

Chemistry between Nature and Technology



CHEMIE UND GESELLSCHAFT
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DEUTSCHES MUSEUM, MUSEUMSINSEL 1, 80538
MÜNCHEN

Chemical vs Natural



- “Give me something against cough... a natural drug not one of those chemicals....”
- “Chemical” and “synthetic” = unnatural, even counter-natural for the laypublic
- Why?

What is wrong with chemistry?



- **How a natural science whose object is nature could be against nature?**
- **“Chemistry creates its object. This creative faculty akin to that of art, forms an essential distinction between chemistry and the other natural or historical sciences.**

(Berthelot 1860)

What is wrong with chemistry?



A Popular Prejudice?



- Natural vs artificial is a non-robust dichotomy
- Why wood, cotton, and wool, are seen as natural whereas nylon are synthetic? They are all processed
- Origin? coal & oil are as natural as sheep

A Popular Prejudice?



- Natural vs artificial is a non-robust dichotomy
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- Quantitative rather than qualitative difference.
- No obvious boundary, depends on many criteria+ comparative...
- **However it determines a moral threshold, a boundary for deciding what is right and wrong.**

A source of chemophobia



- Natural vs artificial = a pre-modern and relative divide. Seems obsolete and irrational.
- In a world saturated with technology what can be the significance and relevance of the ancient divide?
- Why technophobia vs technophilia ?

Chemophobia/Chemophilia polarization?

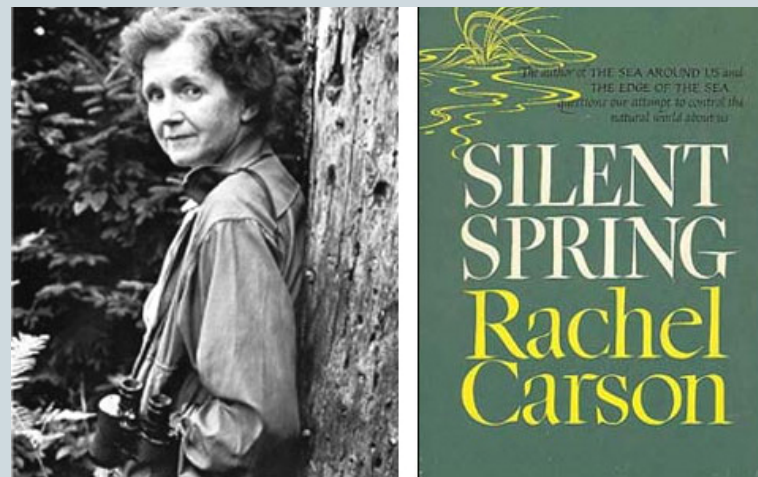
Rachel Carson, *Silent Spring* 1962,
quiet nature destroyed by
chemicals

Chemists's reply: *The Desolate Year*,
horrors of the world without
pesticide.

Controversy:

- chemophobia based on the view of chemistry as a war against nature
- chemophilia became a chemophobia-phobia.

Result: Popular and absurd divide
between chemical and natural.



Not a Temporary Depression



- Historical perspective in the long duration of Western culture (20 to 25 centuries)
- The bad image of chemistry is not a moment of crisis that could be overcome by a good marketing campaign.
- Rather one episode of a long tradition of conflicts deeply rooted in the history and prehistory of chemistry.

Cultural values embedded in chemistry



- Chemistry is not value-free: direct impact on the highly valued notion of nature.
- Chemistry blurs the nature/artifact divide:
 - as a science: knowing through making
 - as a technology: nature instrumentalized for human purposes

A long story of transgressions



A CULTURAL HERITAGE

A Western concept



- Concept of Nature is one of Four ontologies
- totemism
- Animism
- Analogism
- **Naturalism**

Naturalism



- Naturalism is « **simply the *belief* that nature exists, in other terms that some entities owe their being and their development to an external principle, which is not an effect of human will.** Typical of Western cosmologies since Plato and Aristotle, naturalism generates a specific ontological domain [...] it has become a « natural » presupposition which structures our epistemology and in particular our perception of other modes of identification. (Descola, *Les Indiens d'Amazonie*)



Ancient Greek Roots: *Phusis* & *technê*



- Aristotle *Physics* II
- [A]rt partly **completes** what nature cannot bring to a finish, and partly **imitates** her.
- Natural beings have an internal principle of motion and rest while artificial objects – a bed or a coat, for example – do not possess any such innate tendency to change.
- ‘Man is born from man, but a bed is not born from a bed.’

