The Climate Debate

Is global warming real? Here's a fresh look at an old argument.

‘Global Warming’ has its Critics

Reg Morrison

The primary proponents of the theory of global warming are the scientists on the International Panel on Climate Change (IPCC), plus a number of independent scientists and environmental writers. They are opposed by a wide variety of sceptics who champion a broad range of counter arguments. Almost all agree that the global climate is changing to some extent, but the two sides violently disagree on the cause, the size, and the long-term significance of that change.

POSITIVE ARGUMENT:

‘Most of the warming is caused by human activity’

Global warming is real, is accelerating, and is caused to a significant degree by the burning fossil fuels. Our agriculture-based civilization will begin to collapse during this century if we don’t immediately curb emissions of man-made greenhouse gases, especially carbon dioxide. If we delay, we may even face extinction.

They contend that the global-warming proposition is underwritten by an overwhelming body of scientific research that ranges from the melting of polar icecaps and mountain glaciers to the disruption of biological rhythms; and most of the world’s authoritative climate scientists agree on the proposition that global warming is largely due to human activity.

NEGATIVE ARGUMENT:

‘There is little warming and most of it is natural’

The current warming trend is part of series of natural cycles and carbon dioxide is a very minor component of the atmosphere and mostly originates from volcanic eruptions and natural biological sources. Atmospheric levels of CO_2 and global temperatures have often been much higher than today, and life, especially plant life, has thrived in those conditions.

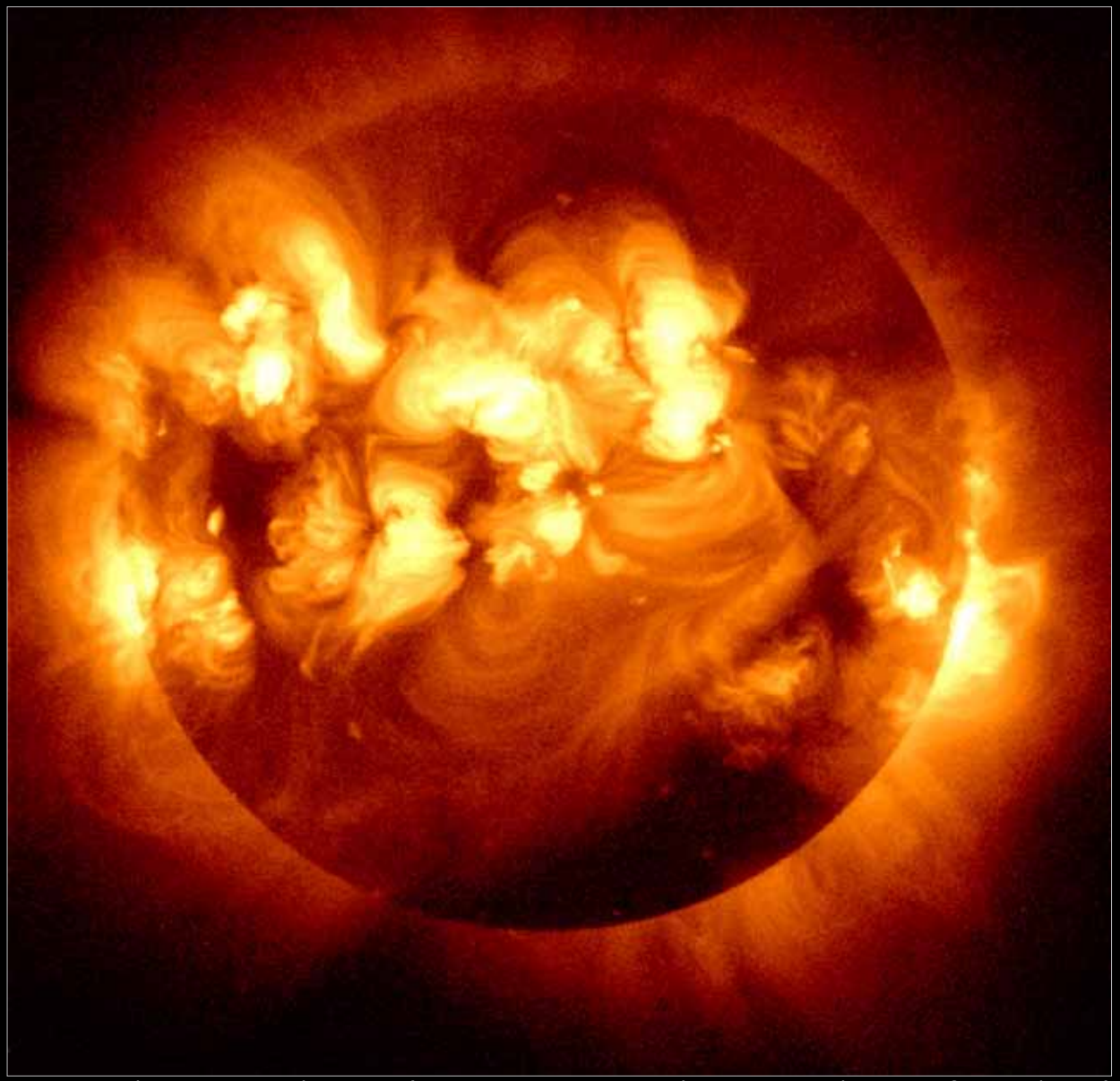
Proponents say that the catastrophic warnings issued by the IPCC are not widely believed by other climate scientists. Some sceptics also suggest that these warnings represents a collusive attempt to destabilise market forces and impose a fundamentalistic ‘Green’ religion on a poorly informed population.

There is only one point of general agreement in this divisive debate:

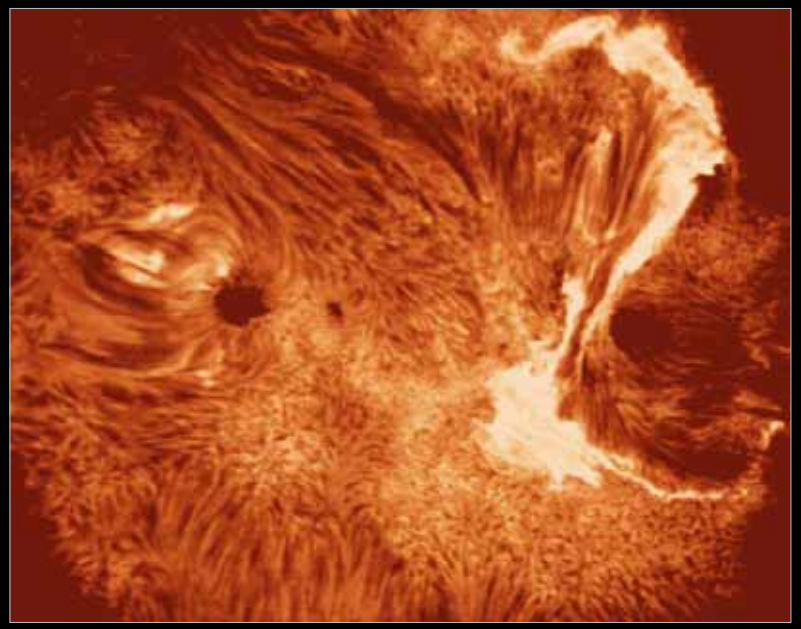
BOTH SIDES AGREE that the Sun is the Earth’s primary source of energy and thereby drives the Earth’s weather patterns and modulates its climate.

THE SUNSPOT – TEMPERATURE LINK

Solar radiation provides the primary drive for the Earth's biosphere. This fluctuates in direct proportion to the number of storms that perturb the Sun's surface. The more solar storms there are, the warmer our planet becomes.



Storms on the Sun, December 2006 (magnetic imaging, Hinode International spacecraft, JAXA/NASA).

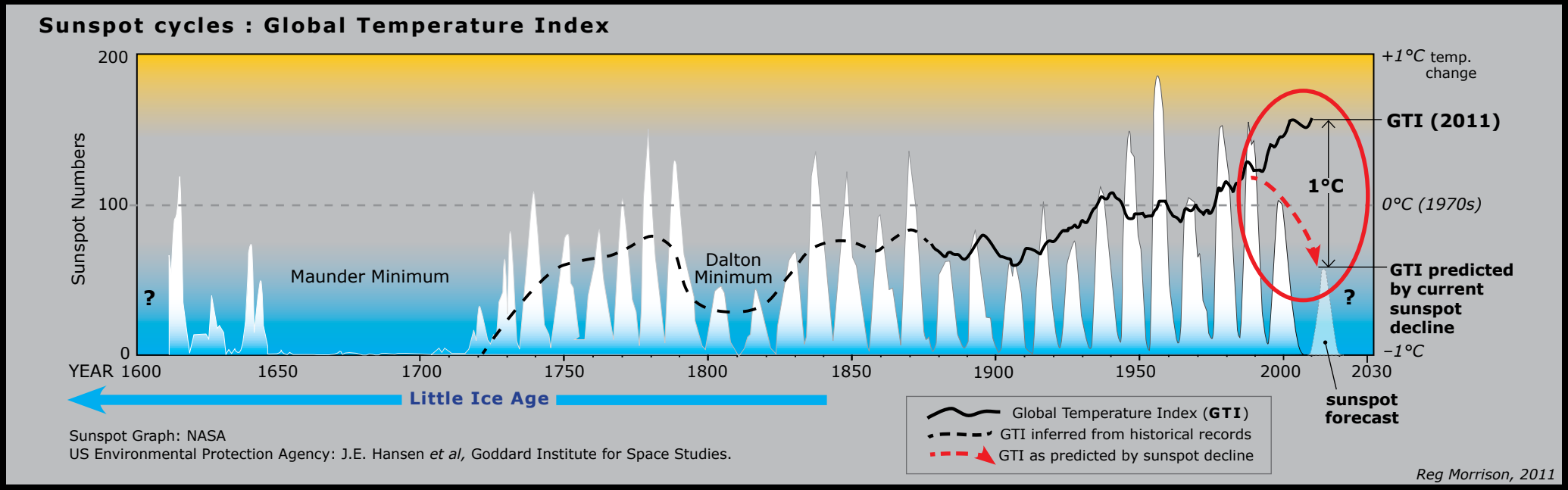


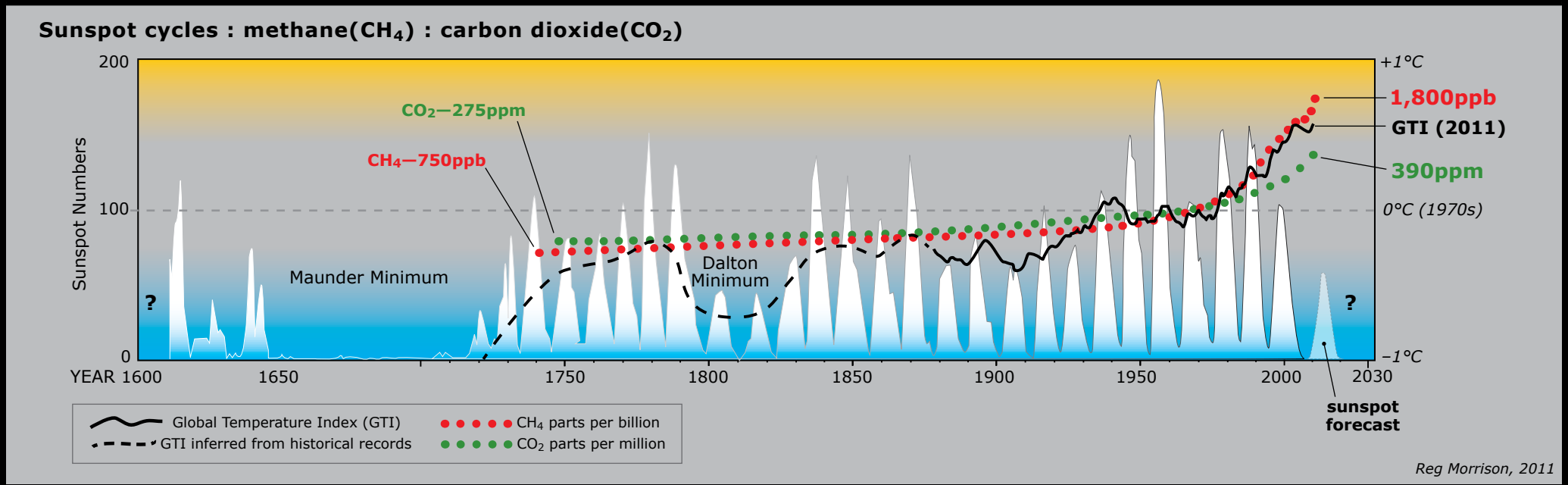
LEFT & ABOVE: The dark spots that appear on the surface of the Sun are all that we see of the violent storms that usually rage across its face. These composite images show the vast eruptions of energy that accompany those storms. Such eruptions, known as faculae, are a primary cause of surges in the 11-year cycle of Earth's temperature fluctuations.

The Sun's face is relatively blemish free—a rare phenomenon. So the Earth's global temperature should be plunging.

But it isn't . . .

The Global Temperature Index has diverged from the sunspot trend for the first time in 400 years.





The coincidental leap in atmospheric methane and carbon dioxide offers an explanation for the discord.

(The current sunspot cycle, No.24, will peak in 2013 and promises to be the smallest cycle of the past 100 years according to NASA)

Climate Change and the 1°C discord:

Judging by the recent dearth of storms on the Sun our planet currently appears to be about 1°C warmer than it should be. This discord may sound small to us, but on a global scale it represents an ominous disconnection from the fluctuations of the Sun, our planet's primary energy source, and a massive aberration that is without precedent in the past 400 years, and is probably without precedent in the past 400,000 years.

Unfortunately however, the loudest and most impassioned voices on each side of the current climate debate seem to be largely unaware of this temperature discord, and they seem similarly unaware of the potential significance of that discord for the survival our species.

Finally, there are three executive factors that are usually ignored by those on each side of the debate . . .

