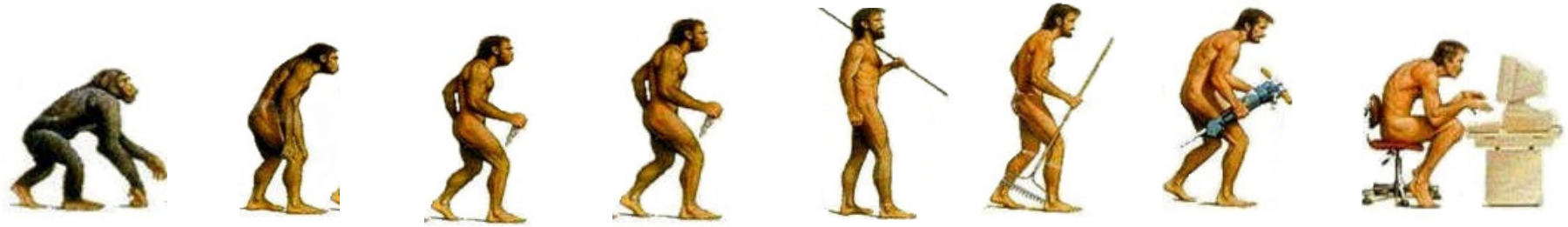
OXYGENATED ATMOSPHERE
2,7 billion years

OLDEST LIFE FORM
4 billion years?

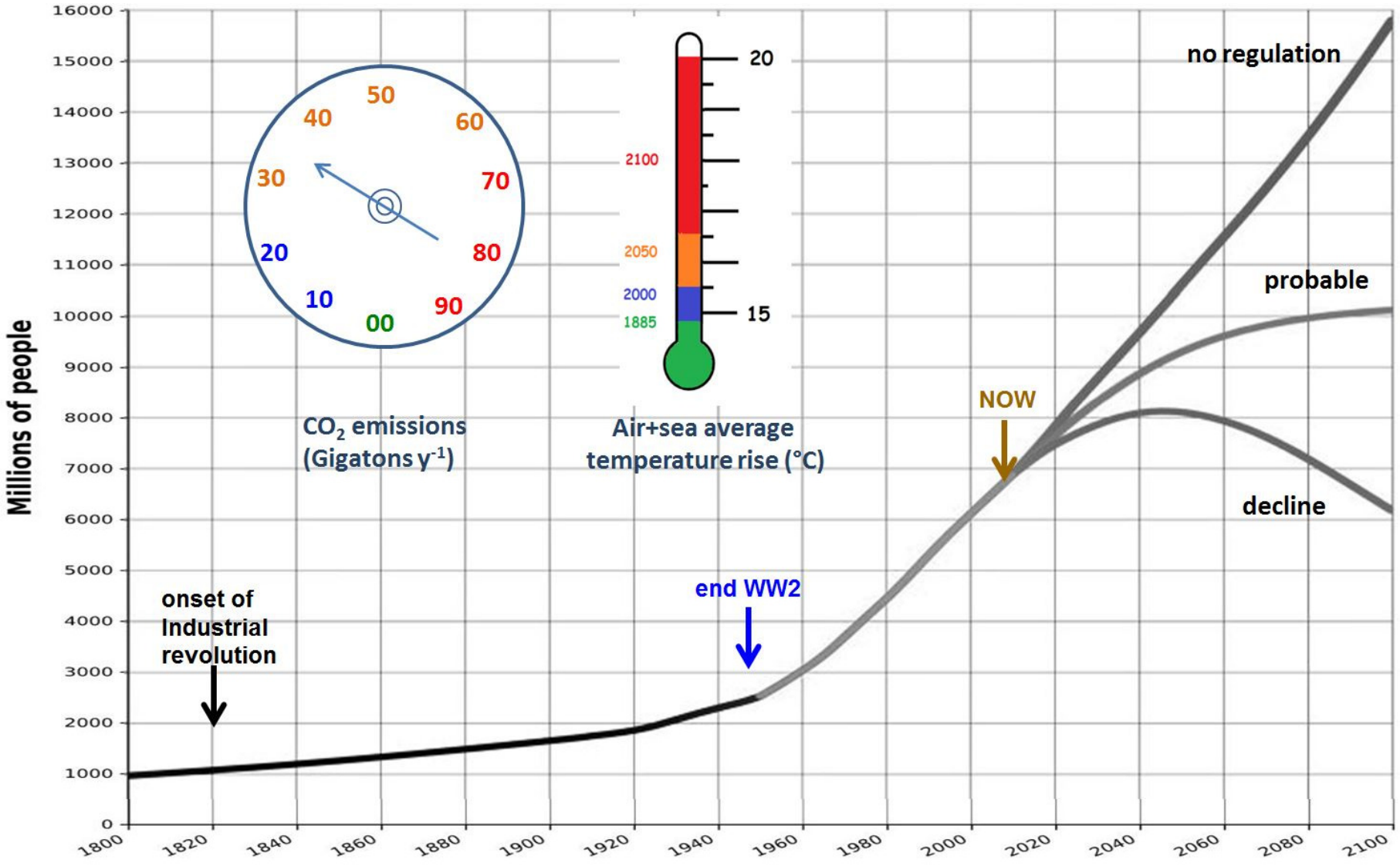
THE STORY OF C IN THE QUATERNARY….

