Dental Amalgam Recycling

Pathways, Principles, & Practice

Academy of Operative Dentistry

CODE Meeting

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The Marquette University School of Dentistry

The Environmental Protection Agency

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WELCOME!

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WELCOME!

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BE THE DIFFERENCE!

PresentationTopics

- Brief history of amalgam
- Extent of amalgam use in the US
- Current government regulation
- Environmental fate and transport mechanisms of amalgam
- Amalgam (Hg) bias by the general population
- Professional and environmentally responsible amalgam management techniques

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HISTORY OF AMALGAM

History of Amalgam

- A Chinese medical text mentions using a “silver paste”, a type of amalgam, to fill teeth in the 7th century.[1]

History of Amalgam

- b. 1678 – d. 1761
- The Age of Enlightenment
- Between 1650 and 1800 the Science of Modern Dentistry developed
- *Le Chirurgien Dentiste* published in 1728
- He advocated the use of lead (plombagel) to fill cavities.

History of Amalgam

Joseph Fox

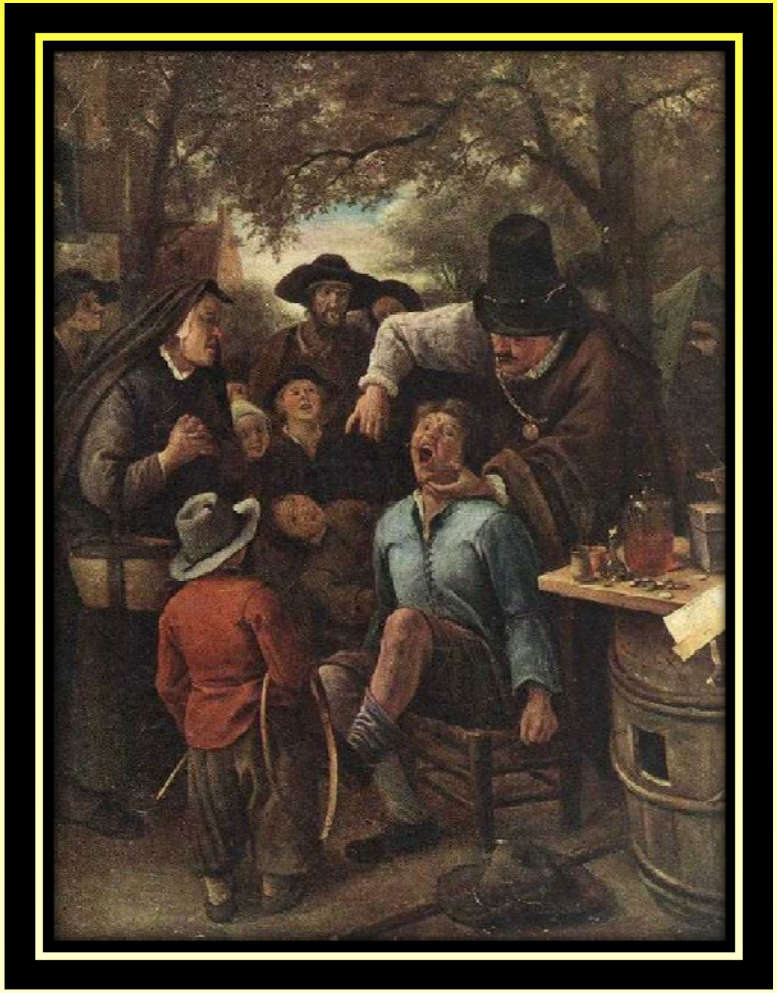
- b. 1775 – d. 1816
- one of the most highly regarded English Dentists of his time.
- In 1803 he created “Fusible Metal”.
- This metallic liquid filling material (bismuth, lead, and tin) when put into the cavity form and cooled, would solidify and replicate the shape of the cavity.
- The problem was the relatively high melting point
  - equivalent to that of water
  - a less than favorable experience.

