Building a Sustainable Future

The role of Risk Science

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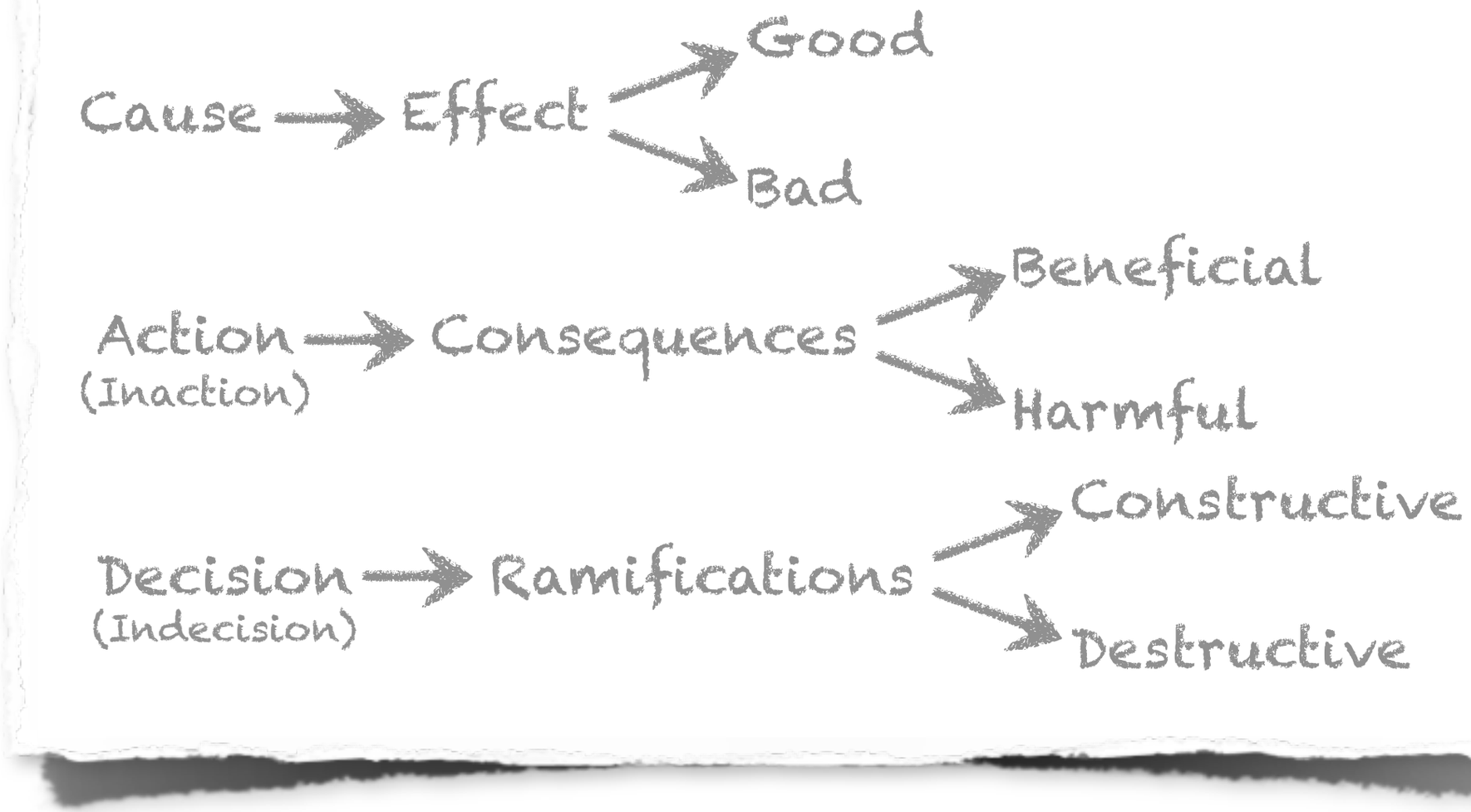
“The future's not set. There's no fate but what we make for ourselves”

John Connor, Terminator 2: Judgement Day, 1991

Risk:

> The likelihood of adverse consequences arising from actions or events

Risk:
Deconstructed



Processes leading to **consequences**

Cause may be **dependent** or **independent** of human action

Inaction is still a **cause** leading to an **effect**

A **balance** between **competing outcomes**

Intervention can alter the **balance** between **outcomes**

off the mark.com by Mark Parisi

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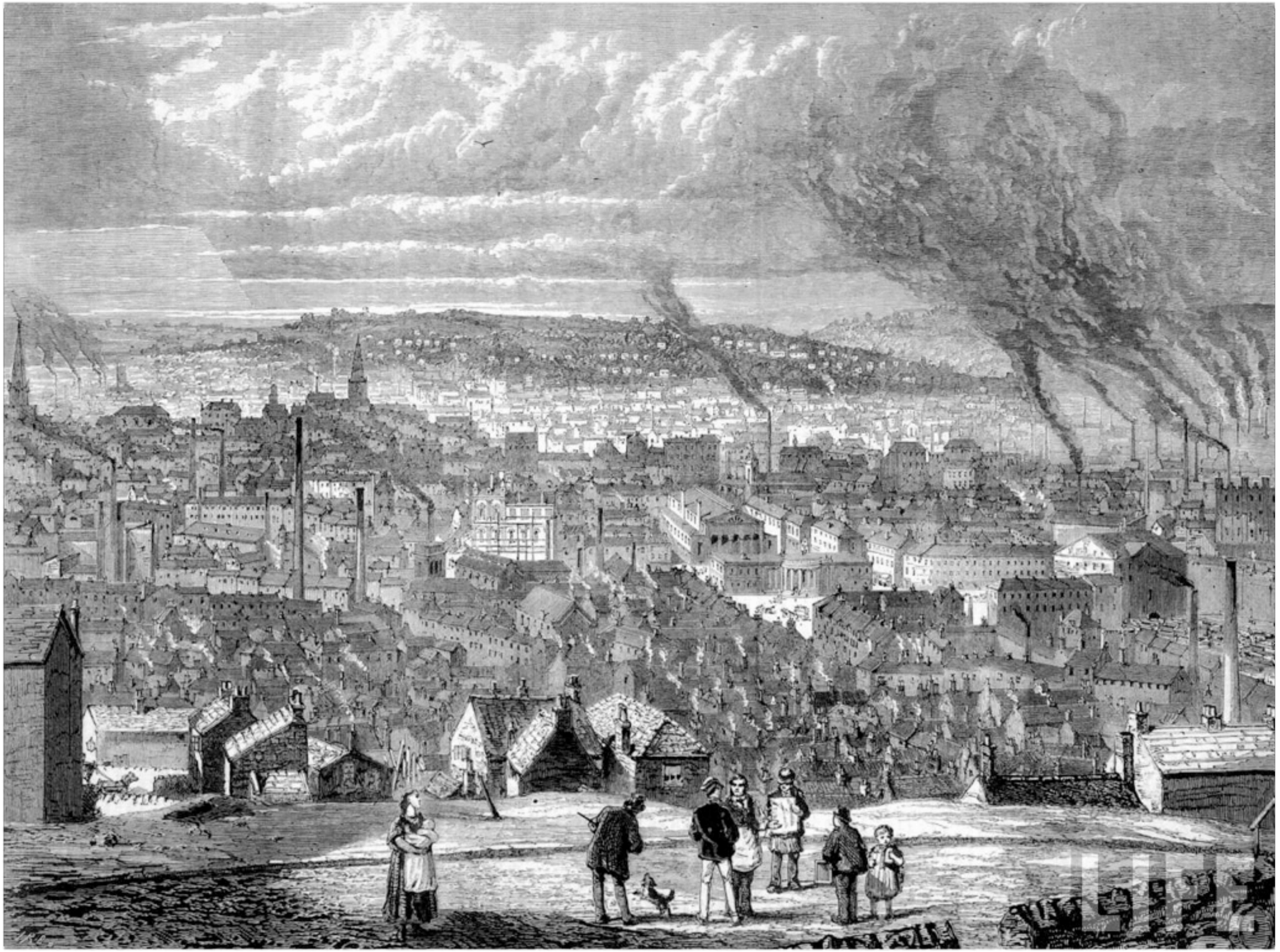
The Eruption of Mt. Vesuvius. Pierre-Jacques Volaire, 1777



Sheffield, *circa* 1874. Source: LIFE

PRAKASH HATVALNE/AP

December 3, 1984: **Victims on a Bhopal street**

Phantoms

…Faced with something unfamiliar, we are simultaneously curious and afraid. To remind us to be careful, we construct things that go bump in the night—phantoms, trolls, chain-saw movies.

This field of shimmering light, with unrecognizeable shapes inside, could be anything; best to assume it's dangerous! (It is, in fact, a fountain playing over rocks; but no matter.) We treat new technologies in the same way. At the beginnig, they are all dangerous: fire, the book, steam engines, genetically engineered bacteria, nanotechnology. But with enough familiarity, we ignore even truly dangerous ones—nuclear weapons, ubiquitous surveillance, smoking, drinking, the sports channel on TV.

The 20th century

Risk *challenge*:

> How do we prevent human instincts causing more harm than good in a technologically complex world?

Science:

Understanding the world through **observation, prediction, testing and re-evaluation**

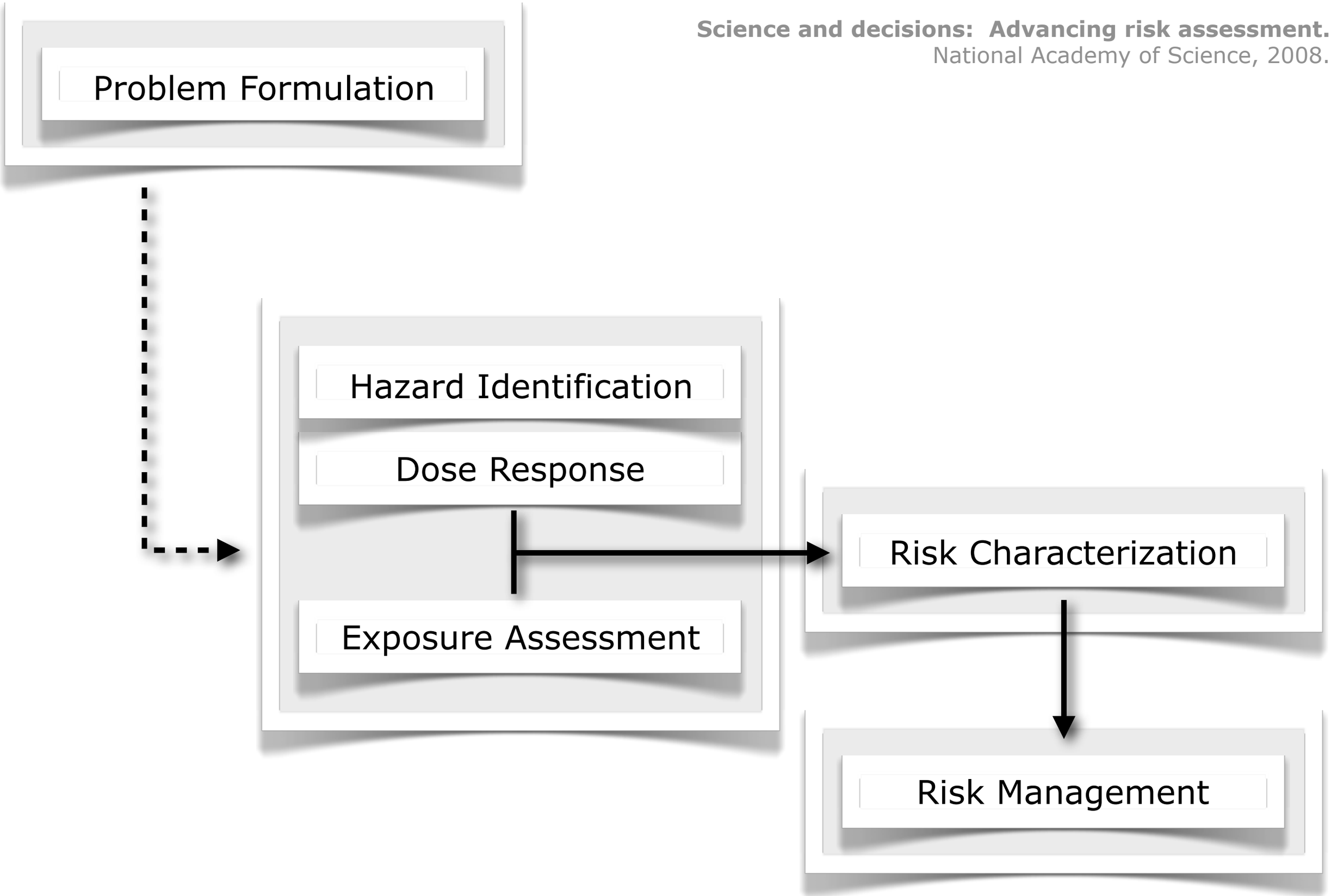
Provides an **independent** and **self-correcting** basis for understanding how **causes** are associated with **effects**