1. **Our thermodynamic universe is Chaotic, and it's running down.**
2. **Earth's biosphere is essentially a by-product of bacteria.**
3. **One group of bacteria constitutes evolution's 'shot-gun'.**

Here is a brief guide to those three crucial factors ...

THE LAWS OF THERMODYNAMICS

The universe is a single Chaotic energy system that is entropic (running down). It is therefore governed by the two primary laws of Thermodynamics:

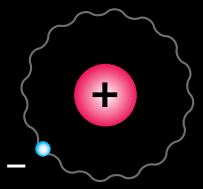
First Law: **Energy can neither be created nor destroyed ($E=mc^2$).**

It can be transformed from one state to another, but each change of state dissipates energy.

Second Law: **Energy only disperses.**

It flows from regions that are energy rich to regions that are energy poor.

The main energy carrier throughout the cosmos is hydrogen ...



- **Hydrogen constitutes ~90% of the known matter in the universe.**
- **It consists of just a single proton attended by a single electron.**

The weakness of this atomic alliance allows the partnership to be broken relatively easily and enables both the proton and the electron to make other molecular associations and perform other roles during the thermodynamic dissipation of energy.

LEFT: The vast clouds of dust and glowing gases that surround the Horsehead Nebula (in Orion's belt) reveal their primary component, hydrogen, by its reddish colour. All other wavelengths were filtered out during a seven-hour exposure made by astronomers at the Star Shadow Remote Observatory (www.starshadows.com/gallery/) in New Mexico, USA. This hydrogen image was then superimposed on a second (unfiltered) image that showed the underlying structure.

The Horsehead Nebula lies some 1,500 light years from Earth, and one of the three major stars from Orion's Belt appears left of centre.

CHAOS THEORY and the 'Butterfly Effect'

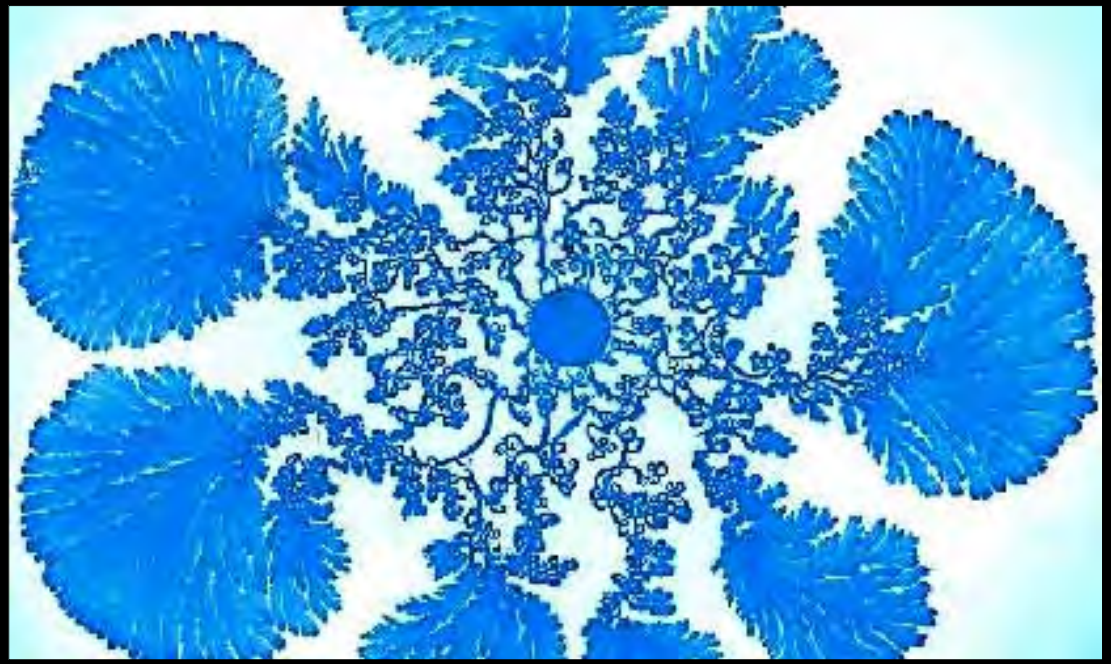
Mathematician and meteorologist Edward Lorenz first formalised this proposition in a paper entitled "Does the flap of a butterfly's wings in Brazil set off a tornado in Texas?" In his paper, originally delivered to the American Association for the Advancement of Science in 1963, Lorenz proposed that small differences in the starting state of a dynamic energy system can lead to enormous differences in its final state. The patterns of energy dissipation that characterise such 'chaotic' systems are essentially fractal (repetitive but non-identical). They are the hallmarks of entropy.

The truth of Lorenz' proposition has since been repeatedly confirmed, and Chaos is now classified as a Theory and generally accepted as a primary characteristic of the entire cosmos. As a by-product of the laws of thermodynamics it prevails at all scales of magnitude from the cosmic to the microcosmic, and permeates all energy systems, biological and non-biological. It is ubiquitously displayed in the fractal patterns of energy dissipation that characterise every aspect of our biosphere.*

As an interchangeable expression of the Earth's crust, life itself is inherently Chaotic and fractal and it graphically displays this in all aspects of its growth, reproduction and diversification (RIGHT).

As an integral component in the Earth's Chaotic system of energy dissipation, all life expresses the 'Butterfly Effect' by its sensitivity to the smallest changes in any of its multitudinous inputs.

Most climate scientists take Chaos Theory into all their considerations. Climate sceptics generally don't.

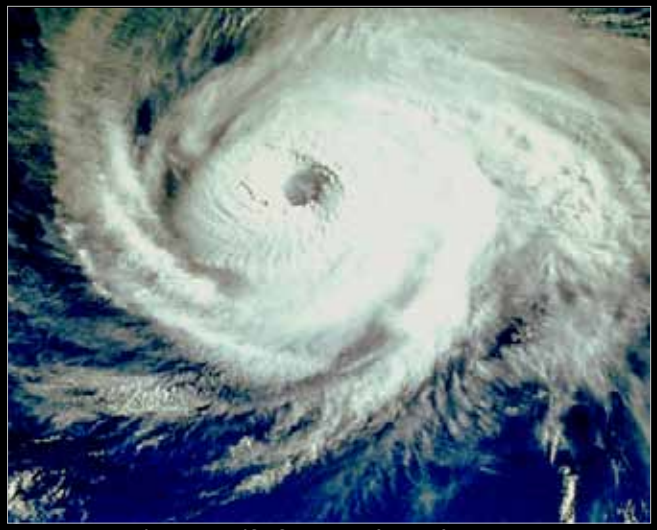


A bacterial colony (*Paenibacillus dendritiformis*). PHOTO: Eshel ben Jacob, Tel Aviv University, Israel.

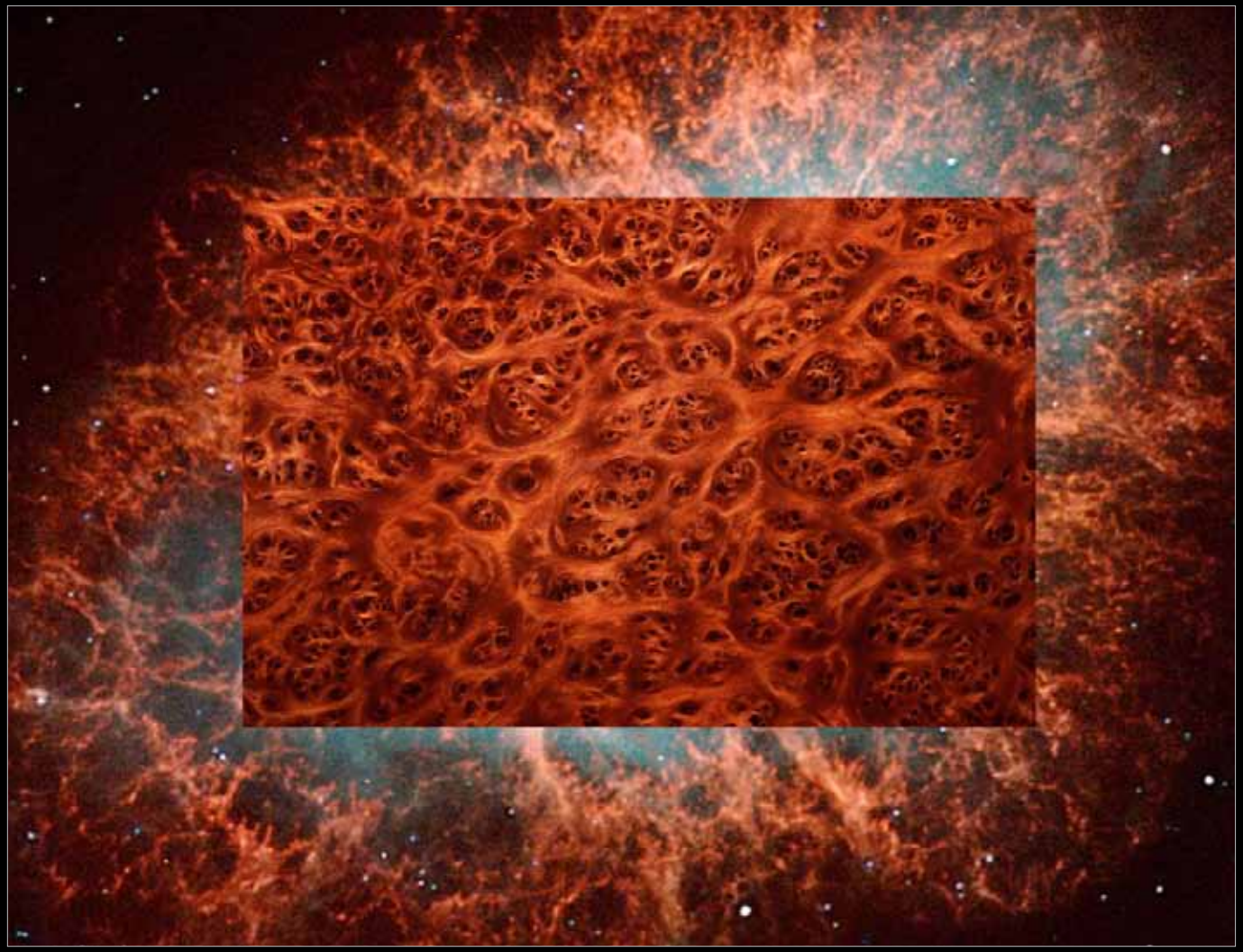
*See: ***"Fingerprints of the Cosmos"***

CHAOS
in the cosmos

Whirlpool Galaxy, Hubble Telescope (NASA).



Hurricane Odessa, Gulf of Mexico (NASA).



ABOVE, BACKGROUND: Chaotic filaments of dust and gas, mainly hydrogen, within the supernova debris known as the Crab Nebula some 6,500 light years away. Light takes 10 years to span the structure. (PHOTO: Walter Nowotny, University of Wien. Nordic Optical Telescope.)

ABOVE, INSET: A chaotic tangle of vascular bundles inside a burl cut from an old New Zealand Kauri tree (Agathis australis). In echoing the pattern of energy dissipation within the Crab Nebula, this cross section displays the fractal 'fingerprint' of chaotic entropy that characterises all cosmic structures at all scales of magnitude from cosmic to microcosmic.

CHAOS
in microcosm

The gaudy swirls of rainbow colour that drift across a soap film shortly before it bursts perfectly illustrate the chaotic and fractal nature of the entire universe.

The colours in a soap film result from wave interference between light waves reflected from the front surface of the film and those reflected from the film's internal rear surface.

As a product of the dissipation of energy within the soap film (via evaporation), the flow of colour that characterises its surface thereby betrays the film's loss of water molecules as it decays, and reveals variations in its thickness against the length of a light wave.

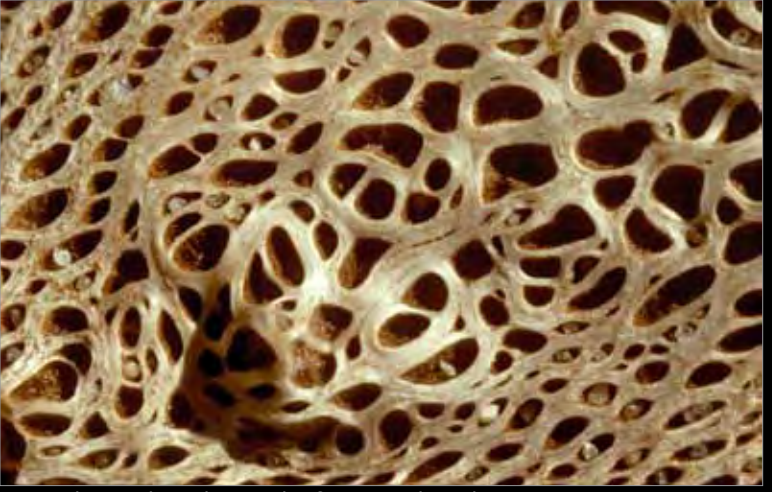
Such patterns recur in all fluid systems at all scales of magnitude from the cosmic to the microcosmic.

ABOVE: The evaporation of water molecules from this soap film occurred in perfectly still air. The flow of colours consequently expresses the standard patterns of chaotic energy flow that typify the entropic process in our thermodynamic universe.

ABOVE: This soap film reflects a disturbance pattern in the air surrounding the soap film. (I breathed out just before taking the shot). This minor disturbance to the evaporation process was enough to rearrange the film's entire pattern of energy dissipation.

FRACTAL FLORA

Founded on the bacterial extraction of hydrogen, mostly via photosynthesis, the Earth's surface life is an integral part of the planet's energy dissipation machinery. The clearest evidence of this appears in the Chaotically fractal nature of all biological growth and reproduction ...



Fractal growth in the trunk of a coastal Bankia, NSW.

Treefern frond, *Cyathea sp. NSW.*

A thalloid liverwort, TAS.