History of Amalgam

- Thomas Bell
  - b. 1792 – d. 1880
  - Fox's successor at Guy's Hospital
  - Around 1826 he invented an amalgam of coin silver and mercury which had a much lower melting point than Fox's metal. (Frenchman August Taveau also came up with a similar discovery around the same time).
  - It remained soft during the procedure and was much more comfortable to the patient.

History of Amalgam

- Crawcour brothers
  - In 1833 introduced Taveau's amalgam in New York
- They went from town to town placing Royal Mineral Succadaneum (Taveau's Amalgam) for all of the people who could not afford the Royal Mineral (Gold).
- They did a remarkable job of advertising.
  - As well as of not removing decay before they filled the teeth.
- Most of the fillings fell out or the teeth split apart from the expansion of the amalgam a few days after they left the town.



History of Amalgam

- The Amalgam War
  - Local dentists organized to fight the use of this “execrable material by swindling villains”
  - Crawcour brothers forced to flee America
- In 1843, the American Society of Dental Surgeons (ASDS) began a crusade to fight the use of amalgam
- In 1845, the ASDS passed a resolution compelling every member *not* to use amalgam
- In 1850, the ASDS rescinds its pledge requirement
- In 1855, the ASDS disbands
  - If you can’t beat them, join them

History of Amalgam

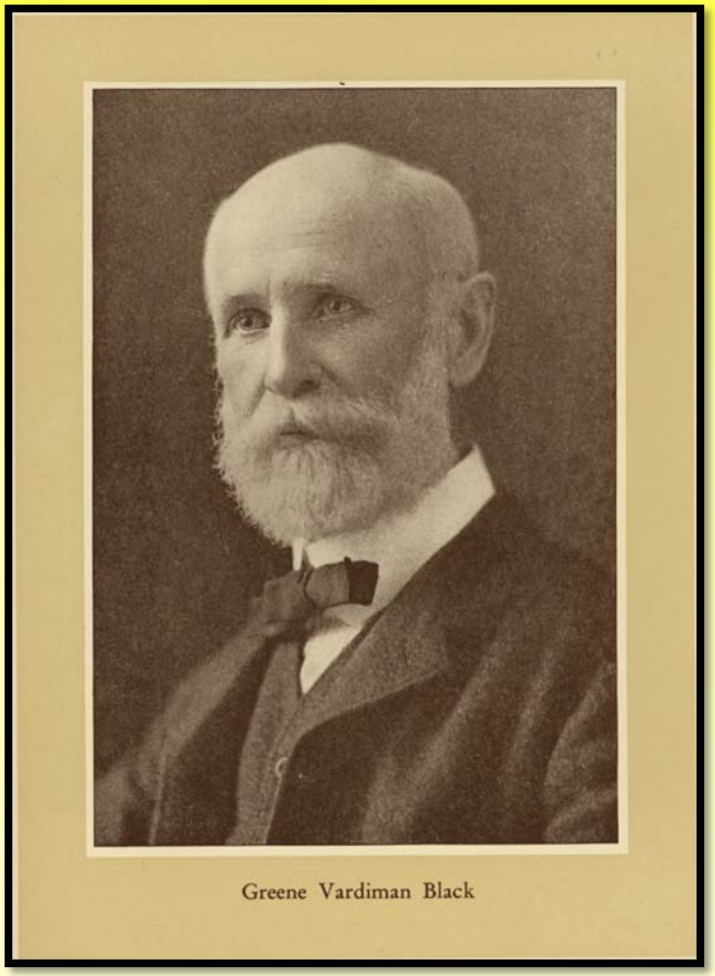
- What ended the Amalgam War?
  - Professional and consumer demand
  - Amalgam was here to stay.

- In 1859, the leaders of the profession regrouped to form the American Dental Association.

- Between 1860 and 1890 many experiments were done to improve Amalgam filling materials.