Supports **evidence-based decisions and actions**

Risk **Science:**

> Science that supports **evidence-informed** risk identification, assessment and management
>
> A **systematic approach** to evaluating and addressing risk
>
> A means of **decoupling** risk-related decisions and actions from potentially harmful **instinctive** responses

Science and decisions: Advancing risk assessment.
National Academy of Science, 2008.



Risk **Science:**

Mechanisms that are:

- **Evidence-driven**
- **Responsive to actual impact**
- **Systematic**
- **Reliable**

Risk **Science:**
In the **21st Century**

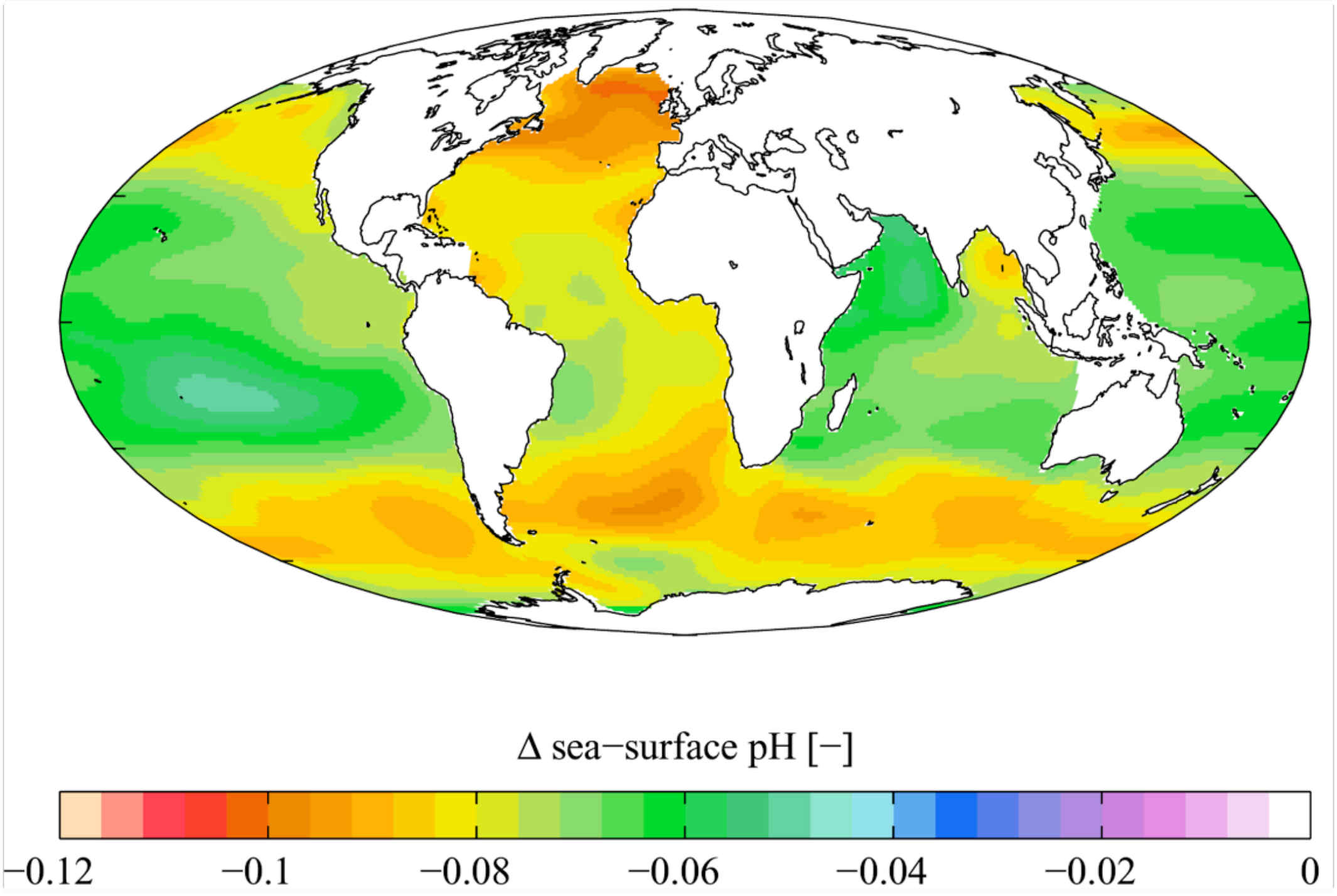
Coupling

Communication

Control

Coupling


APRIL 3, 2006
www.time.com AOL Keyword: TIME
SPECIAL REPORT GLOBAL WARMING
TIME
BE WORRIED. BE VERY WORRIED.
Climate change isn't some vague future problem—it's already damaging the planet at an alarming pace. Here's how it affects you, your kids and their kids as well
EARTH AT THE TIPPING POINT
HOW IT THREATENS YOUR HEALTH
HOW CHINA & INDIA CAN HELP SAVE THE WORLD—OR DESTROY IT
THE CLIMATE CRUSADERS



Estimated change in sea surface acidity caused between the 1700s and the 1990s

http://en.wikipedia.org/wiki/File:WOA05_GLODAP_del_pH_AYool.png

Photo: Andy Gupta

The Colorado river running through Marble Canyon

http://www.flickr.com/photos/77145662@N00/5014081890/

Rare Earth **Elements:**

"Avalon Rare Metals, a Toronto-listed mining company, estimates that about 25% of new green technologies rely on minor metals and rare earths. A typical example is Neodymium, one of the most common rare earths, which is a key part of neodymium- iron-boron magnets used in hyper-efficient motors and generators. Around two tonnes of neodymium are needed for each wind turbine. Lanthanum, another REE, is a major ingredient for hybrid car batteries (each Prius uses up to 15kg), while terbium is vital for low-energy light bulbs and cerium is used in catalytic converters."