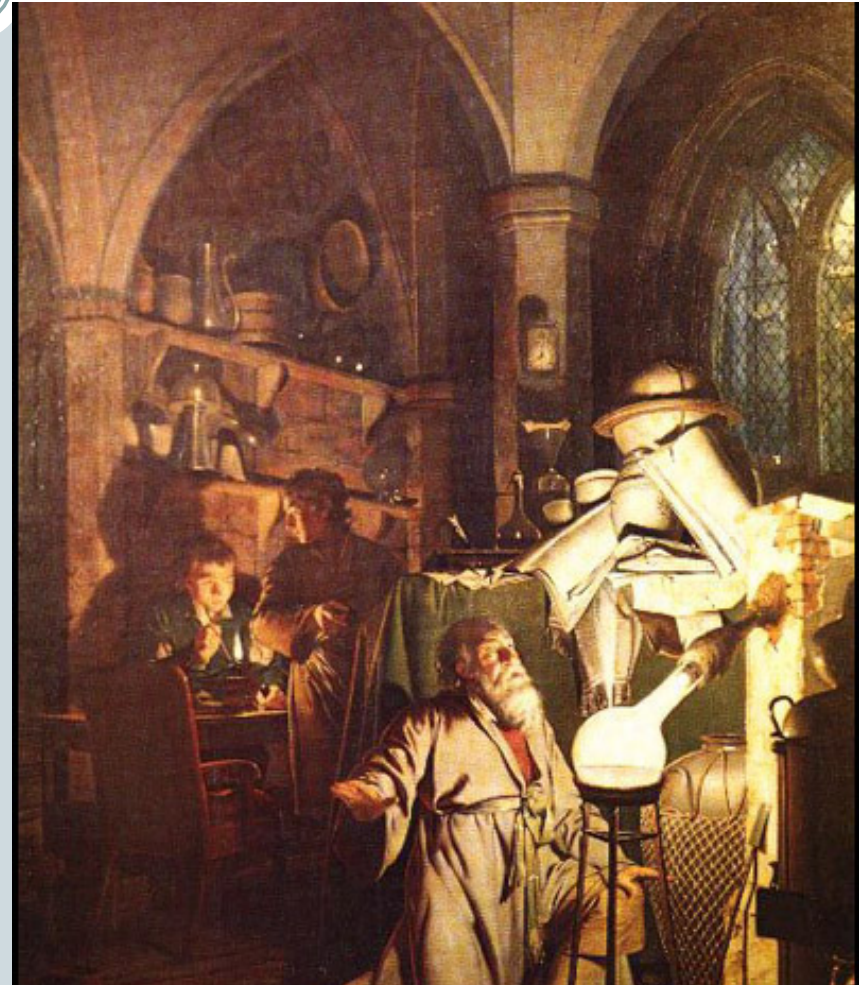
Roots of chemophobia in scholastic culture



- Medieval alchemy developed in a scholastic (post-Aristotelian) context
- Scholastic philosophy:
- Natural substances have a “substantial form”
- Nature/artificial = ontological difference

Scholastic condemnation of alchemy

- No true imitations of natural gold
- Either treachery: charlatans
- Or supernatural power: sorcerers



Alchemists vs Scholastics

Alchemists	Scholastics
Transmutation of lead into gold imitates the natural process of the ripening of ores in mines.	Artificial gold lacks the substantial form given by God.
Alchemical transmutation assists nature by facilitating and accelerating a natural process	Artificial gold cannot be identical to gold matured in the mines.
Alchemy improves nature as it refines raw materials	No one can rival with God's creation
Alchemy imitates the creation of nature	Transgression + Blaspheme

Alchemists' Reply

- **1) experimental evidence:**

- tests to prove the authenticity of the artificial gold made in their laboratory.
- later (17th century) analysis and synthesis to prove the identity of natural and man-made products



David Teniers the Younger, *Alchemist Heating a Pot*, oil on panel, 16" × 12", FA. 00-03-07.

Alchemists' Reply 2



- **2) Hermes Book (13th century):**
 - Man-made products are both artificial and natural since they use natural agencies such as fire.
 - They are by no means inferior to natural products. In some cases they even surpass them

Alchemists = earliest advocates of technology in Western culture.

Dignifying artifacts



- 18th-century “facticious” products (ammonia, sulphuric acid, soda)
- Chemistry celebrated as a useful science, contributing to public welfare and the wealth of nations. Chemists were no longer perceived as dangerous people.