History of Amalgam

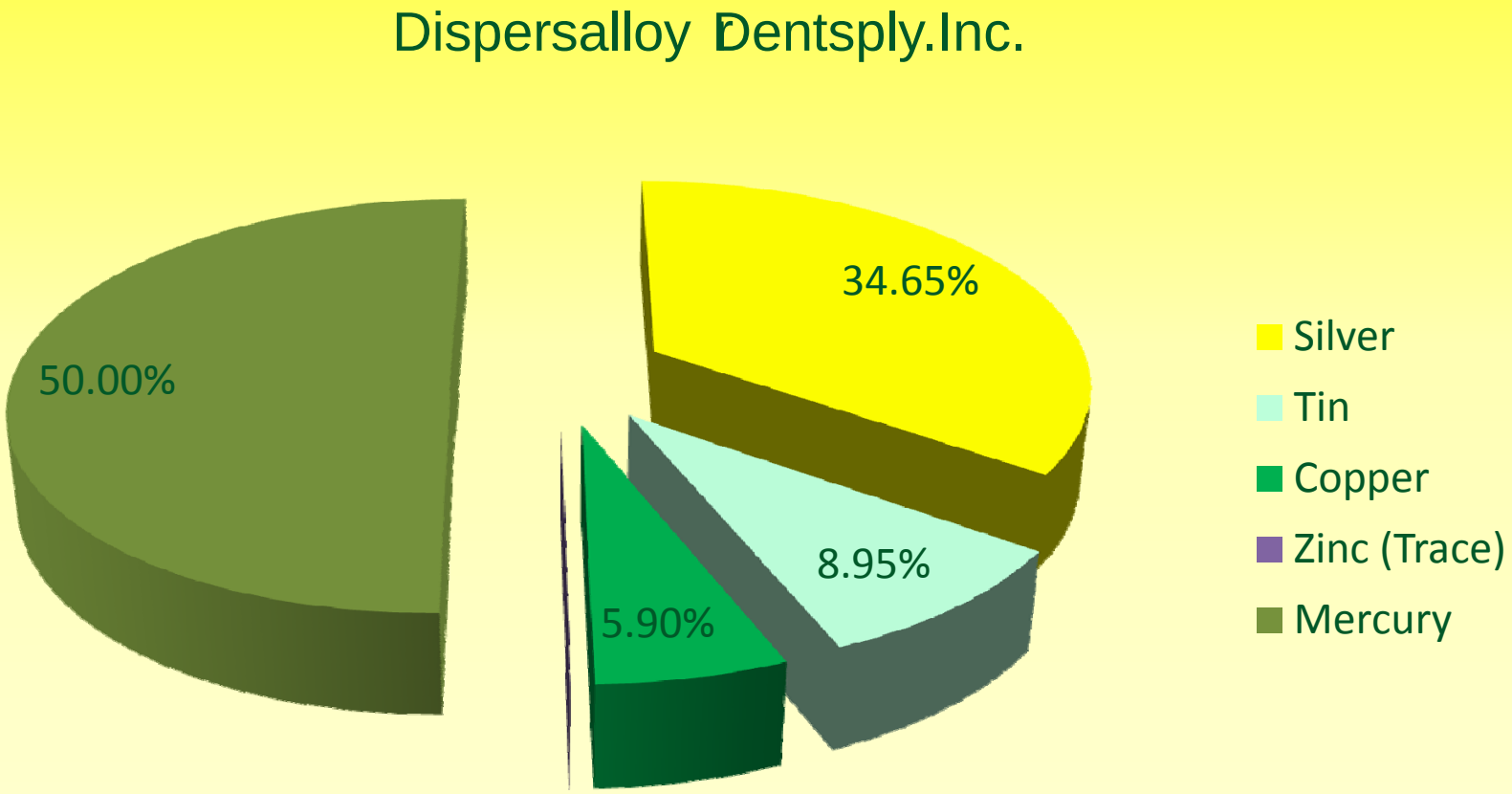
- G.V. Black developed a "good and workable" amalgam in 1895
  - He believed amalgam should consist of 67% silver, 27% tin, 5% copper, and 1% zinc
- Use of amalgam gradually won acceptance as a cost effective way to restore teeth



AmalgamComposition

- Modern day dental amalgam
  - usually referred to as a “silver filling” by patients
  - manufactured product containing two nearly equal parts by weight.
- First part
  - a powder containing silver, tin, copper, zinc and other metals
- Second part
  - liquid mercury (Hg).