Changes in atmospheric CO_2 over the past 420,000 years as recorded in the Vostok ice, showing that **both the rapid rate of change and the increase in CO_2 concentration** since the Industrial Revolution **are unprecedented** in recent geological history.





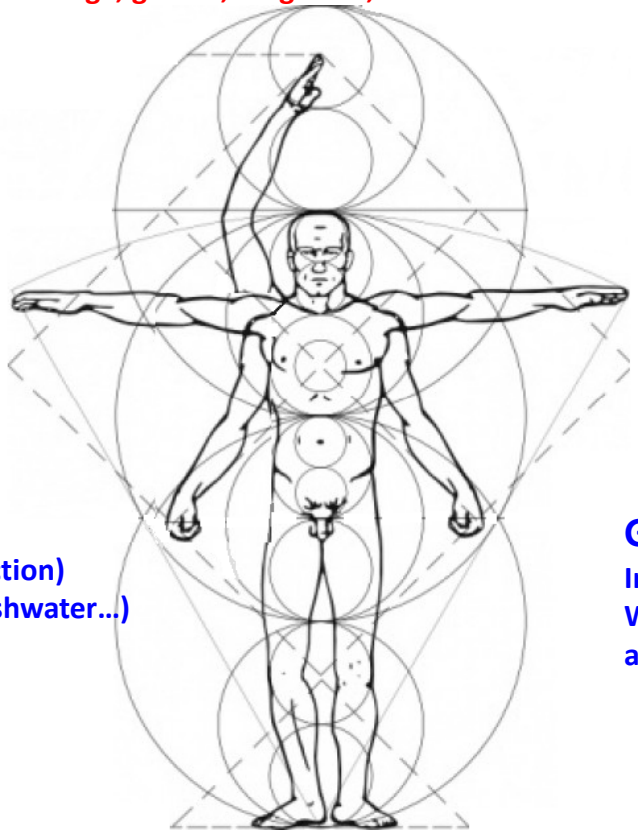
HUMAN POPULATION, CO_2 RISE & GLOBAL WARMING IN 300 YEARS



HUMAN IMPACTS IN A GLOBALIZED ECONOMY

Carbon volatilized in the atmosphere (indirect)

Climate change, global , long term, not reversible in this century



Selective overexploitation of live resources

Destruction of natural cycles

Creation of new genomes and of artificial molecules

Chemical pollution and displacement of wildtypes

Urbanization

Landscape remodelling, (habitat destruction)

Misuse of « common goods » (sand, freshwater…)