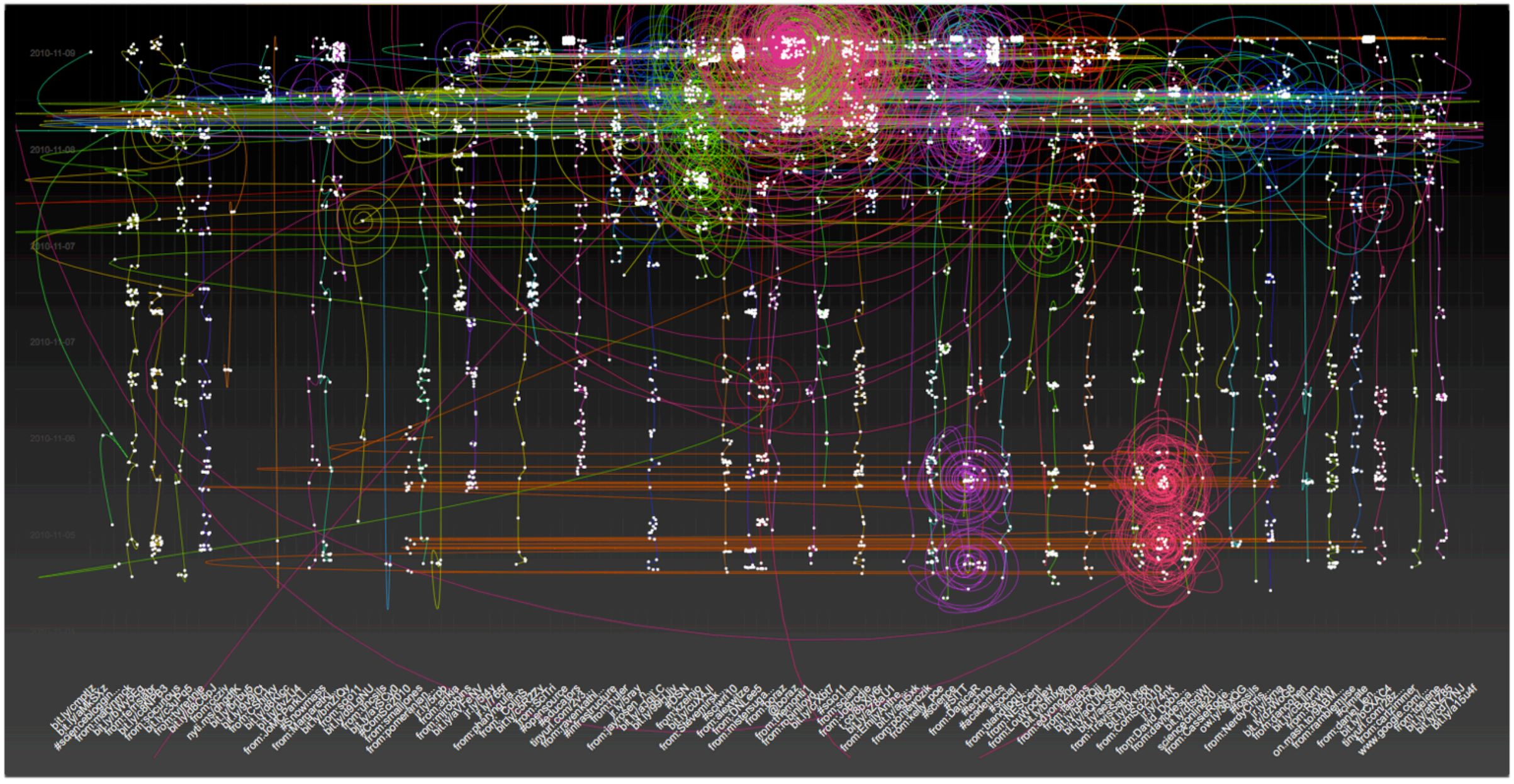
Sustainable technologies for the next decade. Cientifica, May 2010

"China mines 95 percent of the world's rare earth elements, which have broad commercial and military applications, and are vital to the manufacture of products as diverse as cellphones, large wind turbines and guided missiles."