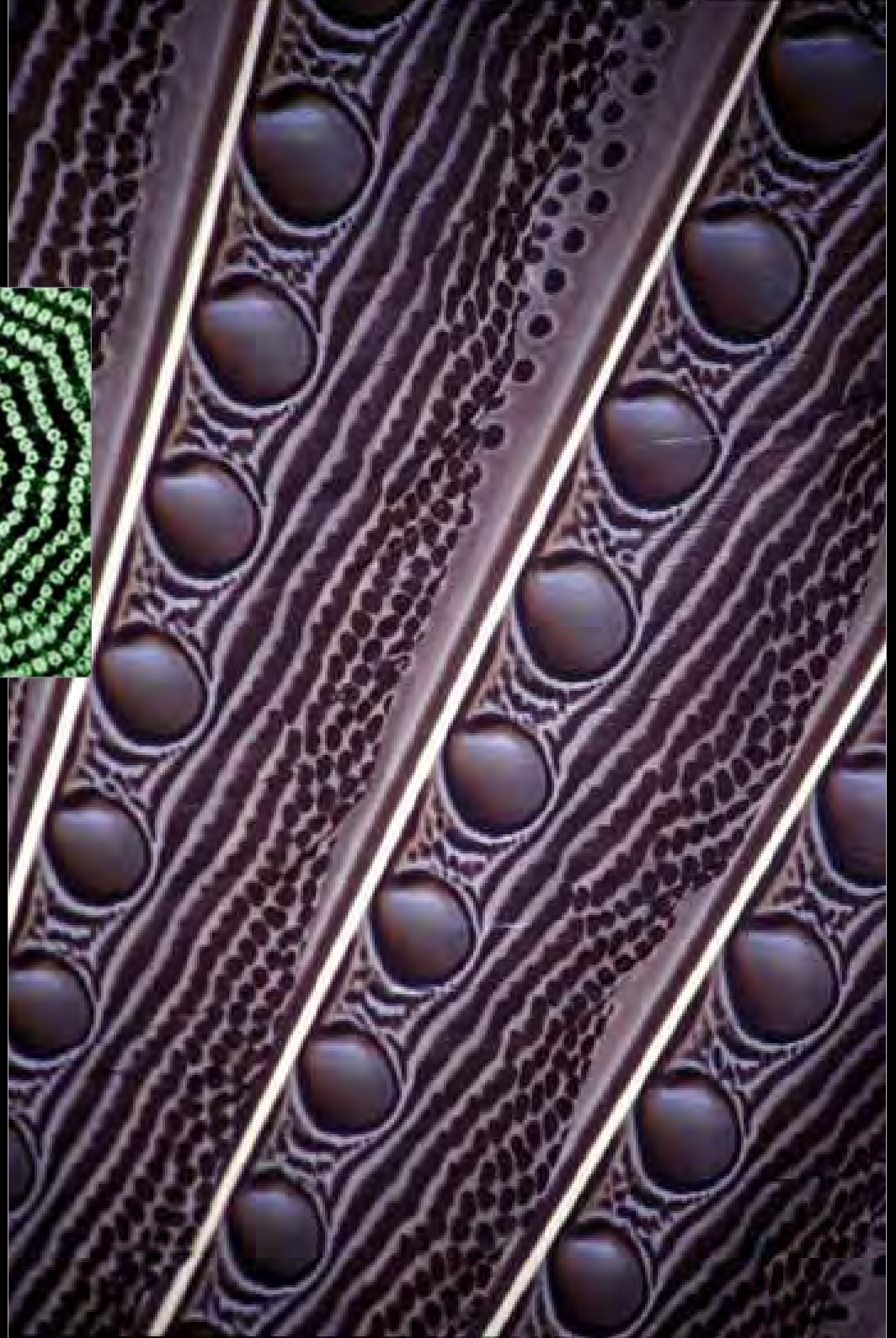
Gimlet gum, *Eucalyptus salubris,* WA.

FRACTAL FAUNA

Sea urchin shell, NSW.

Axopod microtubules 1

Human brain (Broca's area)



Wing feathers of an Argus pheasant (*Argusianus argus*).

THIS COSMIC CAMELOT

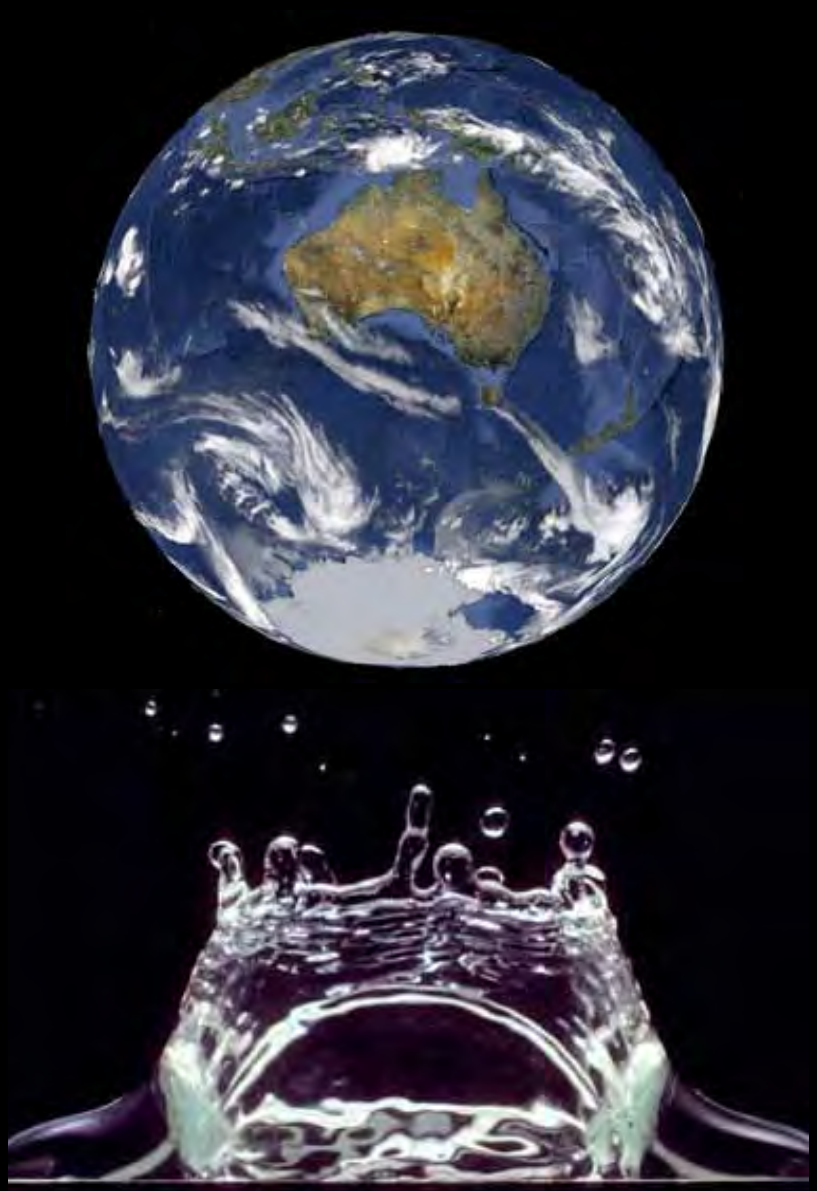
Earth's modern biota constitutes a gigantic air-conditioner. Its organisms cool the planet by pumping carbon from the atmosphere into their bodies, and from there into the soil, rocks and seas, where it may remain locked out of the carbon cycle for long periods of geological time. It is a process that began some four billion years ago when the Earth was young and its atmosphere contained more than 100 times the carbon it holds today. Inevitably, life seized on this abundant, stable building material and by thinning the atmosphere's heat-retentive carbon blanket it cooled the planet to its mild Phanerozoic range of 12°–20°C (current average ~16°C.)

Via this process, life's hydrogen-fuelled primary producers—photosynthetic bacteria—have created a moderate, oxygen-charged biosphere that nurtures a vast biota of other organisms.

This is the cosmic Camelot that we enjoy today.

PHOTO: Robert Simmon and Reto Stöckli, NASA.

OUR PLANET'S CHAOTIC THERMOSTAT



Earth's primary source of energy is solar radiation, and the primary executive factor that governs its distribution throughout the biosphere is hydrogen's oxide, H_2O. Water vapour constitutes somewhere between 60% and 80% of the greenhouse effect. Meanwhile, the latent energy involved in water's change of state between solid, liquid and gas, helps to modulate the planet's climate extremes.

• Higher solar input promotes vegetative growth and higher rates of evaporation. Where this water vapour condenses into clouds it reduces the impact of solar radiation and prevents further global warming.

• Lower solar input reduces evaporation producing clear skies and the spread of deserts in temperate zones. This maximises solar input and counters global cooling.

• If Earth's biota should suddenly collapse and return its carbon to the atmosphere, either in carbon dioxide (CO_2) or in methane (CH_4), global temperatures would swiftly rise by some 15°C.

• Conversely, if Earth were to shed its present atmosphere entirely, the global temperature would plunge some 33°C.

Between those limits however, the temperature is continually adjusted by the biota's natural growth or decline, and its increasing assault by human activity and overpopulation.

For example, a temperature increase of just 1% can generate a 30% increase in plant respiration, and these immediate responses, all of them midwifed by photosynthesis and its harvest of hydrogen, give the biota a very large climate lever to play with.

FOOTNOTE 1 (previous page): Picture of axopod microtubules courtesy of Lynn Margulis, ***Symbiosis in Cell Evolution.*** Further reading: "**Life's Maker and Breaker**"

2. BACTERIA

But there is a second component in the complex machinery that links climate and evolution, an invisible player that acts as midwife in the tumultuous process of creating storm clouds ...

2. BACTERIA

ABOVE: A dead midge and a strand of crumpled spider silk provided the nucleus about which this large droplet coalesced. It epitomises the nucleation process that is midwife to the growth of the dense clouds that form the planet's life-giving rain storms and maintains its highly reflective cloud cover. The dense white cumulous clouds that deliver much of the planet's rain also reflect up to 80% of the incoming sunlight and help to cool the planet.

It has recently been discovered that bacteria, play a major role in the birth of dense, reflective, rain-bearing clouds.

Each of the enlarged droplets that form these clouds requires a nucleus on which water vapour can condense and accumulate.

The land supplies these nuclei in the form of dust as well as the bacteria that escape from green leaves via their breathing pores. Such bacteria form a major component in the mass of organisms that drift about the planet as aerial plankton.

The sea also provides nuclei for clouds in the form of a vapour that is discharged by a broad range of photosynthetic marine plankton. This vapour, a by-product of marine bacteria, is dimethyl sulfide (DMS).

Where dust, pollen, DMS and aerial plankton fail to supply sufficient nuclei for raindrops to form, clouds may still appear, but rain rarely falls.[1]

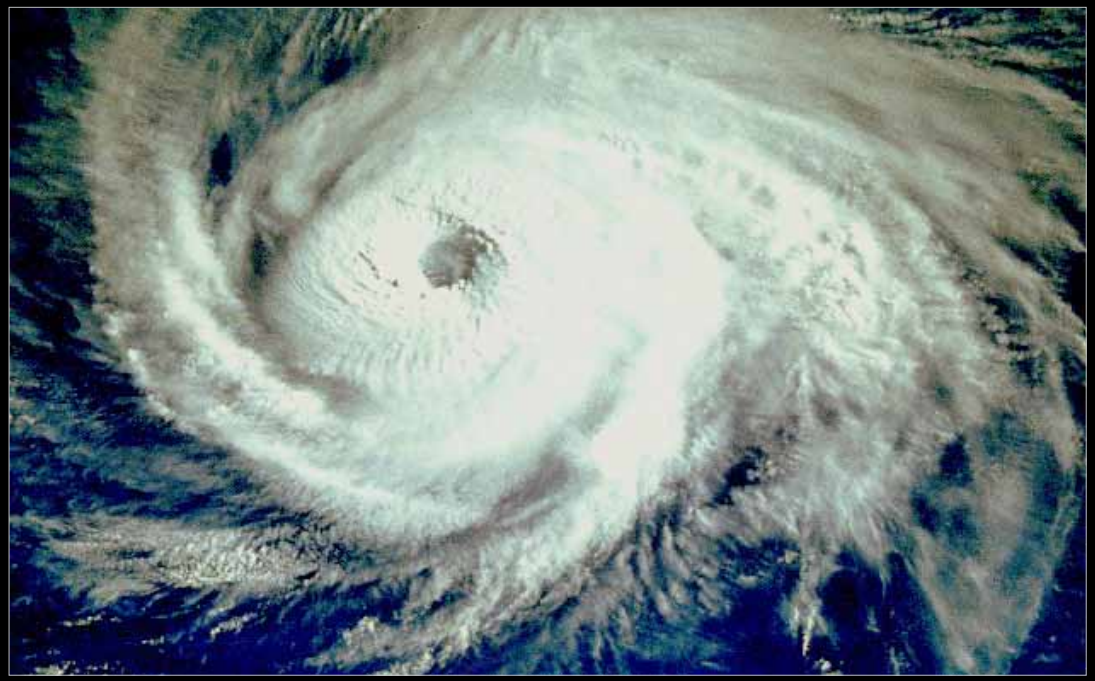
1 Walter Jehne, *Nature and Society*, Jan. 2007 pp.7–14.

THE CLIMATE'S 'FINE-CONTROL'

Millions of tonnes of dimethyl sulfide gas (DMS) are released into the atmosphere each year by planktonic marine bacteria, and it has recently been discovered that this hydrogen-rich gas (C_2H_6S) is a major regulator of the Earth's climate.

It is now known that DMS molecules provides some of the core material about which vapor condenses to form broad sheets of cloud, and where both DMS and other nuclei such as dust and aerial bacteria are abundant, very large, thick cloud masses can accumulate.

The climatic effect of cloud masses like those shown here, is both positive and negative. They not only deflect up to 75% of the Sun's incoming energy, thereby helping to cool the planet, they also block and absorb heat radiating from the planet's surface, thereby enhancing the greenhouse effect. These counterposed effects are finely balanced.