Global commerce

Introduction of alien species

Widening gap between deciders/consumers and between producers/recyclers

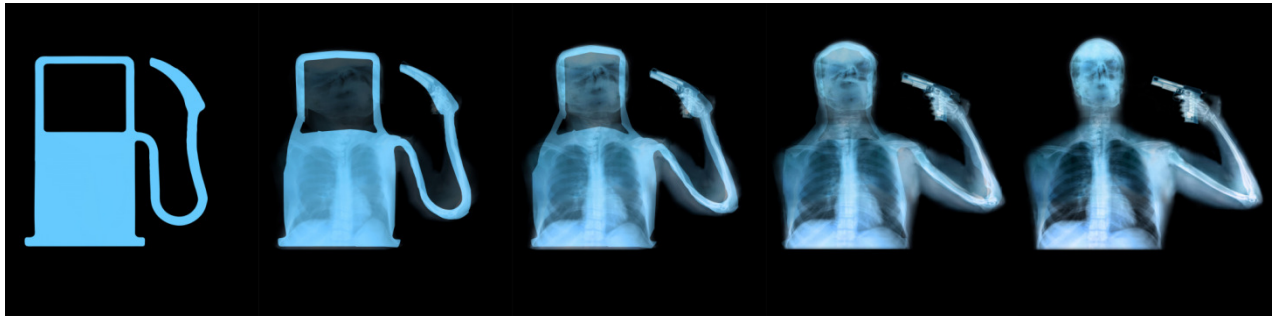
Nitrogen enrichment (direct)

Pollutions and diseases, local, reversible

HUMAN INFLUENCE ON CARBON CYCLING….

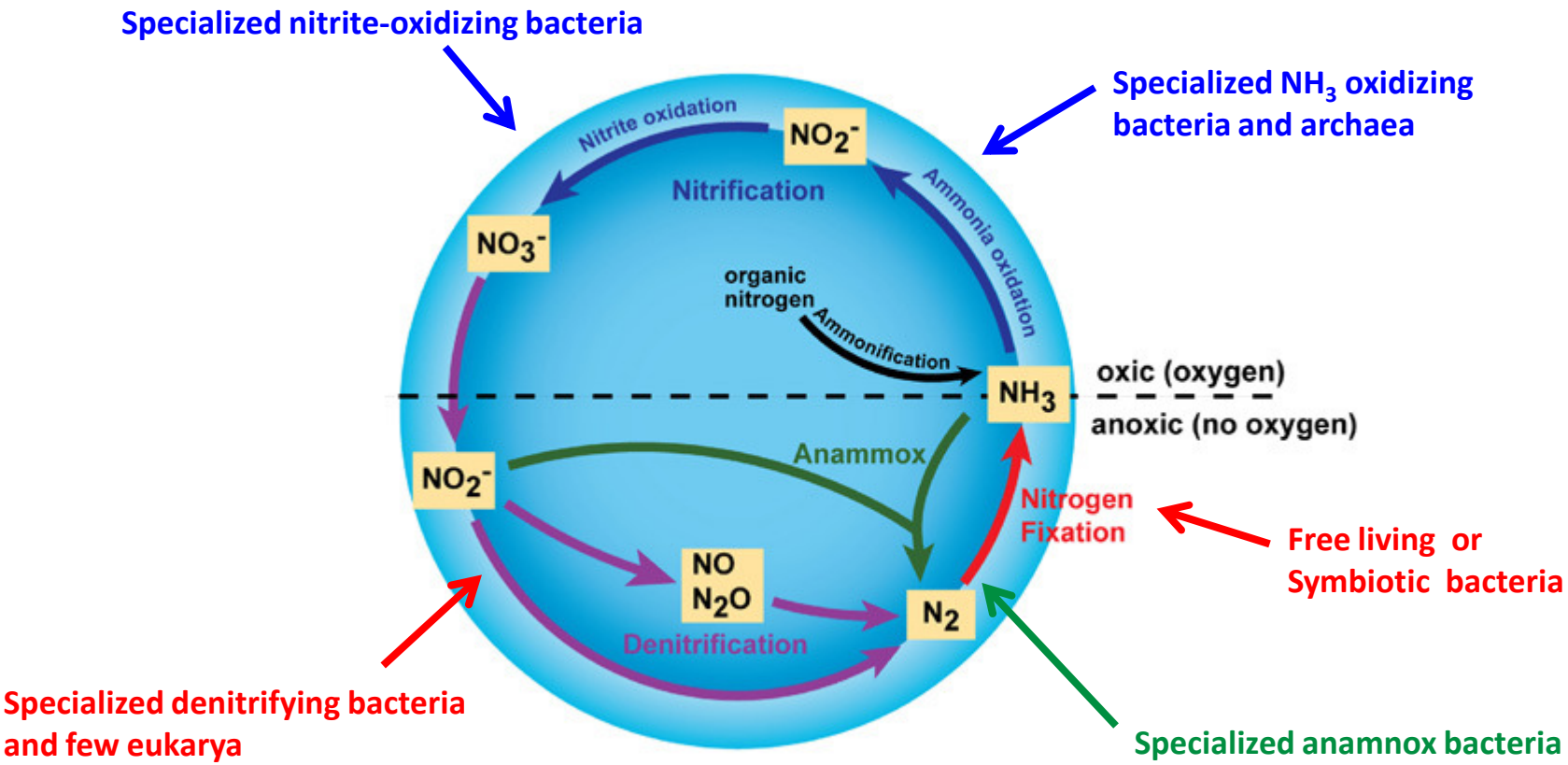
« In one year, we extract the equivalent **of one million** years worth of fossil fuel."
Falkowski, P.G. 2009. Tenth Annual Roger Revelle Commemorative Lecture: The once and future cean. *Oceanography* 22(2):246–251, doi:10.5670/oceanog.2009.57.