New York Times, October 19 2010

Communication

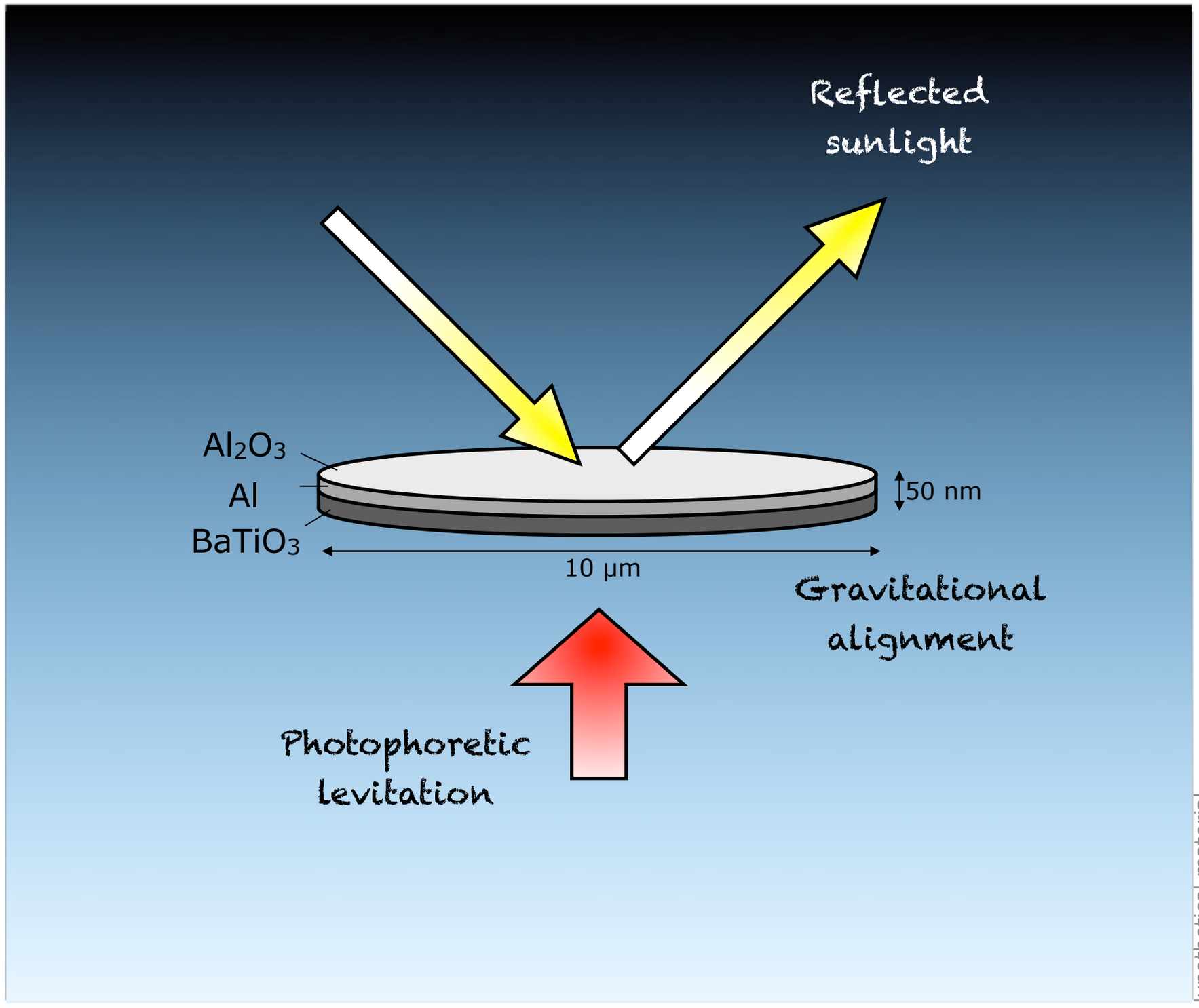
http://www.neuroproductions.be/



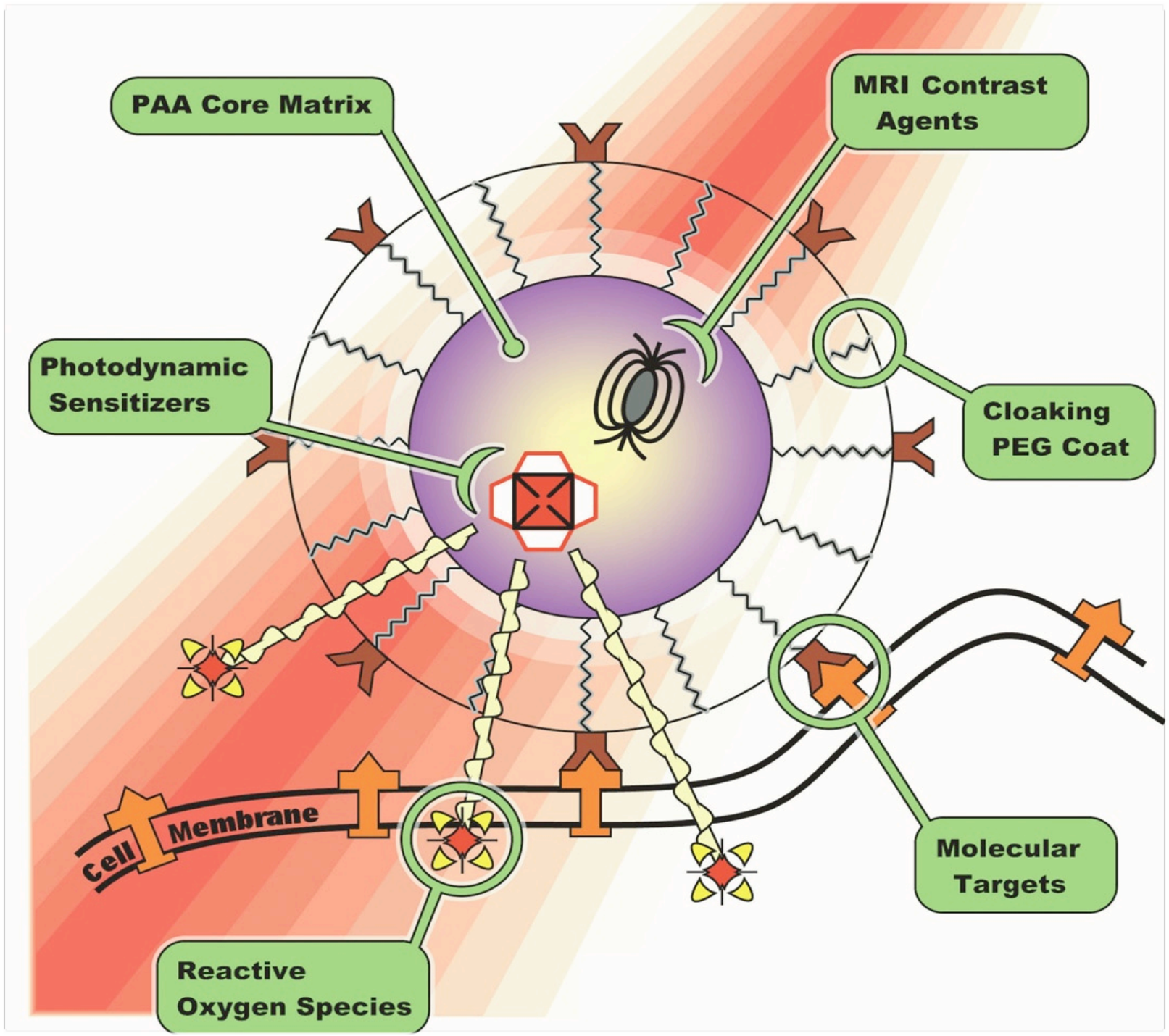
One week's Twitter conversations initiated by @boraz (Bora Zivkovic)