The Chaotic vortex of the Pacific typhoon, Odessa, in 1985 (NASA).

Monsoon storms gather over the Gulf of Carpentaria, QLD.

Each of these clouds sits above the island that gave birth to it in the Gulf of Carpentaria, off Northern Australia. Water vapour and heat rising from the islands produced moist up-drafts, causing their water vapour to condense into visible droplets as they pushed into the cooler air above. By shading the land, these reflective clouds constitute a negative feedback that limits further heating.

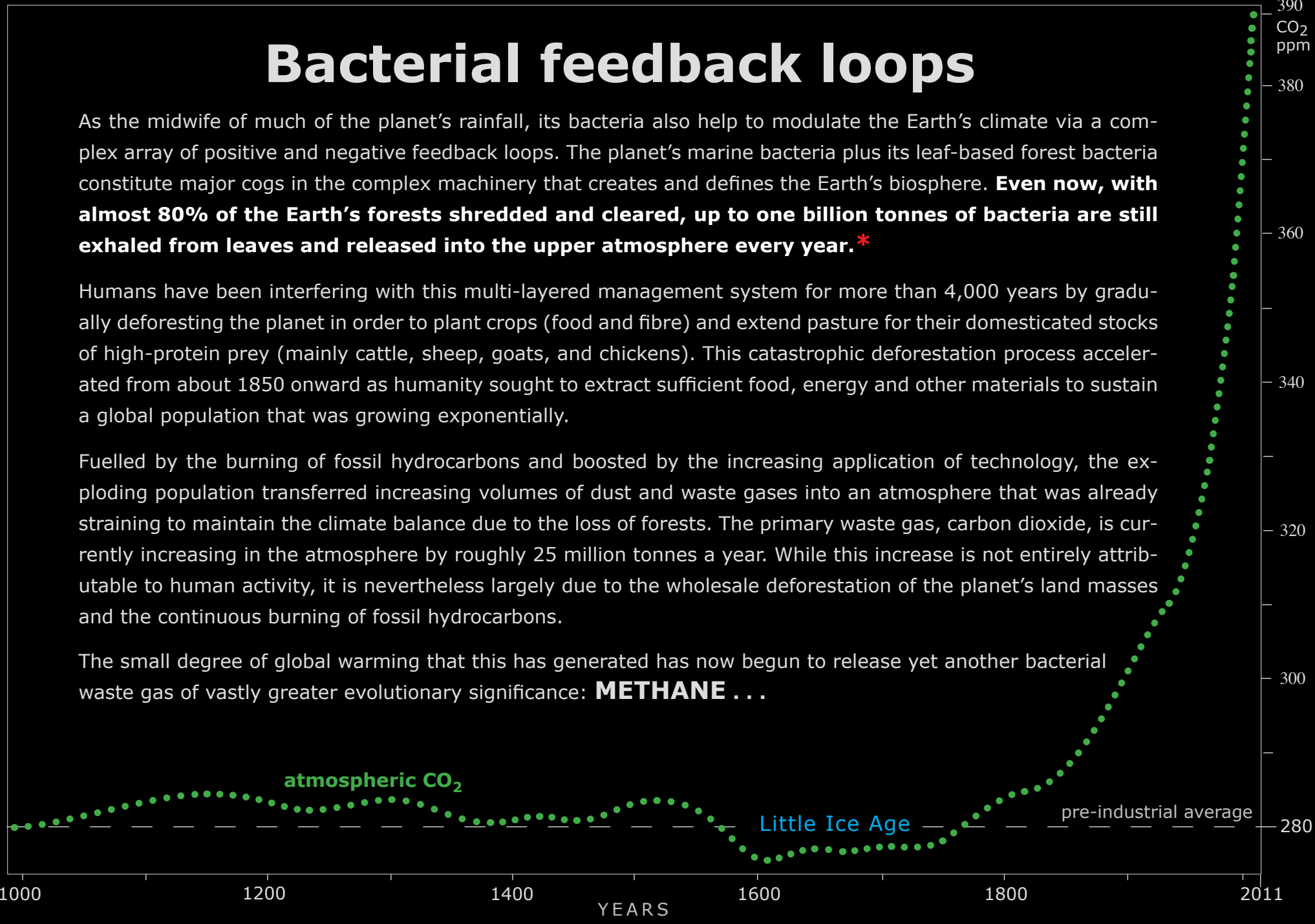
Bacterial feedback loops

As the midwife of much of the planet's rainfall, its bacteria also help to modulate the Earth's climate via a complex array of positive and negative feedback loops. The planet's marine bacteria plus its leaf-based forest bacteria constitute major cogs in the complex machinery that creates and defines the Earth's biosphere. **Even now, with almost 80% of the Earth's forests shredded and cleared, up to one billion tonnes of bacteria are still exhaled from leaves and released into the upper atmosphere every year.***

Humans have been interfering with this multi-layered management system for more than 4,000 years by gradually deforesting the planet in order to plant crops (food and fibre) and extend pasture for their domesticated stocks of high-protein prey (mainly cattle, sheep, goats, and chickens). This catastrophic deforestation process accelerated from about 1850 onward as humanity sought to extract sufficient food, energy and other materials to sustain a global population that was growing exponentially.

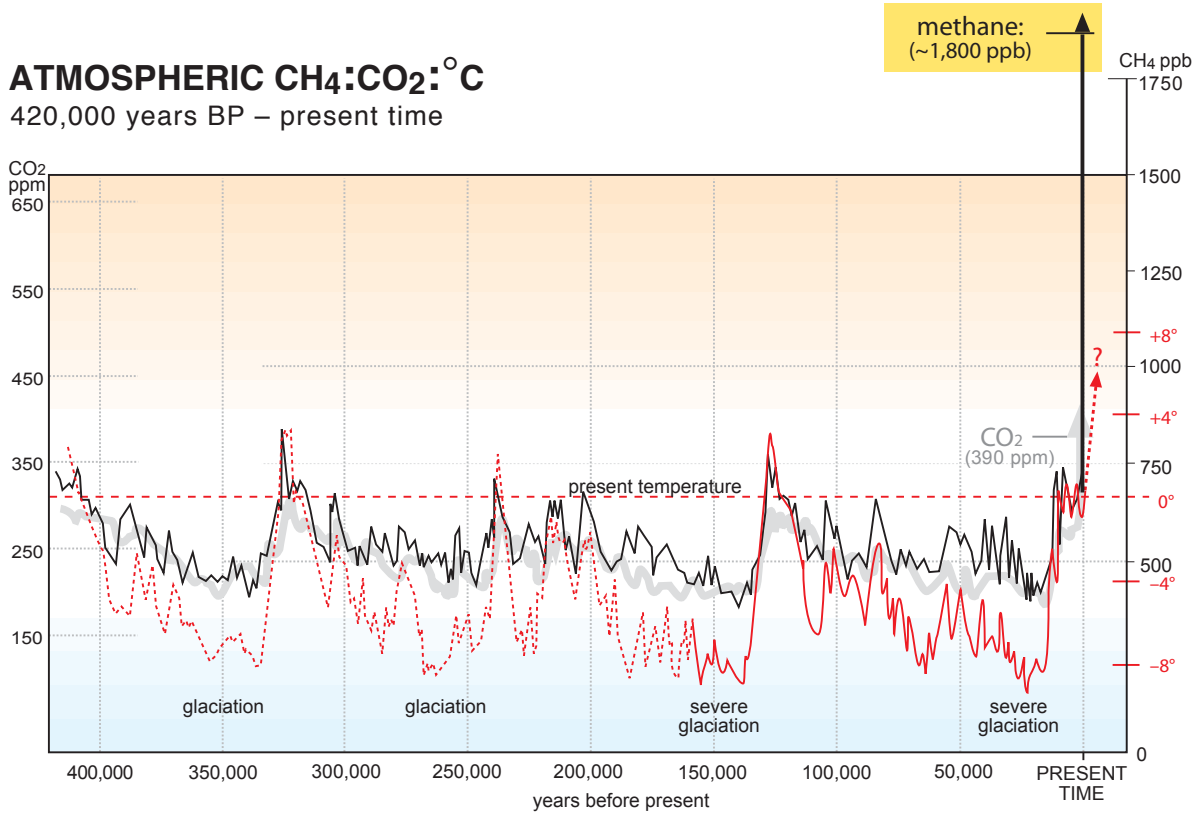
Fuelled by the burning of fossil hydrocarbons and boosted by the increasing application of technology, the exploding population transferred increasing volumes of dust and waste gases into an atmosphere that was already straining to maintain the climate balance due to the loss of forests. The primary waste gas, carbon dioxide, is currently increasing in the atmosphere by roughly 25 million tonnes a year. While this increase is not entirely attributable to human activity, it is nevertheless largely due to the wholesale deforestation of the planet's land masses and the continuous burning of fossil hydrocarbons.

The small degree of global warming that this has generated has now begun to release yet another bacterial waste gas of vastly greater evolutionary significance: **METHANE . . .**



* Walter Jehne. "The biology of global warming and its profitable mitigation." ***Nature and Society***, Dec 2006 – Jan 2007, pp.7-14

Whether you are a bacterium or a human being, any energy that you harvest from the environment ultimately feeds back into the environment and perturbs it—Chaotically.



Based on Antarctic and Greenland ice-core data, and atmospheric data from Cape Grim, Tasmania.

Vostok ice core data: Petit et al, Nature *(No.399, 1999)*
Law Dome ice core data: Etheridge et al., Journal of Geophysical Research *(1996)*
Cape Grim Station data: CSIRO Atmospheric Research and Bureau of Meteorology
°C between 160,000 and 420,000 years BP from IPCC.

GREENHOUSE GASES

Atmospheric levels of two key greenhouse gases, methane and carbon dioxide, have varied continuously throughout the life of the planet and their fluctuations have generally coincided with changes in global temperature. Higher levels coincide with higher temperatures.

Methane is now at its highest level for at least 400,000 years and that level is climbing fast.

Although carbon dioxide is more abundant, it is now known that methane is at least 60 times more effective as a greenhouse gas when measured over a short period such as 20 years, and about 100 times more effective over 5–7 years.

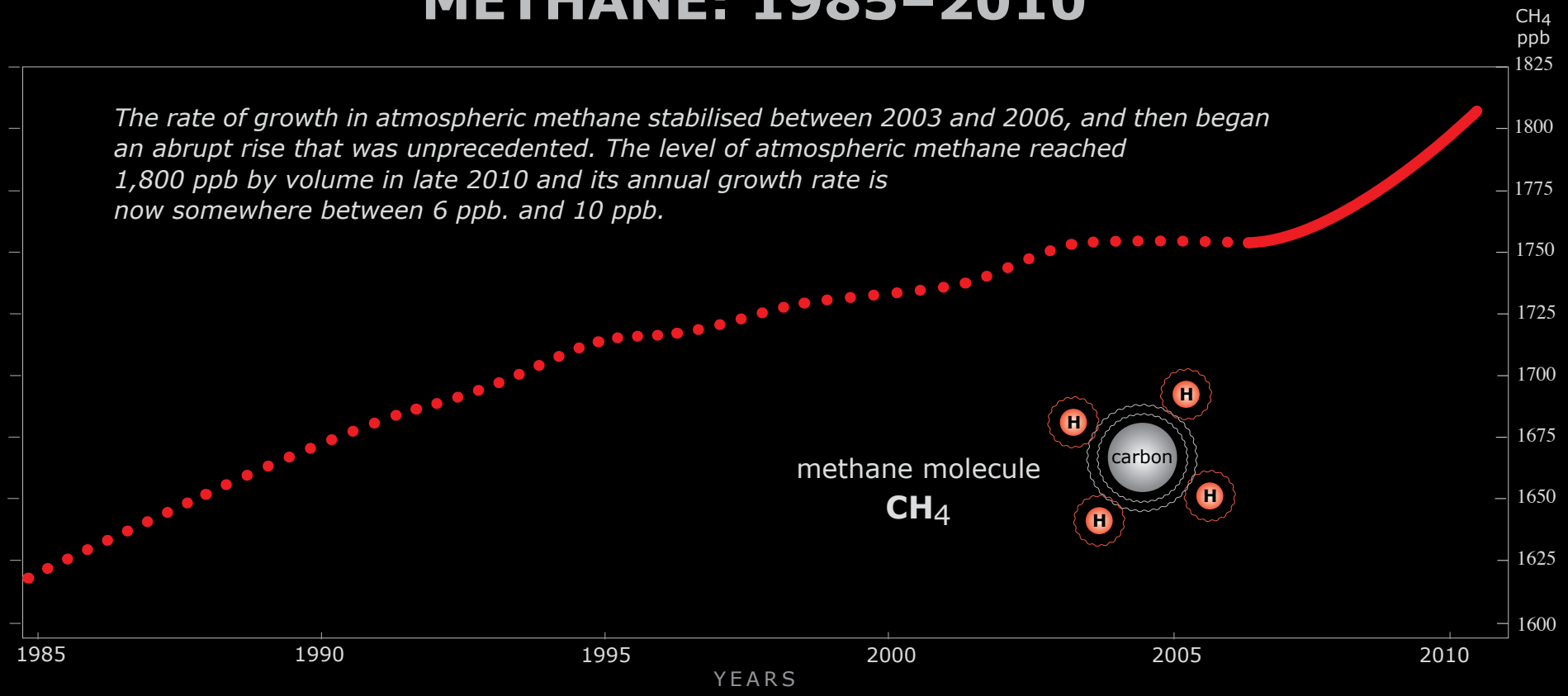
This savage short-term effect is partly due to hydrogen's tendency to react with other atmospheric components in ways that multiply methane's potential as a greenhouse gas.*

Atmospheric carbon dioxide has risen 36% during the past 150 years, but during that time the level of atmospheric methane has more than doubled. It is now at its highest level in 400,000 years. The above graph shows the tight correlation between temperature spikes and the methane spikes. This suggests that the most immediate threat to our survival on this overloaded planet is not carbon dioxide … it is methane.