"… although on geological time scales the anthropogenic emission of CO_2 is a transient phenomenon, it will affect Earth's biogeochemical cycles for **hundreds of years to come**.
Falkowski, P.G. et al. 2000. The Global Carbon Cycle: A Test of Our Knowledge of Earth as a System. Science, 290: 291-296



"…**there is no natural "savior"** waiting to assimilate all the anthropogenically produced CO_2 in the coming century

HUMAN INFLUENCE ON NITROGEN CYCLING AND PRODUCTIVITY



Human impacts: nutient imbalance, changes in C storage, anoxia or hypoxia in water, unbalanced primary production, massive alien bacterial charges, HAB, parasitic and infectious diseases, fresh water pollution and acidification.

Nature Education 2010: http://www.nature.com/scitable/knowledge/library/the-nitrogen-cycle-processes-players-and-human-15644632

HUMAN INFLUENCE ON NATURAL RESOURCES

Natural resources are finite, and living beings evolve slowly through darwinian selection

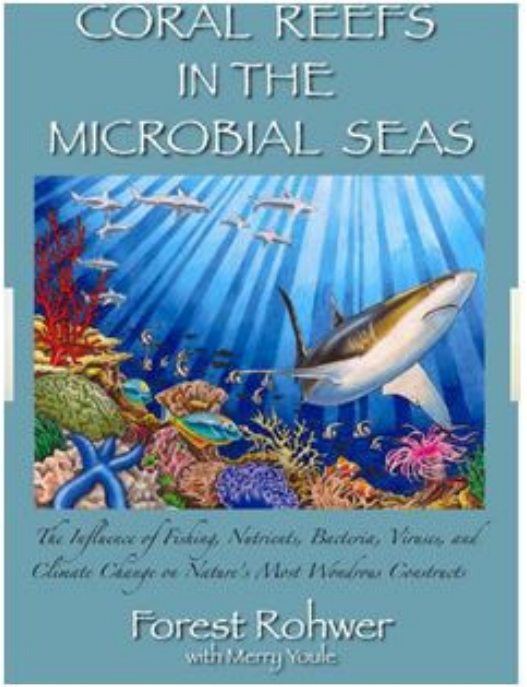
Every species fits perfectly into a natural ecological niche into a biodiverse environment.