Last of 33 Chilean miners to be rescued. Washington Post

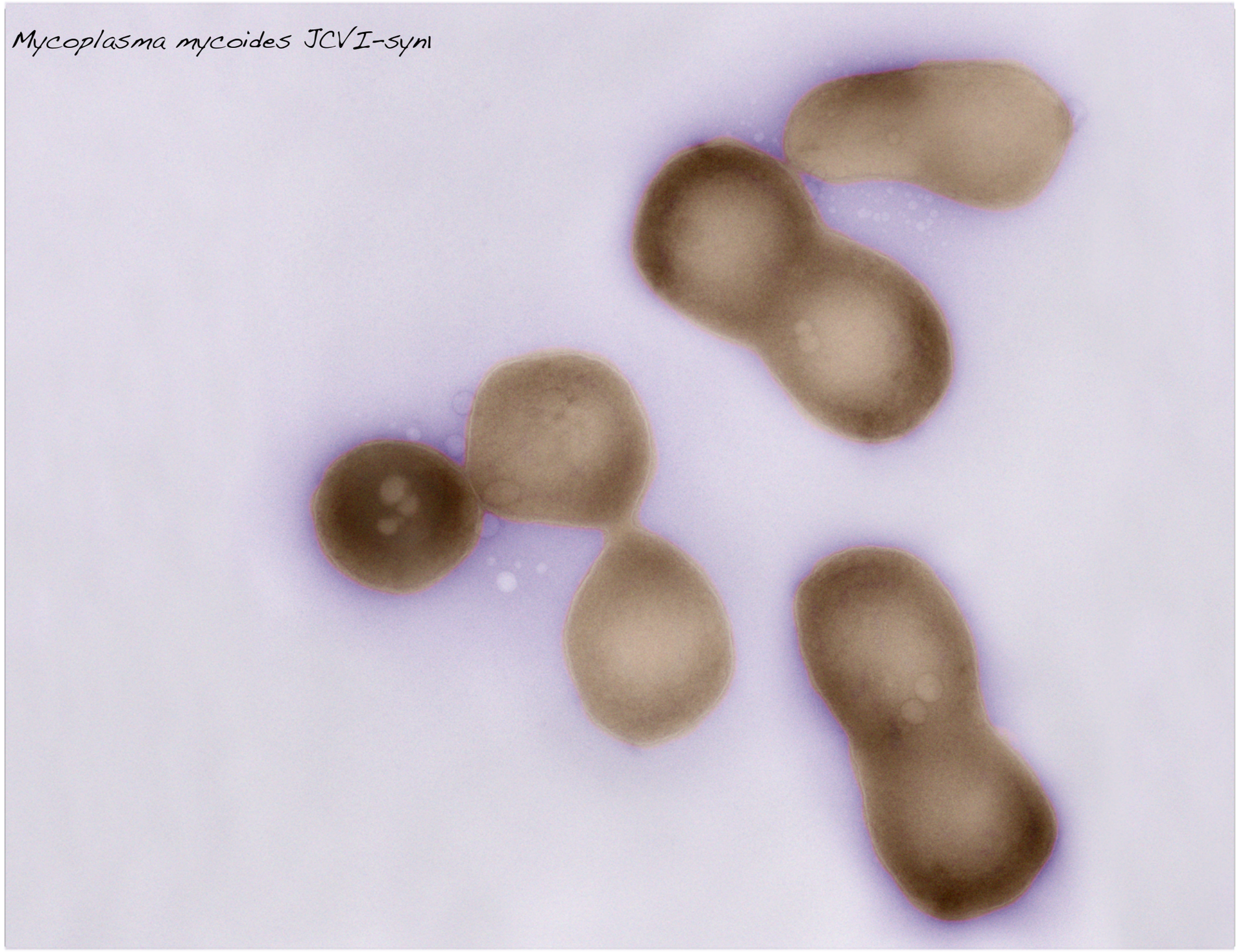
Control



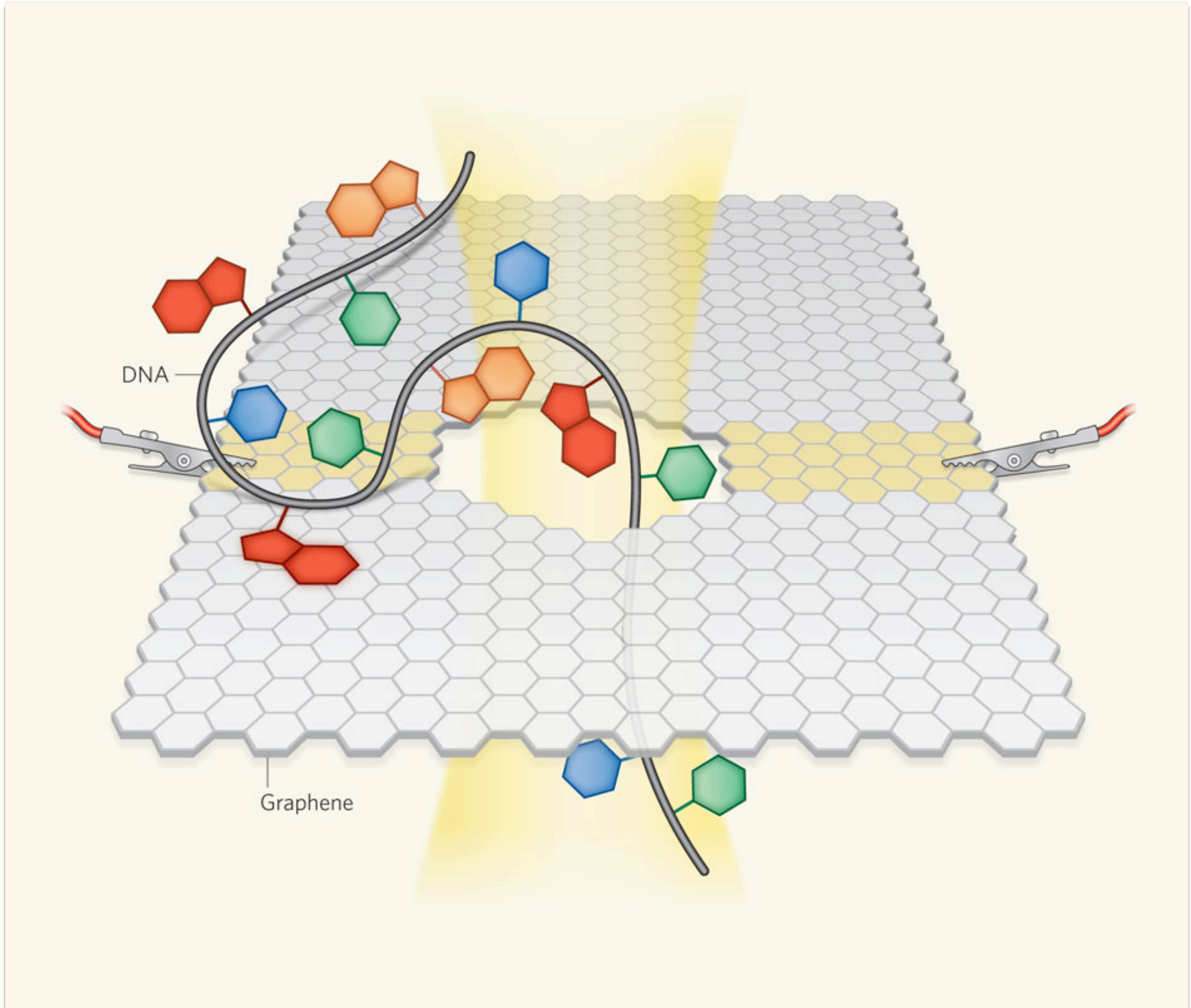
Keith DW. 2010. **Photophoretic levitation of engineered aerosols for geoengineering.** PNAS 107(38): 16429-31.



