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CEE 697z

Organic Compounds in Water and Wastewater

Introduction to Organics in Water and Wastewater

Lecture #1

Organic Compounds: Types?

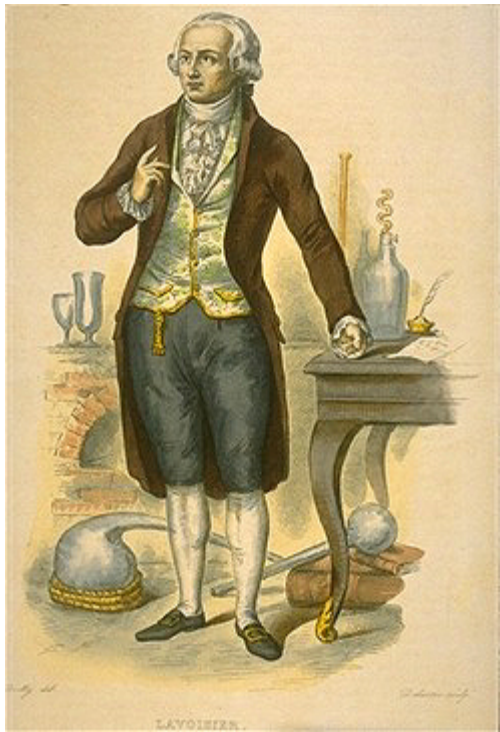
- Natural Compounds
  - Fulvics
  - Proteins, carbohydrates, etc
- Domestic WW Organics
- Industrial Synthetic Organics
  - Plasticizers: phthalates
  - solvents: tetrachloroethylene
  - waxes: chlorinated parafins
  - others: PCB's
- Hydrocarbons & oil derivatives
  - includes products of combustion: PAH's
- Agricultural Chemicals
  - pesticides: DDT, kepone, mirex
- Pharmaceuticals, etc
  - Anti-epileptics
  - Beta-blockers
  - X-ray contrast media
  - antibiotics
- Home & Personal Care Products
  - triclosan
  - Musks, flame retardants
- Endocrine Disrupters
  - Steroidal estrogens
- Natural process byproducts
  - Conjugated pharmaceuticals
- Engineered process byproducts
  - disinfection byproducts, etc

Tentative plan

Week of:	Topic
Sept 1	Introduction & Planning
Sept 8	Natural Organic Matter
Sept 15	
Sept 22	
Sept 29	
Oct 6	Fracking Fluids
Oct 13	PPCPs & Estrogenic Compounds
Oct 20	
Oct 27	
Nov 3	
Nov 10	Cyanotoxins
Nov 17	
Nov 24	Hydrophobic Toxins
Dec 1	

A brief history of Carbon

- 13,800,000,000 BCE: the big bang - now we have matter; and about 400,000 yrs later we have the first carbon atoms
- 1,600,000 BCE – human controlled fire; formation of charcoal
- 3750 BCE – Egyptians & Sumerians use charcoal for reducing Cu, Zn & Sn
- 150: "Vitalism" holds that living organisms are composed of "organic" material
- 1789: carbon recognized by Antoine Lavoisier as an element
- 1824: "Vitalism" is discredited and modern view of organic compounds begins to emerge
- 1840s: water pollution worsens in major urban centers
- 1858: tetravalent nature of carbon is recognized helping to launch modern organic chemistry



Hamlin (1990) A Science of Impurity, University of California Press

3 London's Water: The Dress Rehearsal of 1828

It is vain therefore to say, that where nothing is discovered there is nothing wrong.[1]