* For further information read: **"Methane"**

3. METHANE

METHANE: 1985–2010



A reassessment of methane's Greenhouse impact

The volume of methane in the atmosphere has grown fairly steadily since the beginning of the modern industrial era (~1750) when it was only about 680 ppb. When the daily rate of methane decay finally caught up with the increased rate of injection in 2003, the level stabilised for almost four years. Towards the end of 2006 however, the methane level began to surge again, due no doubt to the accelerating disintegration of submarine and tundra hydrates as the polar ice began to melt.

It has been recently calculated that methane's interaction with other constituents of the atmosphere, especially hydroxyl (OH) and sulfate particles, has enhanced methane's warming effect by 20–40% over previous estimates. Climatologists at NASA's Goddard Institute for Space Studies now believe that methane may account for up to a third of the global warming from greenhouse gases between 1750 and today. *

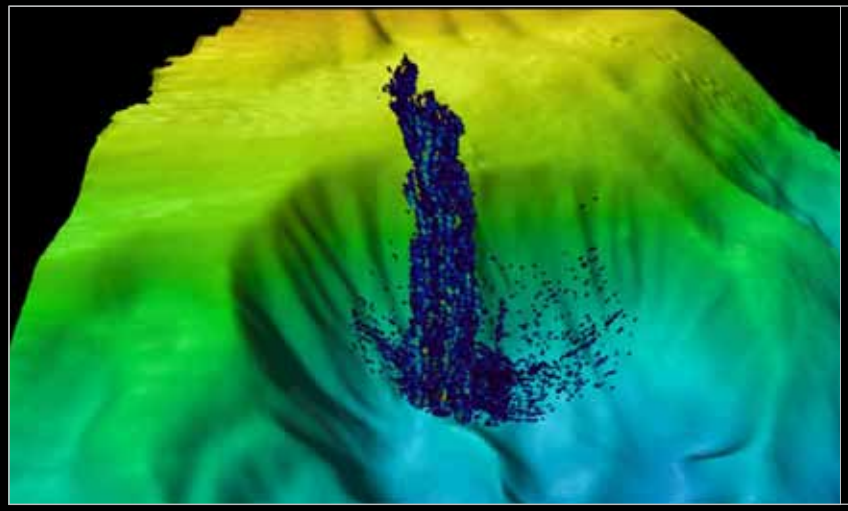
* "Improved Attribution of Climate Forcing to Emissions." Drew T. Shindell, Greg Faluvegi, Dorothy M. Koch, Gavin A. Schmidt, Nadine Unger, and Susanne E. Bauer, 2009. *Science,* 326: 716-718

EVOLUTION'S SHOTGUN

Few are aware that the moderate climate we enjoy is largely a by-product of four billion years of bacterial activity. Even more poorly understood is the fact that one particular group of bacteria played a fundamental role in the evolution of life on Earth, and continues to do so. These are the principle producers of the crucial greenhouse gas, methane (CH_4). They are among the world's oldest life-forms, and without the injection of their heat-retentive waste gas into the young planet's primitive atmosphere, Earth may have remained relatively lifeless.

In considering the role played by these methane generators (methanogens) we need to be aware of methane's greenhouse potential. Its four hydrogen atoms make it a reactive gas with a relatively short life, and it is commonly said to be some 20–23 times more heat-absorbent than carbon dioxide. But this figure only refers to its average potency over a time span of 100 years. Rarely mentioned, however, is the fact that during methane's first decade in the atmosphere it has more than 70 times the potency of CO_2, and during its first five years it has at least 100 times the greenhouse impact of CO_2. Also neglected is the fact that vast quantities of methane are imprisoned in innumerable icy cages all around the world—in frozen tundra bogs and on the semi-frozen seabeds that fringe most of the world's continental land masses. Commonly known as hydrates, these icy gas reservoirs alone hold some 3,000 times the volume of CH_4 in the atmosphere.

In an evolutionary sense this vast stockpile of potent bacterial gas represents one of evolution's most effective culling mechanisms. There is strong evidence to suggest that eruptions of methane from this vast reservoir have contributed to massive extinction events several times in the past. It now appears that the sharp rise in the average global temperature over the past 30 years has once again begun to destabilise these hydrates, allowing this potent bacterial gas to escape into the seas and into the atmosphere.



This is a sonar image of a plume of methane bubbles rising from disintegrating hydrates on the seabed off the coast of California. It was discovered by accident during a test of newly developed multi-beam sonar equipment by the National Oceanic and Atmospheric Administration (NOAA). The slumping pattern around it suggests a recent landslide.

This plume, one of many, originates at a depth of 1,800 metres and after rising about 1,400 metres from the seabed the column of bubbles gradually disappears as the methane dissolves into the seawater, helping to acidify it.

Similar plumes are now believed to exist on many continental shelves around the world. The most spectacular eruptions are in the Arctic Ocean west of the Svalbard Islands, and in the Laptev and East Siberian seas.

Methane Hydrates

Methane discharged by the vast mass of methanogenic bacteria that inhabit the Earth's crust tends to accumulate in the upper layers of the seabed wherever porous marine sediments happen to freeze. The ice crystals in these layers form a dense, interlocked lattice that traps the bubbles of methane and prevents their escape into the atmosphere.

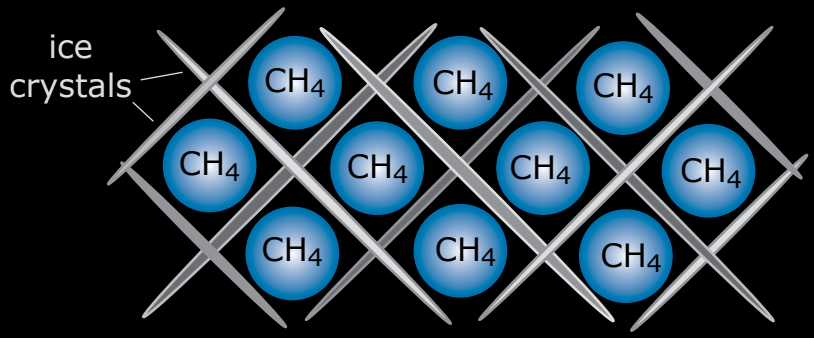
These huge methane reservoirs are continuously recharged, both by the anoxic decay of biological material washed from the continent, and by waste gas that migrates upward from the vast population of methanogenic bacteria that inhabit most crustal material—especially the broad apron of sedimentary material that fringes each of the major continental land masses. This submarine reservoir alone is believed to contain at least 3,000 times the volume of methane that is presently in the atmosphere.

Seismic activity or significant temperature changes can rupture these methane-loaded hydrates, and on occasions, unpin the overlying sediments, allowing them to slip down the slopes that fringe most continents.

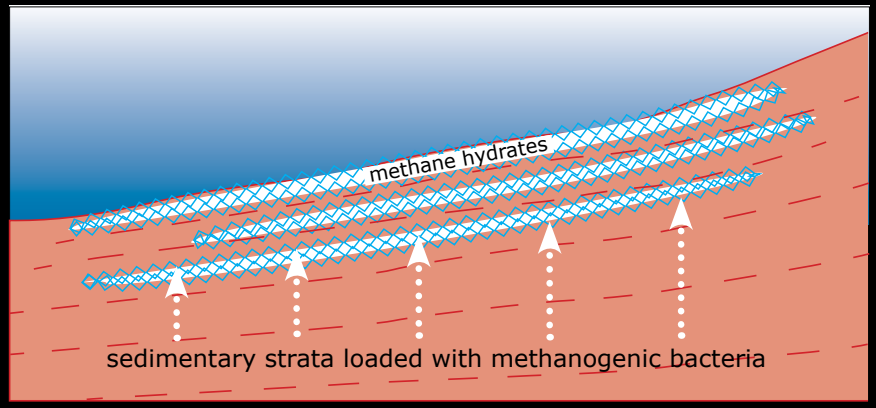
Some submarine landslides have been very large indeed, and methane that is released in this abrupt fashion represents a major threat to the global climate. One recent slippage involved an area of seabed that was described by British researchers as being almost the size of Scotland.

Such explosive releases of abyssal methane are now believed to have been responsible for several of the more abrupt temperature rises that ended glacial episodes in the past. This appears to have contributed to the end of the world's longest and most savage ice age some 620 million years ago* and also helped to wipe out more than 90% of marine species and about 70% of land life during the world's worst mass extinction 251 million years ago.

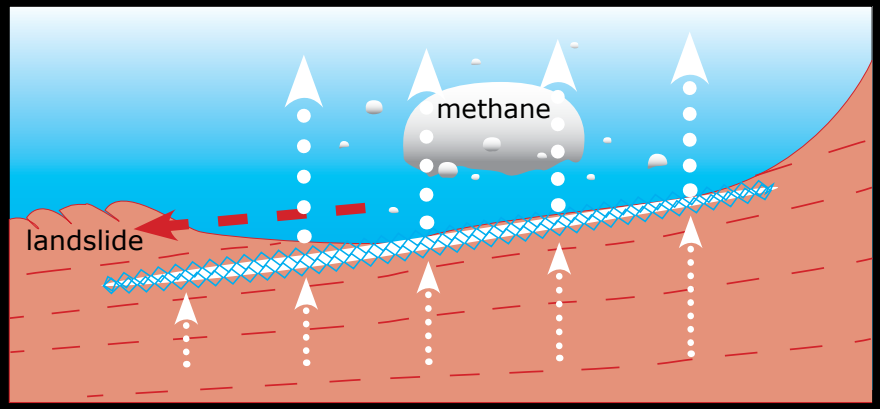
Methane Hydrate
(schematic)



Cold seas



Warm seas



*Martin Kennedy, David Mrofka, Chris von der Borch. "Snowball Earth termination by destabilization of equatorial permafrost methane clathrate." *Nature* **453**, 642-645 (29 May 2008).

Hydrate Collapse

Many marine hydrates are locked in place by the icy abyssal currents that are generated by the sinking of cold, dense saltwater in polar regions. These abyssal currents gradually girdle the planet before surfacing and returning to their polar birthplace. This global circulation system is known as the thermohaline current.

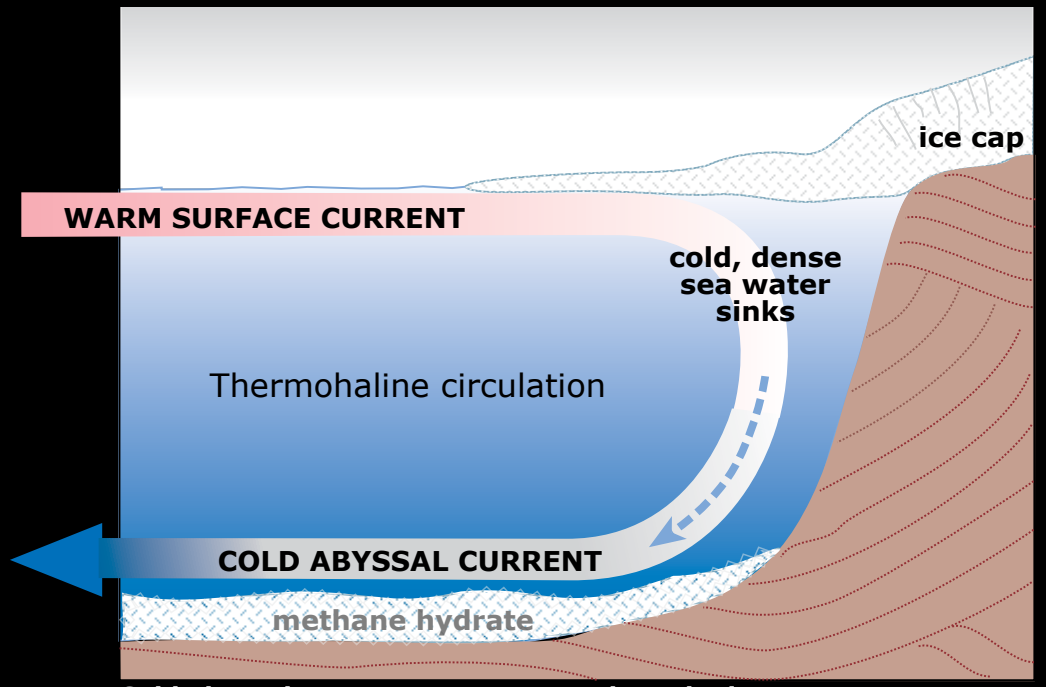
So long as these cold abyssal currents continue to flow, the world's sea-floor hydrates generally remain frozen and stable. But whenever rising temperatures thaw the polar icecaps to any significant degree, the boyant melt-water pools on the surface, inhibiting the driving mechanism that runs the world's thermohaline circulation system. This allows wind-driven fingers of warm surface water to reach down to the sea floor and release the methane from its icy cage.

The last time this appears to have happened was about 55 million years ago, when according to the geological record, a discharge of 1,200–2,500 gigatons of methane caused a temperature spike of 8°–10°C in polar regions and brought lush redwood forest to northern Greenland.