AmalgamComposition



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GOVERNMENT REGULATION

Amalgam: An FDA Regulated Medical Device

- Dental amalgam is a dental device regulated by the Food and Drug Administration (FDA).
  - Specifically the Center for Devices and Radiological Health (CDRH).
  - It is considered to be a stable device for most applications and uses.

- Since the early 90's, Amalgam has been reviewed by the FDA, CDC, and NIH looking for a link between amalgam and health problems.
  - To date, there are no studies that show it is harmful to adults or children.

- In September 2006, an FDA Advisory Council met to discuss benefits and risks of Hg and amalgam. Their findings:
  - ***No*** evidence that amalgam causes health problems in majority of population.
  - Lack of knowledge concerning effects on pregnant women, children, and those who are sensitive to Hg.

Amalgam Waste: An EPA Regulated Product

- The Environmental Protection Agency (EPA) regulates any waste generated from amalgam preparation and use.
- At the federal level, the EPA is not seeking to eliminate the future use of dental amalgam.
- Their goal:
  - to ***teach*** and ***encourage*** the proper management of wastes generated from its use.

Amalgam Waste: An EPA Regulated Product

- Examples of amalgam waste:
  - Non contact amalgam
    - Excess left over after procedure
  - Contact amalgam
    - Has been in contact with human….extracted teeth, carving scrap, traps, filters
  - Chairside traps
  - Vacuum pump filters
  - Amalgam sludge
    - Mix of liquid and solid collected within filters and traps
  - Amalgam capsules
    - Used and unused

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EXTENT OF AMALGAM USE INTHE UNITED STATES

Decline of Hg Containing Products

- Since 1980 mercury usage in products has continued to decline substantially over the years – a decrease of 83%.
- This reduction in use was due in large part to legislation and regulatory standards for mercury usage in batteries and to EPA's regulatory ban on mercury in paint.
- Mercury use in products accounted for an estimated 245 metric tons in 2001. Mercury usage in the form of dental equipment and supplies was 34 metric tons or 14% of the total.

Decline of Hg Containing Products

245 Metric Tons
Norfolk & Western Y6b

34 Metric Tons
USArmy HMMWV

539,000 lbs Total Hg Usage

75,000 lbs of Dental Hg Usage

Extent of Amalgam Use In The US and Its Impact on Water Bodies

- The use of dental amalgam has declined in the past two decades, however, it continues to be placed.
- US dentists placed 200 million restorations in 1990[1].
  - 96 million were amalgam restorations
  - 38% reduction from 1979
    - Decrease in caries rate
    - Improved substitute materials
- US dentists placed 66 million amalgam restorations in 1999.
- There are currently 201,604 licensed dentists in the U.S.[2]
  - One would assume most place and/or remove amalgam restorations

Extent of Hg Use In The US and Its Impact on Water Bodies

- The EPA estimates that the average dentist contributes 0.1 to 0.3 grams of mercury in the form of amalgam per day to wastewater.
- Amount of amalgam waste is .45 mg per procedure.[1]
  - Total of non contact scrap and waste from carving.
- A report released in 2002 by the National Association of Clean Water Agencies (NACWA) indicated that dental clinics are the largest single source of mercury in wastewater.[2]

Extent of Hg Use In The US and Its Impact on Water Bodies

- Products containing Hg sold in U.S.
  - Switches & Relays – 55.1%
  - Dental Amalgam – 30.7%
  - Lamps – 18.4%
  - Thermostats – 14.3%
  - Measuring Devices – 4.9%
  - Other – 3.5%
  - Batteries – 2.6%
  - Laboratory & Chemical Uses – 1.01%

Extent of Hg Use In The US and Its Impact on Water Bodies

- Among these products containing mercury, dental amalgam ***is*** a focus of concern.
- Relative to other sectors, dentists use large quantities of the metal in fillings, and they generate large amounts of mercury-containing waste.
- This waste is easy to capture
  - inexpensive collection systems can collect up to 99 percent of dental mercury.
  - In the United States, relatively few dental offices use these systems.