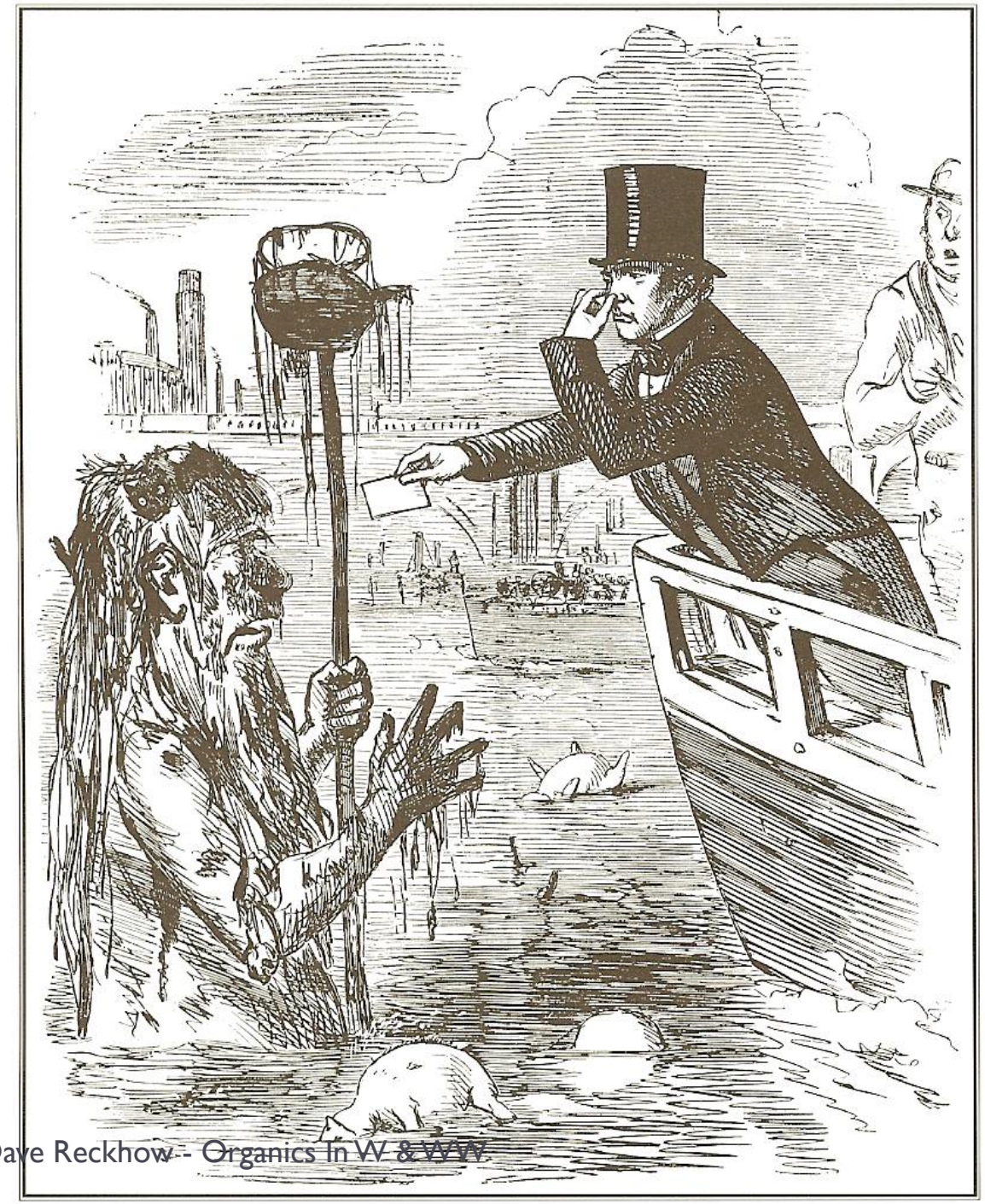
William Lambe

Most chemical analysis of water in the early to mid 1800s was focused on mineral waters used almost exclusively by the rich

In 1828 Dr William Lambe, fellow and censor of the Royal College of Physicians, graduate and fellow of St John's College, Cambridge (fourth wrangler, 1786), and 'one of the most elegant medical writers of his day,' asserted that the ordinary water a great many people habitually drank was deadly: 'I believe the evil to be deep and serious; not merely injurious to cleanliness and comfort but ... a mischief which saps the foundations of life, and brings multitudes to a premature grave.'[2] In particular, Lambe believed that ordinary drinking water, particularly that supplied to Londoners from the Thames, was laden with organic matter in a state of decomposition, which it was 'generally agreed' (Lambe gave no references) had an injurious effect on health.[3] Sometimes these decaying organic matters were perceptible—water would be noticeably foul—and 'in this case, the common feeling of disgust induces men to reject it as unfit for human use.'[4]

London

- The Great Stink
- Michael Faraday presenting his card to Father Thames
  - *Punch*, July, 1855
- Aside from using our noses, how to measure the organic matter?



Halliday (1999) The Great Stink of London, Sir Joseph Bazalgette and the Cleansing of the Victorian Metropolis, Sutton

Earliest Quantitative Methods

- Reaction with Oxidants
  - Hg and Pb salts
    - Early 1800s
  - Permanganate & Dichromate
    - Chemical oxygen demand
      - Permanganate test developed by Forchhammer in 1850 (Denmark)
  - Oxygen "catalyzed" by microorganisms
    - Biochemical oxygen demand
      - 1908 proposed BOD_5 as the best method for river pollution by the Royal Commission on Sewage
      - Later standardized as it is today
- Color

- To next lecture