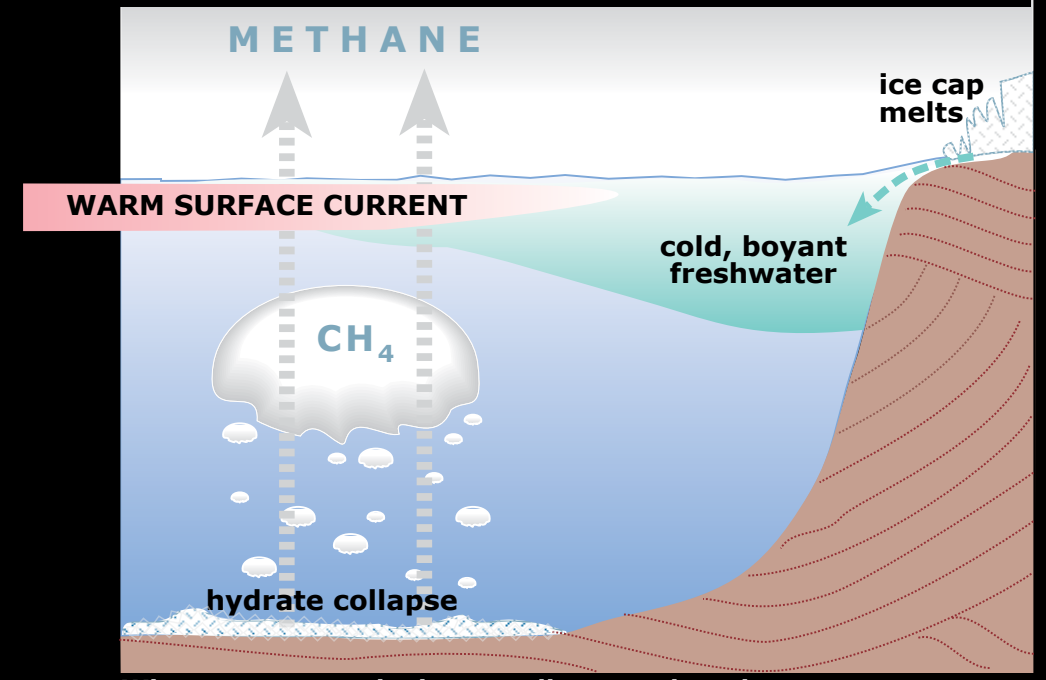
Such polar warmth generated a deep-ocean temperature rise of 5–7°C in high latitudes, and appears to have switched off the the world's thermohaline circulation starving the inert abyssal waters of oxygen. The carbon-loaded acidified seas caused a mass extinction of marine foraminifera.

The temperature spike that occurred at this time appears to have been vastly greater and more abrupt than could possibly have been generated by the gradual rise in atmospheric CO_2 that preceded it.[1]

The global temperature has risen almost 30 times faster than this during the past 30 years.



Cold abyssal currents preserve methane hydrates.



When seas warm, hydrates collapse and methane erupts.

1 Zachos J.C., M.W. Wara, S. Bohaty, M.L. Delaney, M.R. Petrizzo, A. Brill, T.J. Bralower, and I. Premoli-Silva, 2003. "A Transient rise in Tropical Sea Surface Temperature During the Paleocene-Eocene Thermal Maximum." *Science*, 302: 5650, pp1551-1554. Also: Flavia Nunes and Richard D. Norris, 2006. "Abrupt reversal in ocean overturning during the Palaeocene/Eocene warm period." *Nature* 439: 60-63.

3. METHANE

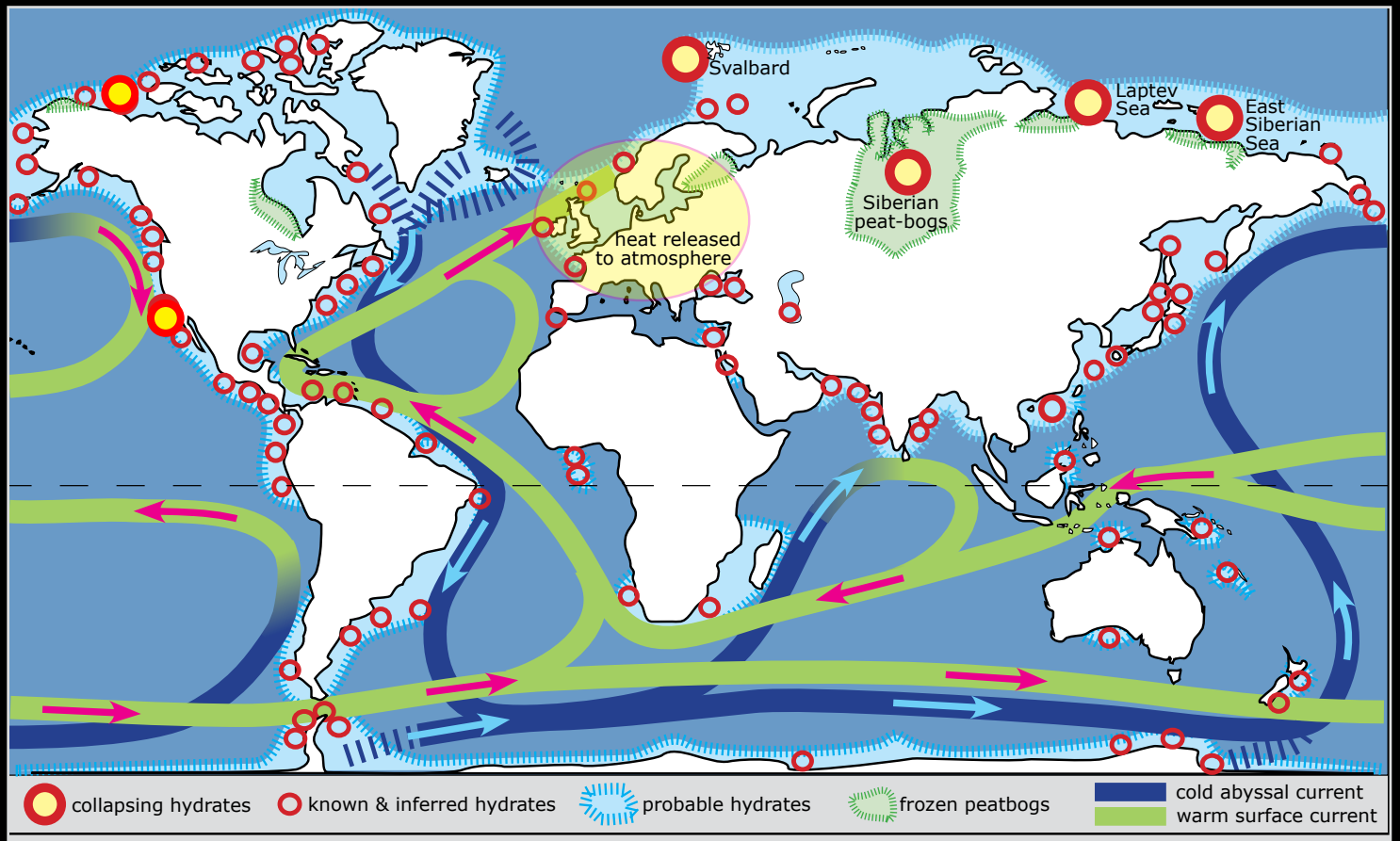
Hydrate Meltdown

Scientists aboard a Russian research ship that recently sailed the whole length of Russia's northern coast have detected aerial concentrations of methane—sometimes up to 100 times the background level—spread over many thousands of square kilometres of the Siberian continental shelf. They also saw patches of sea that were foaming with the gas as it bubbled up from the sea floor in the form of "methane chimneys".

They believe that vast blankets of submarine permafrost, which formerly acted like a "lid" to prevent the gas from escaping, have recently melted, releasing the methane from underground deposits that predated the last glacial period.

Scientists on a British research ship said that they too had recorded methane plumes bubbling from a relatively shallow seabed (~400m deep) in an area covering about 50 square kilometres off the west coast of Svalbard.

They counted about 250 plumes at that site alone and then discovered a set of plumes rising from about 1,200 metres at a second site nearby. Analysis of local sediments and seawater confirmed that the rising gas was methane.



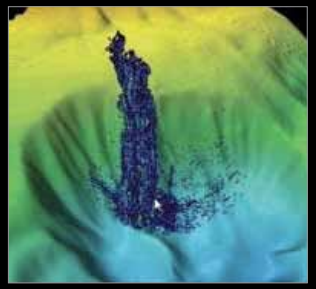
The flow pattern of ocean currents, schematically traced out above in blue and green, represents the thermo-haline circulatory system that girdles the planet and helps to redistribute heat throughout its oceans. The system is largely driven by the sinking of cold dense salt water in polar regions while the westward flow of the equatorial current is generally helped on its way by trade winds.

It takes somewhere between 1000 and 2000 years for water to complete the cycle and this continual redistribution of heat energy plays a major role in maintaining the world's weather patterns and global temperature.

Whenever the polar drive slows, the seas' well-defined temperature layers mix, and the ocean warms. This dissolves some hydrate ices, releasing their methane. Similarly, when the oceans warm the atmosphere, the tundra permafrost degrades, releasing some of its methane.

A vast expanse of frozen swampland in western Siberia has now begun to release methane that has been locked in its permafrost for some 27,000 years. So much gas is now escaping that some lakes are refusing to freeze, even in midwinter.

The Smoking Gun



Much of the methane that is currently escaping from abyssal hydrates all around the world is absorbed by the sea water and converts to CO_2. This absorption shows up clearly in the sonar image of the Californian methane plume, which peters out entirely after rising almost one kilometre through the water column.

The injection of this methane-derived CO_2 into the world's oceans not only increases their acidity, it extracts oxygen from the water and reduces the ocean's future capacity to absorb CO_2 from the atmosphere, thereby maximising the greenhouse impact of our own carbon emissions.

There are now many such hydrate plumes scattered around the world, some of them more than a kilometre in diameter. Whether or not their methane reaches the atmosphere, all of them are continuously injecting fresh carbon into seas that are already saturated with it. If the icy aprons of abyssal hydrate that fringe the planet's continental rafts continue to disintegrate, this carbonisation process will accelerate and the seas will become more acid. Data collected between 1981 and 2004 by researchers from the University of East Anglia, UK,[1] suggest that the vast Southern Ocean, one of the world's largest carbon sinks, has been saturated with CO_2 for at least two decades, and its high level of acidity is already showing up in the biota.

The carbonate casings that protect one species of zooplankton (*Globigerina bulloides*) have proven to be 30%–35% thinner than shelly casings deposited by the same plankton about 250 years ago, just before the modern industrial era began.[2] According to recent drill-core evidence gathered from the Great Barrier Reef, these casings are now far thinner than they have been for at least 200,000 years.[3]

Planktonic organisms underpin the entire marine food chain, and even the world's largest fish, the Whale Shark, is essentially a plankton feeder. So any erosion of this marine food base is an ominous sign indeed. There is also clear evidence that corals are now having trouble building their durable structures and have been growing much more slowly in recent dacades

Finally, there is isotopic evidence that some of the carbon that zooplankton and coral polyps are currently building into their bodies has been derived from the burning of fossil fuels. So here too, the circle of life is unbroken and the 'Butterfly Effect' of Chaos reappears yet again. Although the smoking gun that lies at the foot of this body of evidence is molecular in scale, it nevertheless bears our fingerprints.

1 Lough, J., Australian Institute of Marine Science. ABC *News in Science*: http://www.abc.net.au/science/articles/2005/09/30/1470355.htm

2 Andrew D. Moy, Stephen G. Bray, Thomas W. Trull, William R. Howard
"Reduced calcification in modern Southern Ocean planktonic foraminifera." *Nature Geoscience,* 8 March 2009 (DOI:10.1038/ngeo460)

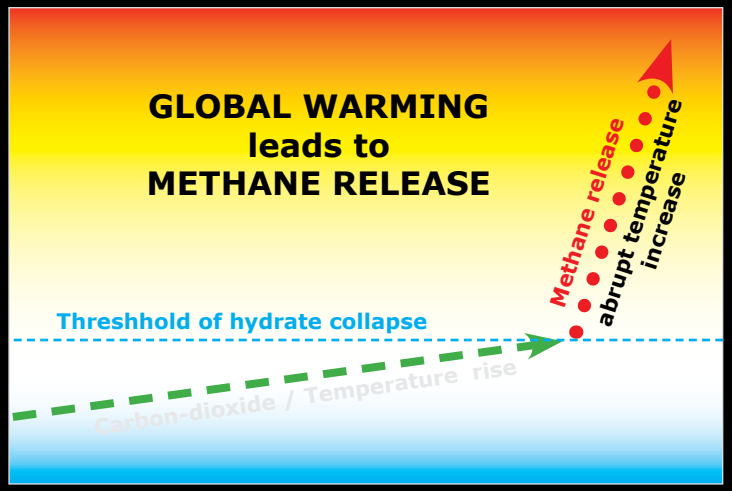
3 Dodge, R.E., C. Birkeland, M. Hatziolos, J. Kleypas, S.R. Palumbi, O. Hoegh-Guldberg, R. Van Woesik, J.C. Ogden, R.B. Aronson, B.D. Causey and F. Staub.
"A call to action on coral reefs." *Science,* 10 October 2008: 189b-190b (DOI: 10.1126/science.322.5899.189b)

