Chemistry Leadership

Interdisciplinary Research

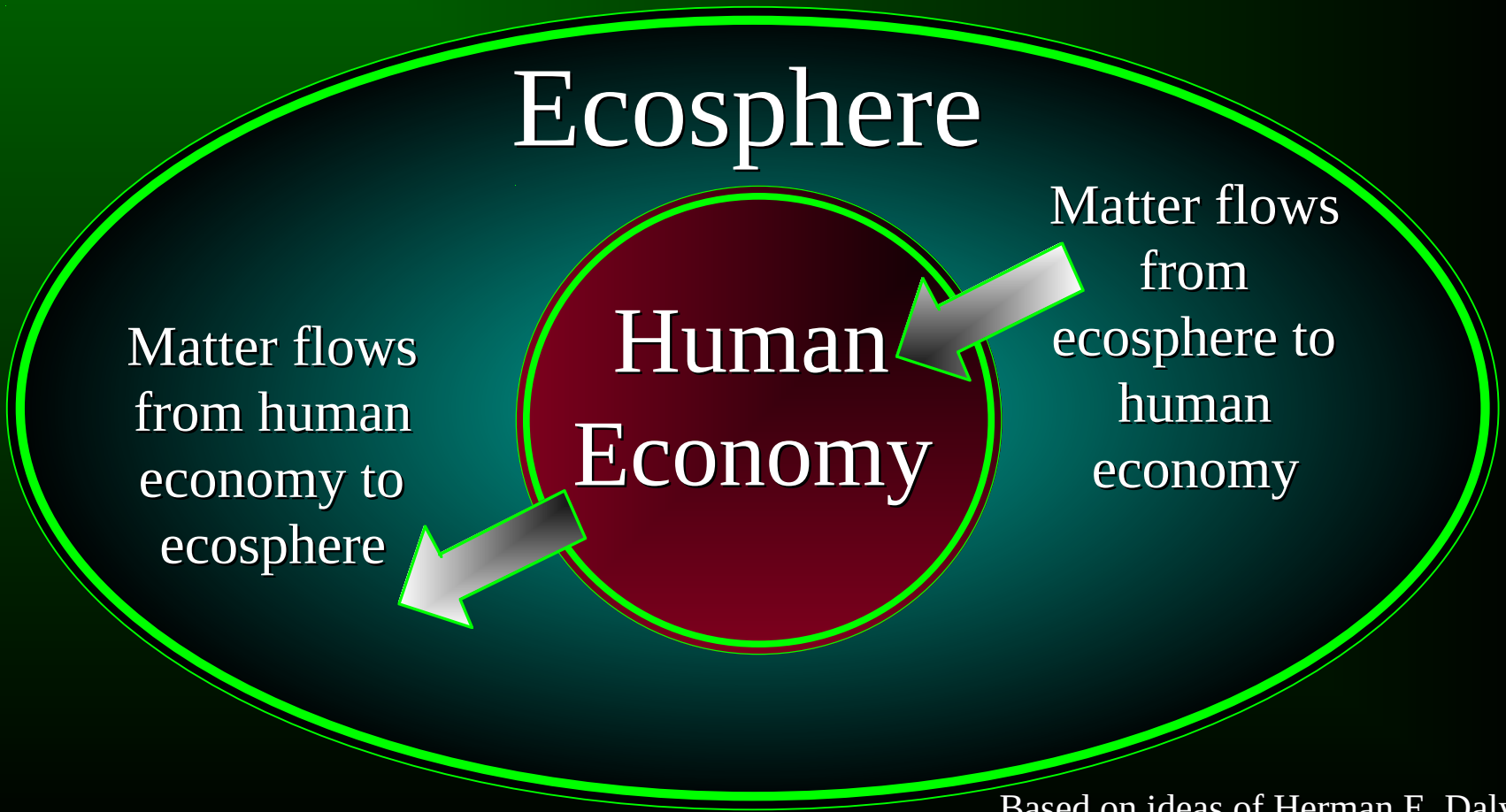
Green Chemistry and Sustainability

Terry Collins

Educational Sea Change

Economic Opportunity

Ecospherical Responsibility of Chemists



Based on ideas of Herman E. Daly

The Chemical Goals for Sustainability

Safe Energy

Improve passive, active, photochemical and photovoltaic for solar energy conversion

Renewable Feedstocks

Obtain economical feedstocks for chemical and polymer industries from plant matter

Pollution Reduction

Move technology's elemental balance closer to biochemistry by developing new economical processes

T.J. Collins, *Science*, 207, 48-49, Jan. 5 2001

Nonbenign Activities

How Should Scientists Promote Sustainability?

Technology invented, sustainability a nonissue

↓

Technology grows in importance - sustainability issues become evident.

→

Destabilizing technology becomes a defining feature of the civilization

↑

New Technology invented to resolve sustainability issue

Science Must Advance to a Comprehensive Strategy for Sustainability

The Energy Research Problem

20 days of sunlight equals the planetary reserves of oil, coal and natural gas

C 20th energy research

→ nuclear fission, fossilized carbon

→ devastation of sustainability

T.J. Collins, *Science*, March 9, 2001

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Nature

Small number of elements, supported by elaborate design, sustain the complex chemistry of life.