A Climax of Transgression



THE PLASTIC AGE

Glamorous synthetic materials

May, 1940, Nylon euphoria

Du Pont's "Better things for better living . . . through chemistry," as a new style of life,



news about NYLON

it all started with a stocking
... a shorter, longer, longer-wearing stocking than women had ever dreamed of.

Today you're choosing nylon hose as fashion right, because it's light, takes stress, resists, and provides strength for their weight. You're looking for the ease of one-piece, proper, slip, hose, gloves - you're looking for nylon's strength and elasticity in essential industrial uses.

DU PONT
REG. U.S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
... THROUGH CHEMISTRY

TO MANUFACTURERS: Are there textile fibers in your product? Then you'll want to read "Nylon Textile Fibers in Industry." Write for this important book now!

NEW! FREE look for women, teachers, students - "About Du Pont Nylon." Write to Nylon Division, E. I. du Pont de Nemours & Co. Inc., Washington 25, D.C.

PACK IT - washable, quick-drying nylon men's suits! So light it takes up little room - so long-wearing you'll be packing it for many trips to come! Because nylon can be "beaten," wrinkled creases are no worry.

WORK WITH IT In the water - and again - commercial laundries must be strong, light, extra-long-wearing. And they are made with nylon. Tough, elastic nylon fibers have a high tensile strength that is unaffected by detergents.

WASH IT Hang it up! Your nylon blouse is short work to wear again. For nylon that "set" during life! Nylon's little stretch can be set to hold its shape. Your blouse will keep its fresh, crisp and feminine look - wear and WEAR!

FOR NYLON FOR RAYON FOR FIBERS TO COME LOOK TO DU PONT

Cornucopia of material plenty



The Wonderful World of Synthetics



- consumption of material goods.
- control of production, pure products
- Comfort for all: Synthetics as agents of democratization
- economic benefits *one plastic a day keeps depression away*”
- job opportunities,
- Regular supply



From properties to Virtues



- Lightness
- Plasticity (potential for indefinite change)
- Impermanence (one-use commodities)
- Clean = >
- Protecting nature: “The use of chemical substitutes releases land or some natural raw material for other more appropriate or necessary employment” (Williams Haynes, *Men money and Molecules* (1936))

Dignifying the artificial

- Plastic = major cultural value

Roland Barthes (1971)
'Plastics are like a wonderful molecule indefinitely changing..

Connotations:

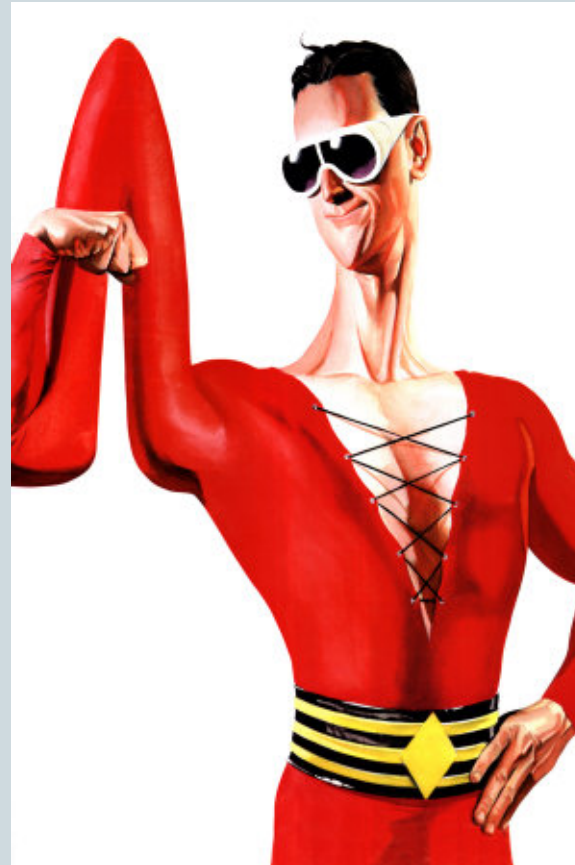
- magic of indefinite metamorphoses
- Virtual reality.
- Superficiality