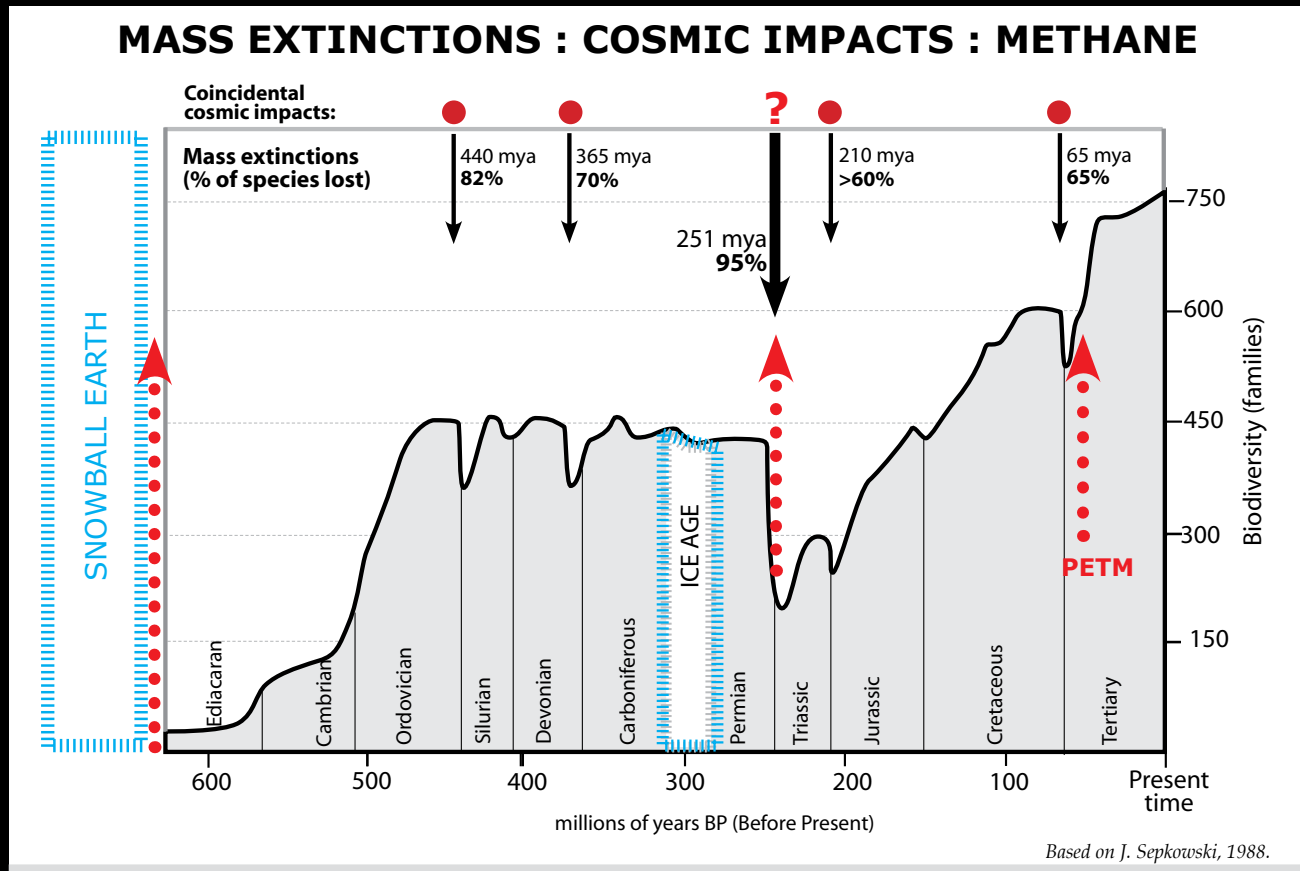
METHANE RELEASE

The massive reserves of bacterial methane that become trapped in marine and tundra ices for long periods of geological time may well represent the ultimate climate-control mechanism for the whole planet.

There is good geological and biological evidence to suggest that there have been three or four occasions in the past when eruptions of methane into the atmosphere have sent global temperatures soaring upwards. On each of these occasions the geological and fossil record indicates an increase in atmospheric CO_2 and a slow temperature rise, followed by an abrupt warming that can only be accounted for by a massive release of methane.

Ominously, each of these methane eruptions also coincides with a mass extinction of life.





The two-stage sequence consisting of a long, slow temperature rise followed by abrupt global warming has been clearly identified on at least three occasions in the past. By far the most spectacular of these was the two-stage warming event that ended the world's greatest Ice Age around 630 million years ago. It ended more than 100 million years of global deep freeze, a time known as 'Snowball Earth'.

The second major methane release came around 251 million years ago when the massive forests that characterised the Permian period lay rotting in the deepening swamps of the world. It coincided with the greatest mass extinction of life in the fossil record. A smaller methane release occurred about 55 million years ago during a lethal warming event known as the Palaeocene-Eocene Thermal Maximum (PETM).

3. METHANE

$CO_2 + CH_4$ = Climate Chaos

STEEL INDUSTRY, NSW

ANTHROPOGENIC METHANE SOURCES

CATTLE AND SHEEP

NT

COAL & GAS MINING

WA

FLOOD IRRIGATION

NSW

GENERAL WASTE (LANDFILL)

VIC

See also: *"The Clean-Coal Delusion"*

‘Fracking’ for gas

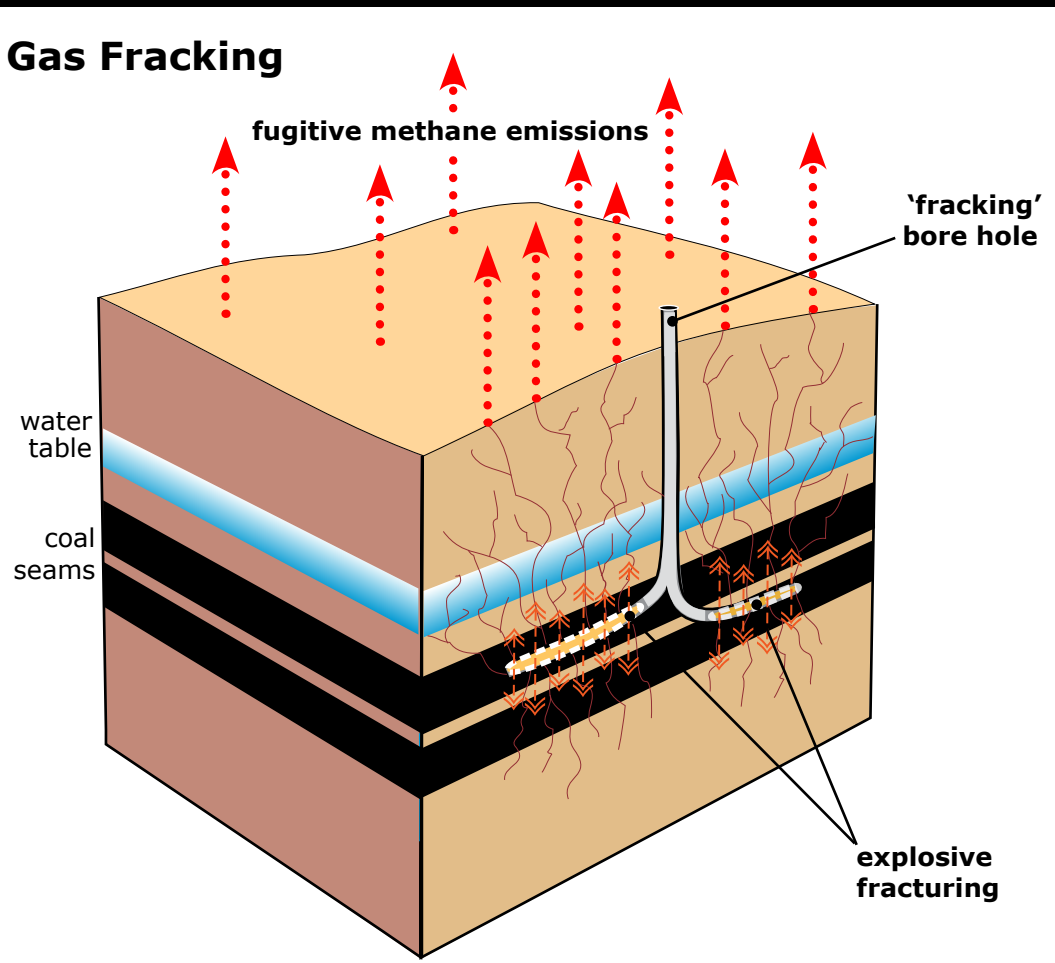
The primary intent of ‘fracking’ (hydraulic fracturing) is to open a multitude of cracks in the surrounding strata in order to release bacterial methane that has been accumulating in the country rock over hundreds of thousands, and perhaps millions of years. (Methane lasts indefinitely in anoxic interstitial environments.)

Since gravitational pressure increases with depth, the shallower the rock strata, the more easily it fractures. So fractures that begin at a coal-seam drill site invariably extend upwards much more easily than do those fractures that extend downwards.

This virtually guarantees that any blast designed to fracture the strata surrounding a coal seam will open a filigree of fine cracks throughout the region, some of which will extend all the way to the surface.

This extensive fracturing guarantees that methane and a variety of fracking chemicals will leak into any water table that overlies the coal seam, and also guarantees that methane will continue to leak into the atmosphere from small surface fractures on a semi-permanent basis.

When commercial interest in the gas field ceases, for whatever reason, maintenance of the the metal and concrete installations will cease and they will gradually disintegrate. This will enable an increasing leakage of methane from the boreholes.



“Fracking” is the technique of pumping a mixture of water, sand and a cocktail of toxic chemicals under pressure into horizontally drilled wells in order to liberate the gas from coal seams and shale. But fracking extracts only 20 per cent of the gas, a figure confirmed by Canada’s National Energy Board. The rock formations shattered by fracking will allow the remaining 80 per cent of shale gas to continue bubbling into the groundwater and into the atmosphere through the fracture system and the disused and disintegrating wellhead fittings. *

* Marc Durand, former Professor of Hydrogeology, L’Université du Québec à Montréal (UQAM).

EVOLUTION'S PENALTY CLAUSE

- ***Energy only dissipates***

(second law of thermodynamics)

All energy gains are short-term and conceal disproportionate energy debt in the long-term

As the world's oil reserves begin to shrink and concern over CO_2 emissions from coal-burning grows, our increasing hunger for energy is switching commercial attention to the extraction of methane (CH_4).

The rush to drill explosively into coal seams and gas-bearing shales will inevitably open billions of new methane leaks from the hundreds of thousands of new gas fields that are being tapped on all continents.

Recent research from several US gas fields shows that fugitive methane emissions from each well site annually averages around 4% of the total volume of the extracted gas. This peer-reviewed study, published in *Nature* warns that this figure does NOT include additional losses from the pipeline and distribution system. This new assessment is more than double the official inventory figure.*

With atmospheric methane already at an all-time high and accelerating upwards due to the melting of marine hydrates and tundra permafrost, it seems that our hunger for energy has invoked evolution's Faust clause yet again. It will be expressed via runaway global warming and catastrophic sea level rise.

* http://www.nature.com/news/air-sampling-reveals-high-emissions-from-gas-field-1.9982

SUMMARY

Here again are the three factors that have been largely neglected in the current climate debate:

1

Chaos Theory

Chaos in deep space

Chaos in a soap film

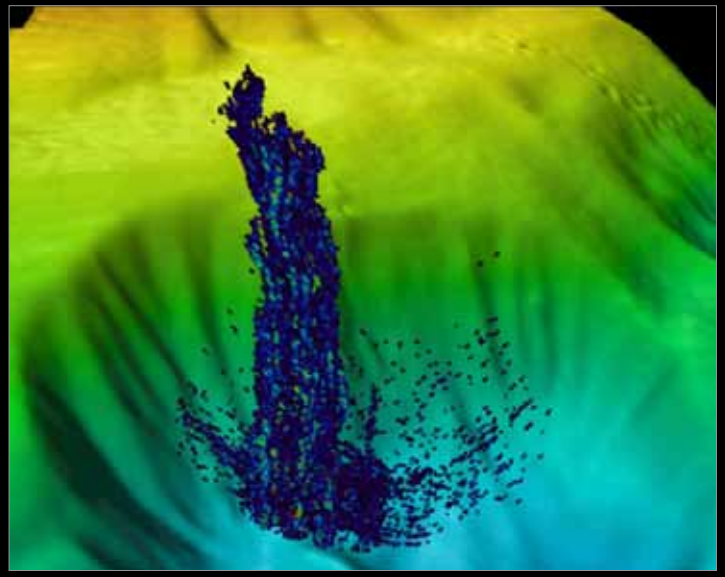
2

Earth's bacterial managers

Monsoon arrives in the Gulf of Carpentaria, QLD.

3

Bacterial Methane



Methane hydrate collapse, off California, 2009. (NOAA)

Ignorance of these factors has brought us to the brink of methane hydrate collapse and catastrophic global warming.

THE PRICE OF OVERWHELMING SUCCESS

Only once before in the entire life of our planet has life been so successful that it threatened its own existence by the volume of its toxic waste. That lifeform was photosynthetic bacteria, essentially cyanobacteria, and its toxic waste was oxygen.

By discharging their highly reactive waste gases into the biosphere between 2.5 billion and 2 billion years ago, these microscopic lifeforms not only transformed the global environment, they altered the direction of all future evolution and generated an entirely new branch on the bacterial tree of life.

In the short term however, the problem that all organisms faced, was to find a way to survive in the poisonous, oxygenated environment. There were only three options: evolve defenses, take refuge, or die. Most species died.

This biological crisis still represents the most pivotal moment in the story of life on Earth, and a spectacular memorial to this dramatic event still sprawls across the spinefex plains of north-western Australia in the form of the Hamersley Ranges. They are all that remains of a gigantic iron-oxide seabed that took half a billion years to accumulate. Despite a billion years of savage erosion this iron seabed is still up to 2.5 kilometres thick in a couple of places.

It was formed when the soluble iron in the water became oxidised by the waste gases that were dumped by the photosynthetic bacteria that lived there. When the soluble iron bonded to bacterial oxygen it became insoluble, and it then fell to the seabed as a rain of rusty sediment that continued for half a billion years. *

The iron in this massive layer of biologically generated rust now underpins the economy of modern Australia . . .