Chemistry

Entire periodic table used to attain selectivity allowing for comparatively simple design.

Selectivity

Picture from C&E News

Reducing Persistent Pollutants

Class 1

Elemental toxins; the prototypical persistent pollutants

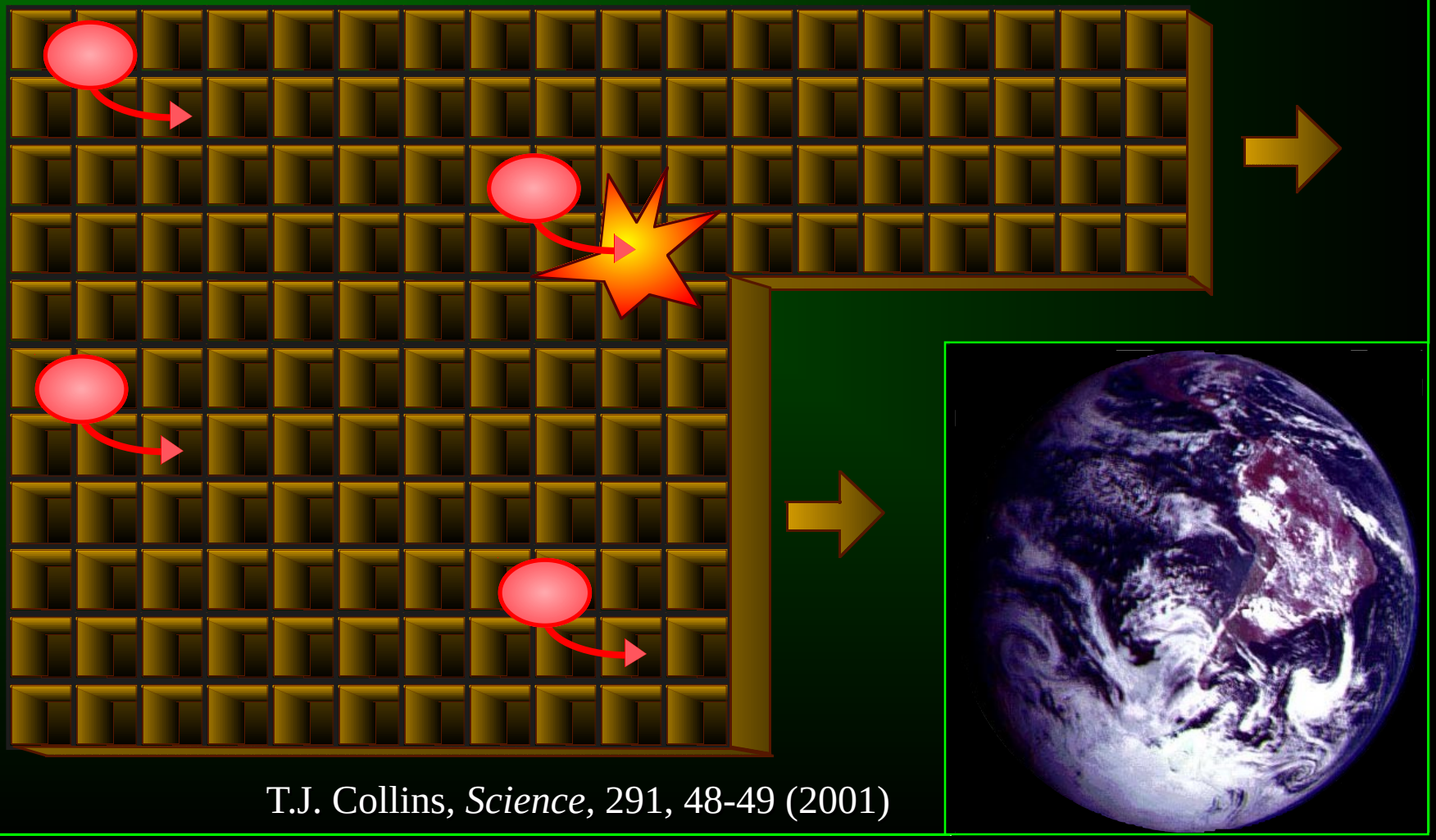
Class 2

Particularly stable molecular species

- chlorine!