A cultural Model



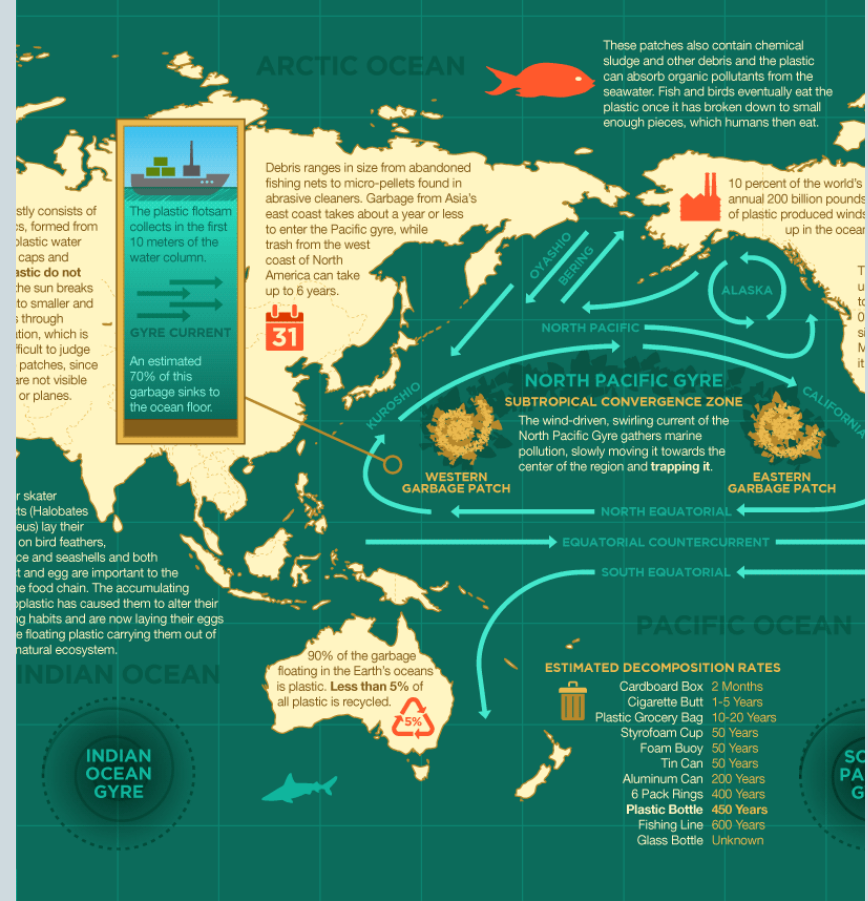
Plastic man
Ever changing
Superficial
Fun
Flexible
Adaptable
Convivial



Plastic accumulation



GREAT PACIFIC GARBAGE



Desperately seeking natural substitutes



Legends of Transgression



CREATING LIFE IN A TEST TUBE

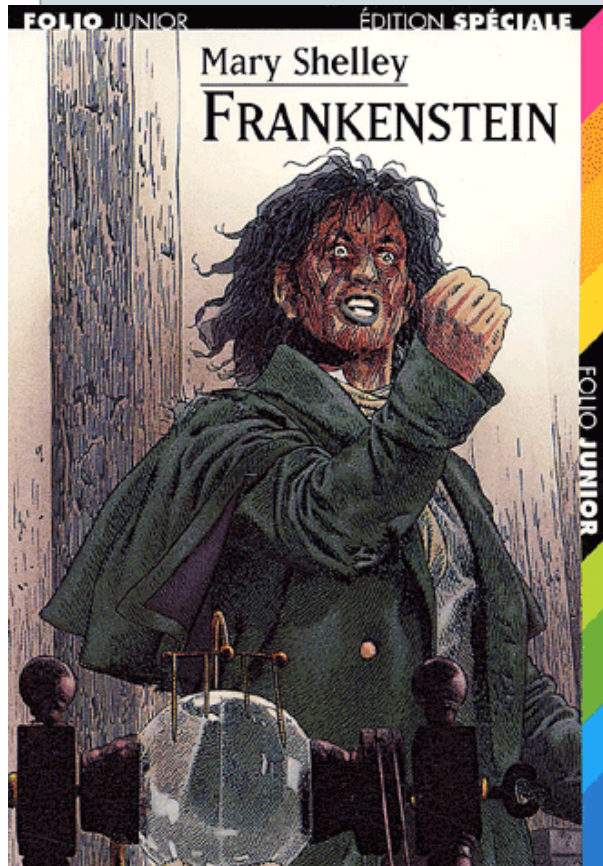
Renaissance



- Paracelsus's attempts at making life in a test-tube
- Faust Legend



A Literary theme



Honoré de Balzac La Recherche de l'absolu

Préface de Raymond Abellio



folio  classique
Texte intégral

Wöhler synthesis of urea

- **1828, synthesis of organic compound**



- **Death of metaphysical vital force**
- **Dawn of a new era when chemists would be able to create organisms**