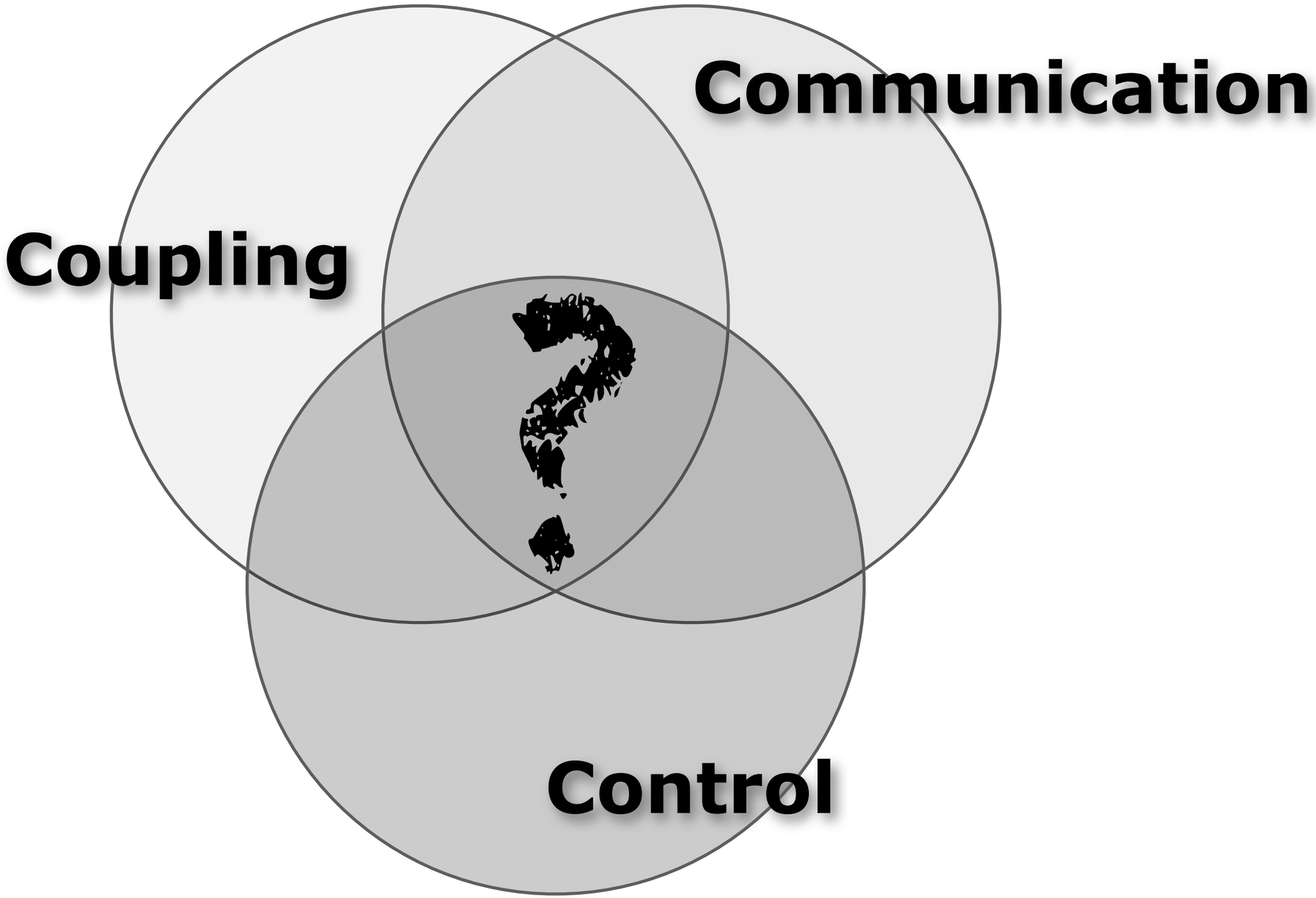
Martin Philbert and Raoul Kopelman



Gibson DG, Glass JI, Lartigue C, Noskov VN, Chuang R-Y, Algire MA, et al. 2010.
Creation of a Bacterial Cell Controlled by a Chemically Synthesized Genome.
Science 329(5987): 52-56.