Limitations of Science: The Ecosphere as a Postal Network

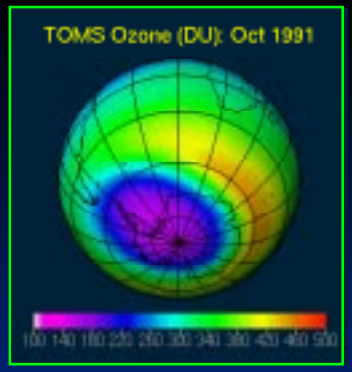
Persistent Pollutant



T.J. Collins, *Science*, 291, 48-49 (2001)

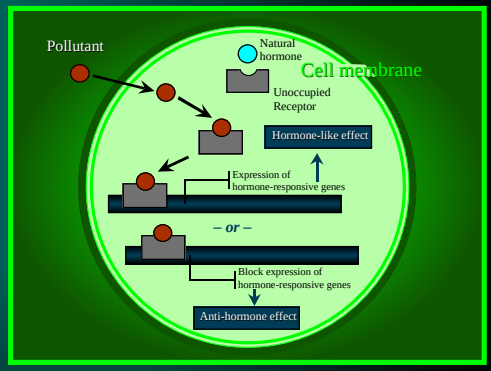
Progress with Persistent Pollutants

Replacement of **LEAD** in wine correcting, fuel, paints, solder, piping, batteries, chemical synthesis – more to do



Replacement of **CFCs** with HCFCs and HFCs for refrigeration, blowing agents, air conditioning, others

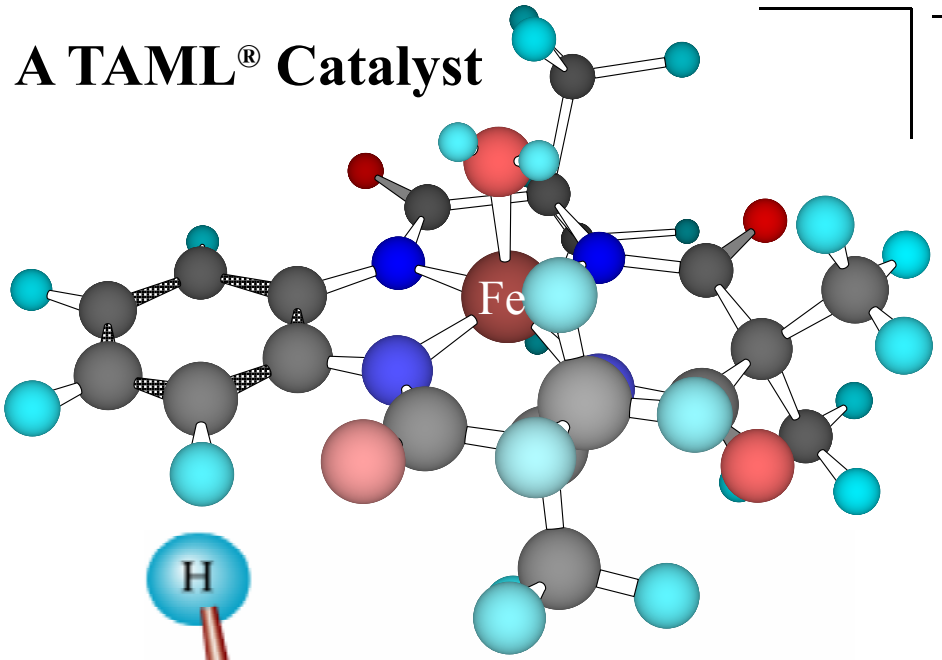
Large curtailment in **DIOXIN**/PCB emissions; public–regulatory–industry coordination – much more to do, esp. in less-developed countries



Discovery and understanding of mechanism of action of **ENDOCRINE DISRUPTORS**

TAML®s Are Broadly Useful Oxidation Catalysts

A TAML® Catalyst



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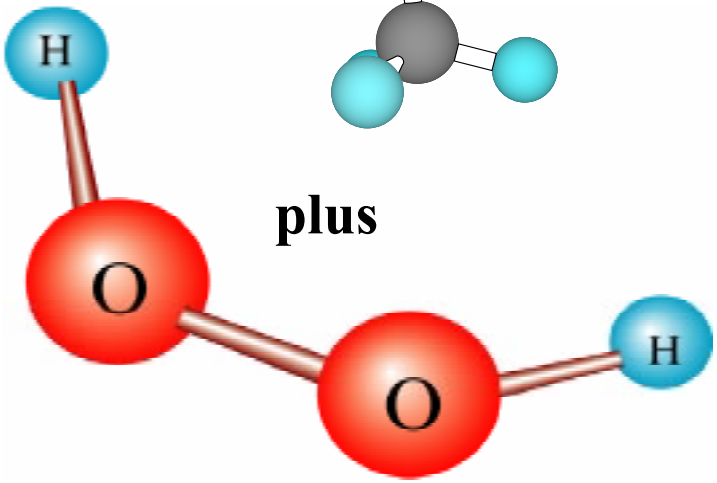

TEXTILES
dye bleaching and effluent decolorization

PULP AND PAPER
pulp delignification and effluent decolorization

WATER CLEANING
halogenated aromatics and organics destruction

LAUNDRY
dye transfer inhibition and stain bleaching

Key Sustainability Challenges for Chemistry Profession

- Incorporate **green chemistry principles** into teaching and research
- Increase **public confidence** that chemical risk is treated in a fair and reasonable manner
- Ensure green chemistry attacks the **genuine problems** of sustainability
- Support the **long-term research** that sustainabilty will require
- Incorporate **sustainability ethics** into chemical education