A Legend



- Legend propagated by Herman Kolbe, Wilhelm August Hoffman and Marcellin Berthelot.
- Urea is an organic substance but not an organism
- Not a total synthesis (from cyanate extracted from horns)
- A product of life but was not synthesized through the same process in the organism (Claude Bernard).
- Anti-metaphysical claim \leq confusion between organic and organized and between products and process.

Synthesis vs Metaphysics



- Marcellin Berthelot 1860
- Synthesis: “The reproduction of the complete set of natural compounds using the elements in partnership with only the play of molecular forces and the chemical metamorphoses that matter undergoes in living beings”.
- **“the chemical effects of life are exclusively due to chemical forces”.**

From synthetic chemistry to synthetic biology

- **Biology is technology**
- “The genetic code is 3.6 billion years old. It’s time for a rewrite”
- Tom Knight (Silver, Life 2.0 in *Newsweek International* June 4, 2007)



Redesigning life

24 November 2009 www.nature.com/nature THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE

nature



GLOBAL WARMING
California lives the dream

TRANSPLANT REJECTION
A necessary evil?

QUANTUM COMPUTING
Cool for qubits

NATUREJOBS
NGO for H!

SYNTHETIC BIOLOGY

Life is what we make it



Again: The death of Vitalism



Nature, June 28, 2007:

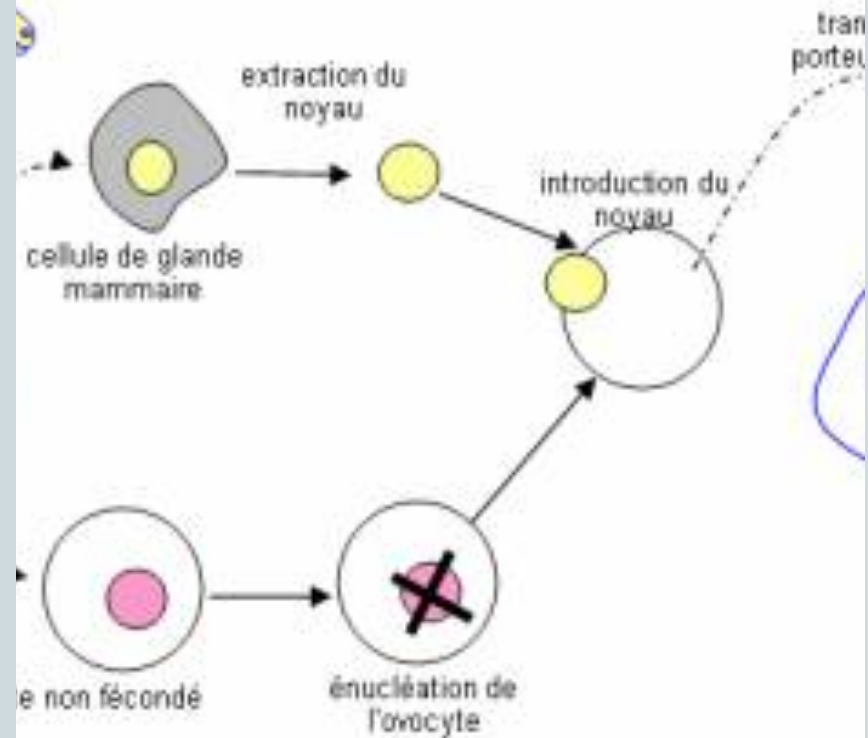
**“Synthetic biology provides a welcome
antidote to chronic vitalism”**

cultural benefit: “life is a molecular process lacking a
moral threshold at the level of the cell.”

Unnatural living organisms



clonage à la Dolly
(d'après courrier de l'Unesco 1999)



To sum up...



- Chemistry struggles in the symbolic order: given the resilience of the natural/artificial divide, chemistry keeps an aura of transgression
- Chemical Synthesis = main historical target
- When chemistry is no longer the only science who creates its own object... transfer of the burden of transgression

What next?



- How to reconcile chemistry and the Western valuation of nature?
- biomimetic synthesis?
- Green chemistry?
- Cultural Values Matter.....