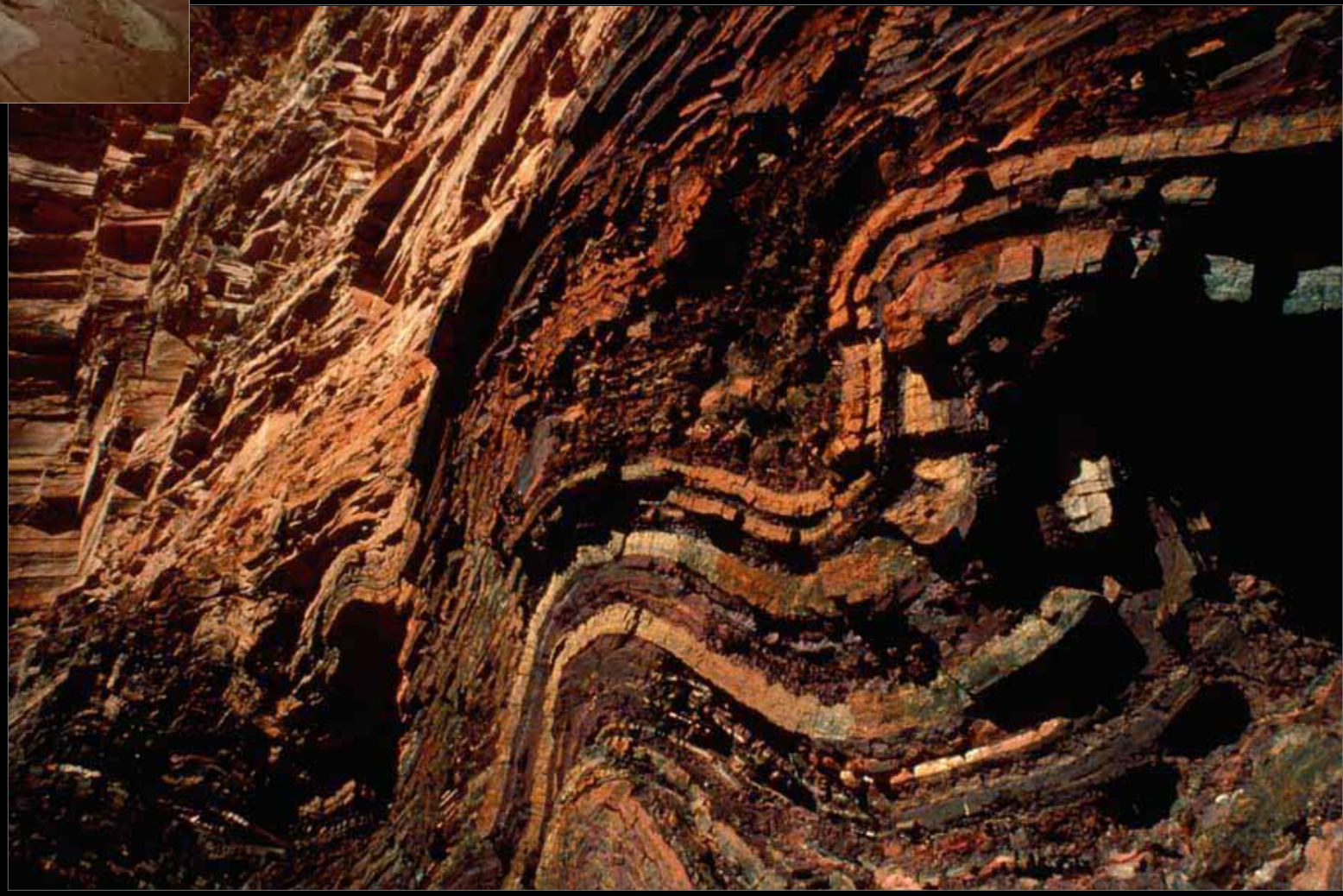
* For more information on evolution please read: http://regmorrison.edublogs.org/files/2012/03/Lifes-Maker-Breaker2-1kaa8uu.pdf

EVOLUTION'S PENALTY CLAUSE

Hamersley Ranges, Pilbara, WA

This is all that remains of a vast iron seabed several kilometres thick that accumulated as a direct result of photosynthetic bacteria 'breathing out' their oxygen wastes into iron-rich seas. When repeated plagues of those bacteria infested the seas about 2.5 billion years ago the oxidised iron fell to the seafloor in clouds of rusty sediment. This iron now underpins Australia's mineral wealth.

As the only animal species that has ever managed to alter the global atmosphere on a scale approaching those oxygen producing bacteria, we should note well the ominous evolutionary message implicit in this massive environmental fallout.*



Hamersley Gorge, Hamersley Range, Pilbara, WA

Red Gorge, Hamersley Range, Pilbara, WA

*See also '***The Pilbara: Life's Turning Point***'

EVOLUTION'S TURNING POINT

All the world's major iron deposits are about the same age and all commemorate the same event: the pollution of the planet by a particular form of bacterial waste—oxygen.

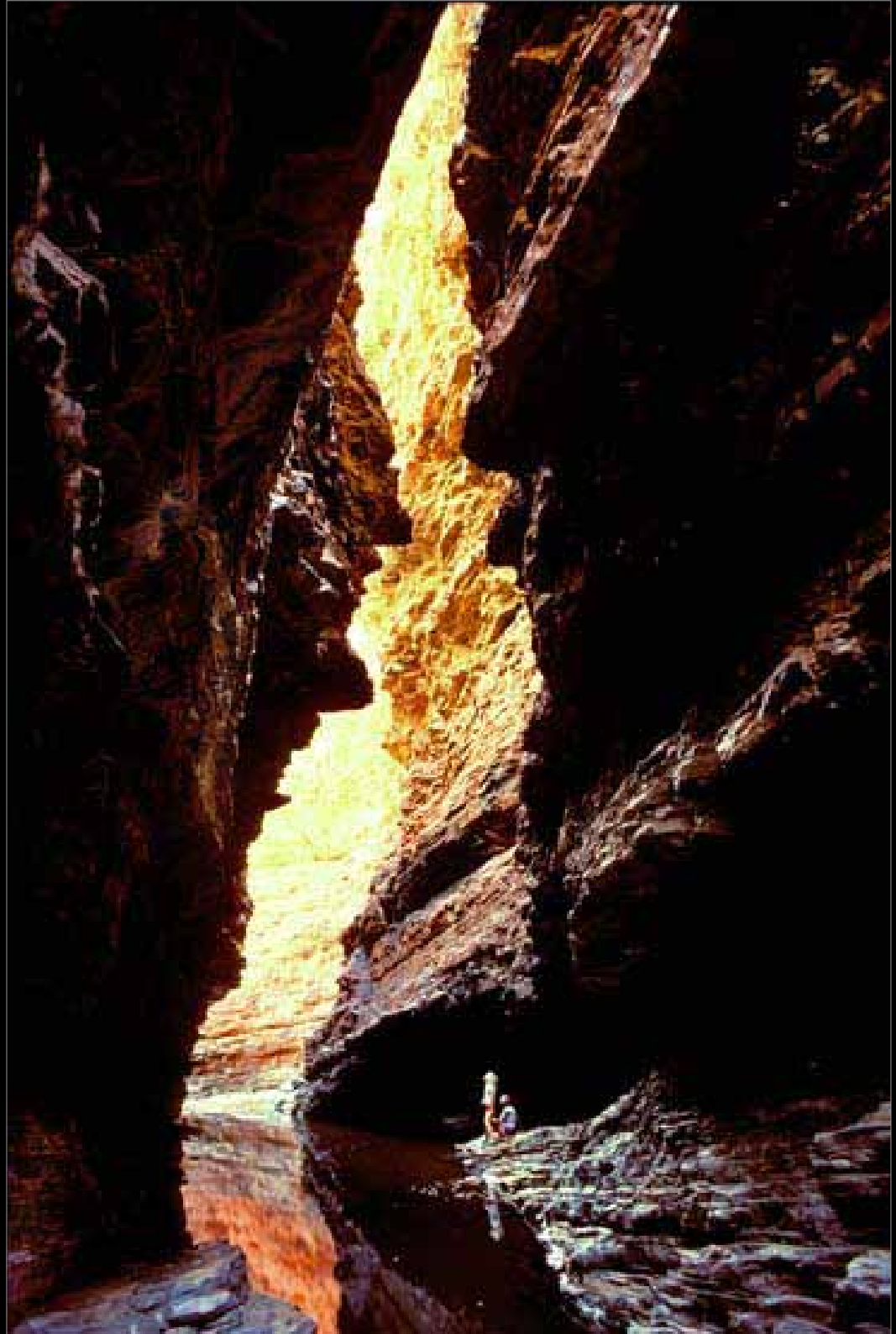
Walk into one of the Hamersley's spectacular slot-canyons and you walk back into the bowels of deep time, a time when repeated plagues of photosynthetic bacteria were 'breathing out' this aggressive toxic gas into coastal seawater, rusting its soluble iron, and clouding the seas with insoluble iron-oxide sediment.

Sadly, there are still many people who don't believe that our species could possibly disrupt the pattern of energy dissipation within the atmosphere merely by 'breathing out' a few waste gases. They seem unaware that this did happen once before. Even more remarkable, the original polluter was not a large animal armed with combustion engines and coal-burning power stations, but just a few species of bacteria armed only with chlorophyl.

The doubters also seem to be unaware that all of the lifeforms that we see around us today, including human beings, are the by-product of that same pollution event, the event that built the Hamersley Ranges and extinguished most of the life on this planet.

In short, if the Hamersleys did not exist, then neither would we.

Sadly, one of Earth's lifeforms has once again become so successful that it has triggered a tidal wave of extinction throughout the biota, and now threatens even its own existence by the volume of its waste products. And in this case the threat comes from just a single animal species: *Homo sapiens*.



Weano Gorge, Hamersley Ranges, WA.

EVOLUTION'S FAUSTIAN BARGAIN *

By 1960 our global population had reached three billion and was growing exponentially at 2% a year. This rate of growth was consistently outrunning the growth in agriculture, and as Malthus had warned, global starvation loomed ahead, possibly as early as the mid 1970s.

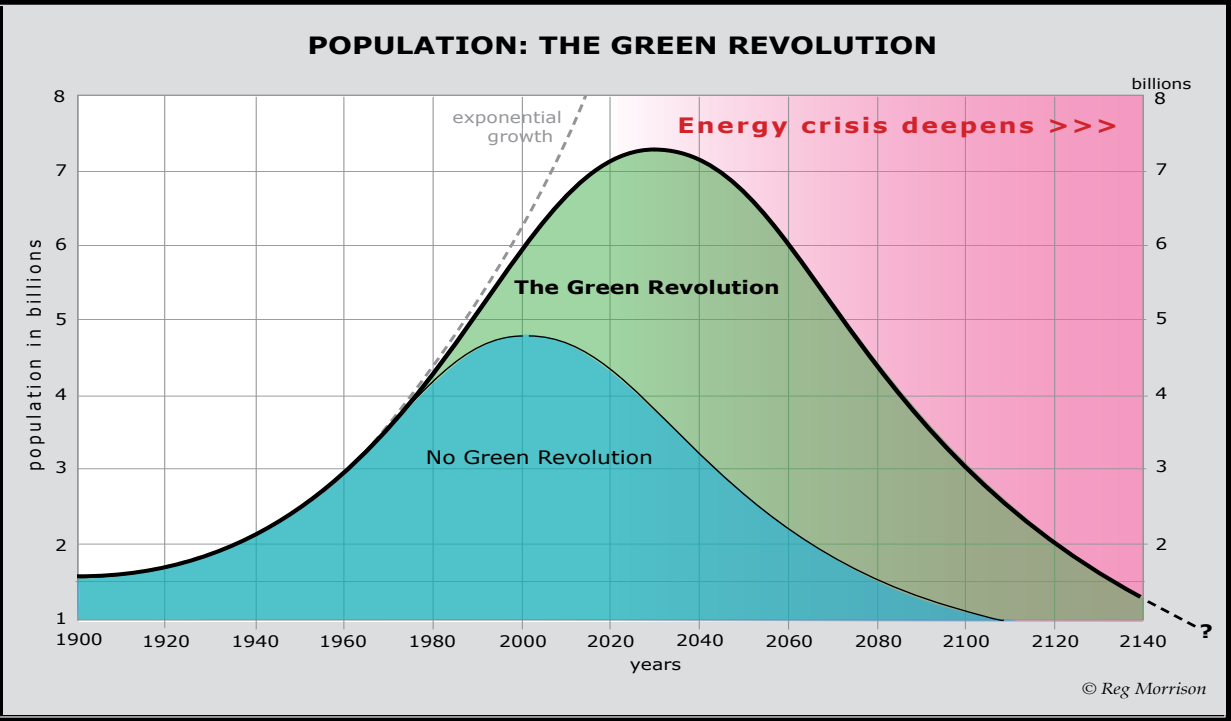
But science and technology came to the rescue—or so it seemed at the time. The development of high-yield crop species and a liberal application of petroleum-based fertilizers tripled the global harvest between 1960 and 2000. This not only averted a global food crisis, it boosted harvests to the point where human reproduction could safely go into top gear. As a consequence, the global population doubled in just 35 years. Science, technology and human ingenuity appeared to have saved us once again.

But cosmic laws determine that energy can neither be created nor destroyed, so 'high yield' is just a euphemism for 'high cost'. Inevitably then, the high per-capita harvests of the 1980s gradually disappeared in the 1990s as soil fertility shrank, fertilizer responses declined, and the population continued to explode. Our species has now returned to the evolutionary precipice on which it stood in 1965 … but with two crucial exceptions. We are now wholly dependent on oil for motor fuel, lubricants and fertilizer, and twice as many people now face the spectre of starvation as global oil supplies begin to shrink. Hydrogen, the generator of life, is about to become its breaker once again.

When pandemic disease, Selye's GAS, and the backlash of a bruised environment begin to fulfil their standard anti-plague roles we will face collapse once more, but having overshot Earth's carrying capacity and drained our cheap energy sources, this time there will be no escape.

Technology's hidden face

*This graph reveals the Faustian face of human technology. All of the advantages it appears to offer are invariably outweighed by its hidden costs. Technology takes its 'pound of flesh' in the form of energy loss at some other place or at some later time, or via what is known as Jevon's Paradox.** *It means that technology is never the panacea that it seems, and given time, it inevitably incurs a disproportionate cost. These are the inviolable rules of existence in a thermodynamic universe that is entropic (running down).*



* See APPENDIX 2 and NOTE 8

Climate Change: The Bottom Line

With our planet's ancient methane reserves already breached and leaking from permafrost and marine hydrates, from swamps and irrigated cropland, from coal mines, gas fields, oil fields, and the world's growing herds of flatulent farm stock, the time for academic argument and political negotiation is long past.

It is now time to devise the last-ditch strategies and infrastructures that might enable some of our species to ride out the storm that is likely to burst upon us when the sunspots cycles surge once more.