Overexploiting wild species, capturing exotic animals, modifying natural environments, creating artificial molecules and genomes inevitably results in destroying much of the biodiversity.

Overexploiting « common goods » e.g. freshwater, sand, high value minerals modifies natural settings and creates pollution

OFF THE PRESS

Going extinct before being described ?



No coral reefs left by 2100?

The Telegraph

Home News World Sport Finance Comment Culture Travel Life
Politics Investigations Obits Education Earth Science Defence

HOME › NEWS › UK NEWS

All seafood will run out in 2050, say scientists

Image 1 of 2
If the rate of over-fishing continues, the world's currently fished seafoods will have reached what is defined as collapse by 2048

By Charles Clover, Environment Editor

No natural seafood left by 2050?

NATIONAL GEOGRAPHIC Daily News

Home Animals Ancient Energy Environment Travel/Culture Space/Tech Water Weird News Photos News Video News Blogs

Species Extinction Happening 1,000 Times Faster Because of Humans?

At the same time, new technology is helping conservation make big strides.

Trending Now

01 Erupting Alaska Volcano Puts on Fiery Display

02 Tiananmen Square Still Haunts Photographer Brothers After 25 Years

03 No Longer a Lone 'Westernmost Wolf' in Lower 48 States Is a Dad

04 Last Stand for U.S. Orcas?

Species extinction 1,000 faster due to man?

Enormous amounts are produced by some and improperly recycled by many

RECYCLERS

Enormous amounts are produ d by some and mproperly recycled by many

CONSUMERS

PRODUCERS

EVERYONE'S SOLUTIONS ON PRESSING ENVIRONMENTAL ISSUES

Carbon volatilization

CLEAN/RENEWABLE ENERGY SOURCES

Selective overexploitation of live resources

EDUCATION

PROTECTED ZONES

Creation of new genomes and of artificial molecules

SAFE MANIPULATION & DISPOSAL, TRACEABILITY

Urbanization

RECYCLING

Global commerce

THINK GLOBAL, ACT LOCAL

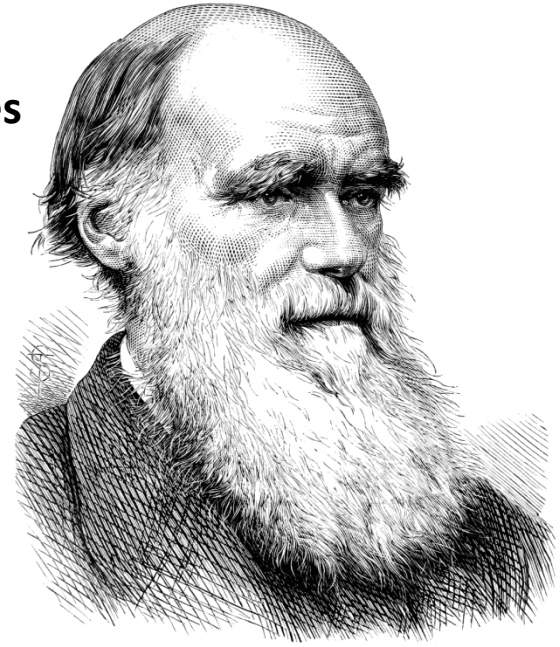
Nitrogen enrichment

OPTIMIZED PRACTICES

… but this is not sufficient !

SOLUTIONS ON PRESSING ENVIRONMENTAL ISSUES

… we need scientists at the rescue !



Monitor new & disappearing species

Link biodiversity and chemodiversity

Systems biology

Bioinspiration

Molecular biology (omics)

Bioinformatics for metadata treatment

Metagenomics

Connectivity

Use multi-scale approach (micro to global)

Biogeochemical cycles

Sampling and data collecting

Evo-devo

Metabolic studies (loss/gain of function)

Nutrients and food chains

PART FOUR

CONCLUSION

Ainslie Roberts – The Dreamtime Heritage