Bayley H. 2010. **Nanotechnology: Holes with an edge.** Nature 467(7312): 164-165.


Communication
Coupling
Control

Ten *Pressure-Point* **Technologies:**

Bio-construction
Viruses programmed to build new materials

Regenerative medicine
Fixing "unfixable" problems

Synthetic biology
Digitally designing "life" and downloading it into reality

Multifunctional drugs
"Seek and destroy" therapeutics

Printable electronics
Cheap and versatile solar energy

Energy-scavenging:
"Micro" energy for "nano" devices

Geoengineering
Planet-wide climate intervention

Smart grids
Rethinking how we generate and use electricity

Machine-human interfaces:
Better-than-human?

Cognitive enhancers
Designer drugs for aspiring high achievers

The 20th century

Risk *challenge*:

> How do we prevent human instincts causing more harm than good in a technologically complex world?

The 21st century
Risk *challenge*:

> How do we ensure evidence-informed, socially-responsive and proactive risk-decisions in a highly complex, interconnected and interdependent world?

Drivers of **change**:

Complexity: Agents of harm are increasingly complex, and innovation cycle so fast that established linear, reactive approaches to addressing risk are failing

Interconnectedness: Increasingly complex local and global relationships between decisions and their ramifications

Distributed decision-making: Non-traditional decision-influencers and decision-makers are becoming increasingly influential, including citizens

The ***New***
Risk **Science:**

Building on **established risk science**, with **evidence-informed** decision making front and foremost

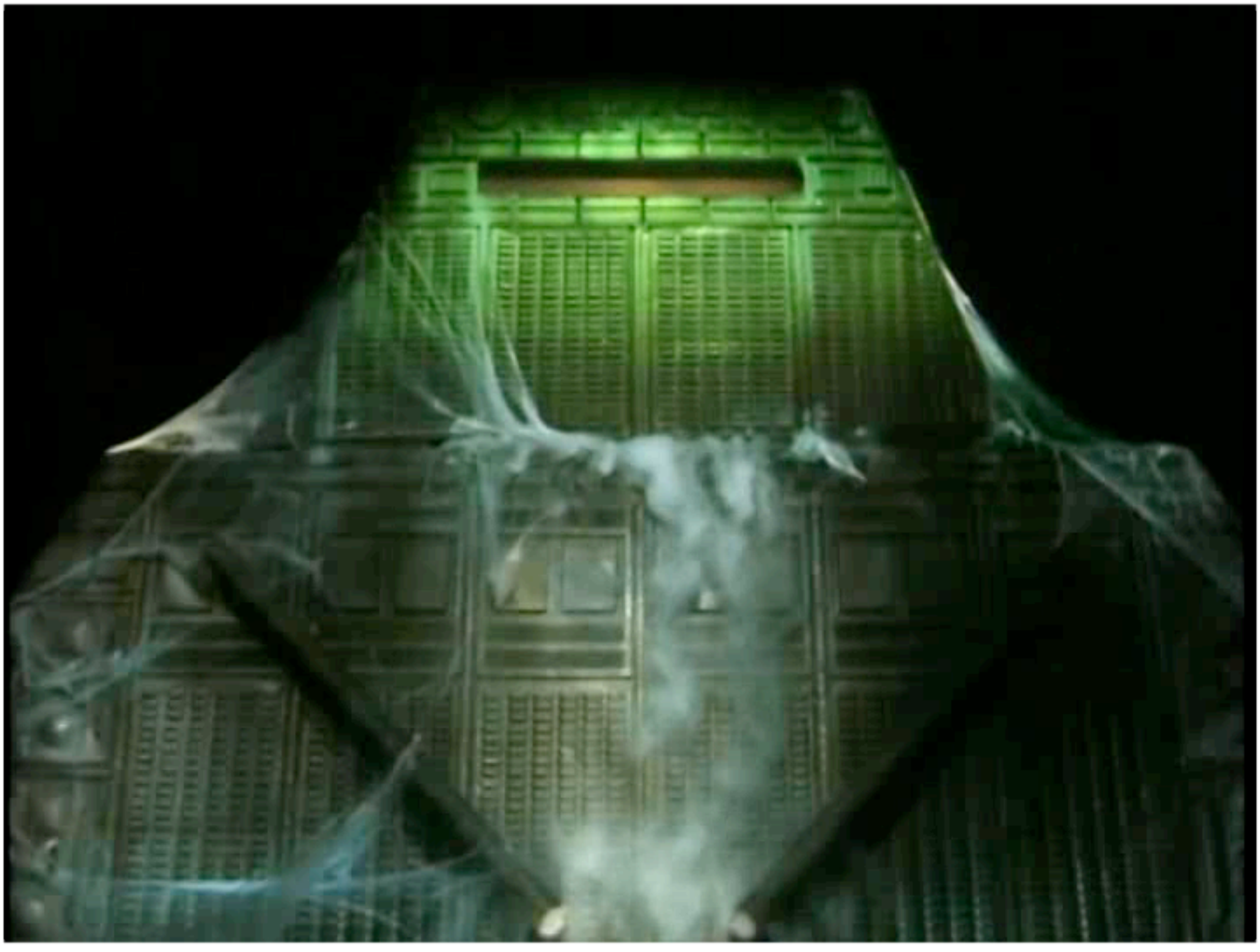
Incorporating expertise across **diverse disciplines** to support i**ntegrative approaches** to risk-related decision-making

Engaging fully with **stakeholders** - including citizens

Enabling evidence-informed decisions that are **socially responsive, sustainable, and ultimately preventative**

The ***New***
Risk **Science:**

Building a *sustainable* **future...**



The Hitchhiker's Guide to the Galaxy. Douglas Adams. BBC, 1981

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