Why Is Dental Amalgam Still Being Used?

- Relatively easy to place
- Low cost
- Good resistance to compressive forces especially for posterior teeth.
- Insurance plans have traditionally covered placement procedure
- No current, adequate substitute
  - If amalgam were banned, US dental costs would rise $8.2 billion in the first yr alone[1]
  - 10% of all current dental expenditures

Past Management Practices = More Pressure on Dentists Today

- Despite its continued use, management of amalgam waste has created substantial environmental contamination and has created more pressure on the industry to recycle amalgam to prevent it from getting into the environment.

- In 2003, half of the state legislatures in the country as well as the United States Congress introduced bills to protect the public from mercury.[1]

- Many states have already mandated the use of specific technologies to control the amount of amalgam reaching the environment from the dental office.

Best Management Practices

- In March 2004, the American Dental Association released “Best Management Practices for Amalgam Waste”
  - A set of guidelines about recycling amalgam wastes.
  - Stresses recycling of amalgam collected in the dental office.
  - No mention of installing amalgam separators to remove amalgam particles from wastewater.

ADA
American Dental Association
www.ada.org

BEST MANAGEMENT PRACTICES
FOR AMALGAM WASTE

American Dental Association
March 2004

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Best Management Practices

- In October 2007, the American Dental Association revised "Best Management Practices for Amalgam Waste"
  - Essentially the same except it mentions:

- ***Amalgam separators***
  - Select an amalgam separator that complies with ISO 11143.
  - Follow the manufacturer's recommendations for maintenance and recycling procedures.

- For information on amalgam separators see:
  - "Laboratory evaluation of amalgam separators" 2002:133;577-89.
  - "Evaluating amalgam separators using an international standard" 2006:137;999-1005.
  - "Purchasing, installing and operating dental amalgam separators: Practical issues" 2003 134: 1054-65.

States Requiring Separators

- One manufacturer tallies its separator sales in those states that don't require them: (2003 data)
  - Wisconsin – 2
  - Texas – 1
  - New York – 2
  - New Jersey – 0.[1]
- Its sales in Connecticut which *does require them:*
  - *exceed 600.*

States Requiring Separators

- Connecticut, Maine, Massachusetts, New Hampshire, New York, Vermont, Rhode Island (eastern half of state), Vermont
- VT and CT include separators in BMPs and require dentists to implement BMPs
- King County Washington (soon to be the entire state)
- New Jersey is working on a requirement for separators
- Majority of Wisconsin – mandating by 12.31.08

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AMALGAM BIAS

Major Studies Show Impact on Water Quality From Dental Amalgam

- Recent studies by the New York Academy of Sciences indicate as much as 40% of the New York Harbor mercury loadings are from dental offices.

- The National Association of Clean Water Agencies (NACWA) estimated that 36 percent of mercury entering publicly owned treatment works (POTWs) is discharged from dental offices due to mercury from its waste amalgam.

- Mercury discharges from dental offices far exceeded all other commercial and residential sources, each of which was below 10 percent.

The Problem with Mercury

- Mercury is persistent, bio-accumulative, and toxic and is responsible for significant environmental degradation around the world.

- Although its use in most product applications does not present a risk, the subsequent disposal of any product containing mercury does.
  - Amalgam is no different.

The Problem with Mercury

Three types of Mercury:

- Elemental Hg
  - Heavy, odorless, silver colored liquid
  - Inhalation is the main source of toxicity
    - Hg well absorbed by lungs
  - Need long term exposure or one large exposure
- Inorganic Hg
  - Known as Mercuric salts…i.e. mercuric chloride, mercuric iodide, cinnabar
  - Found in many folk medicines
  - Corrosive and damage the kidneys
  - Long term use can cause skin irritation, staining, and nerve damage
- Organic Hg

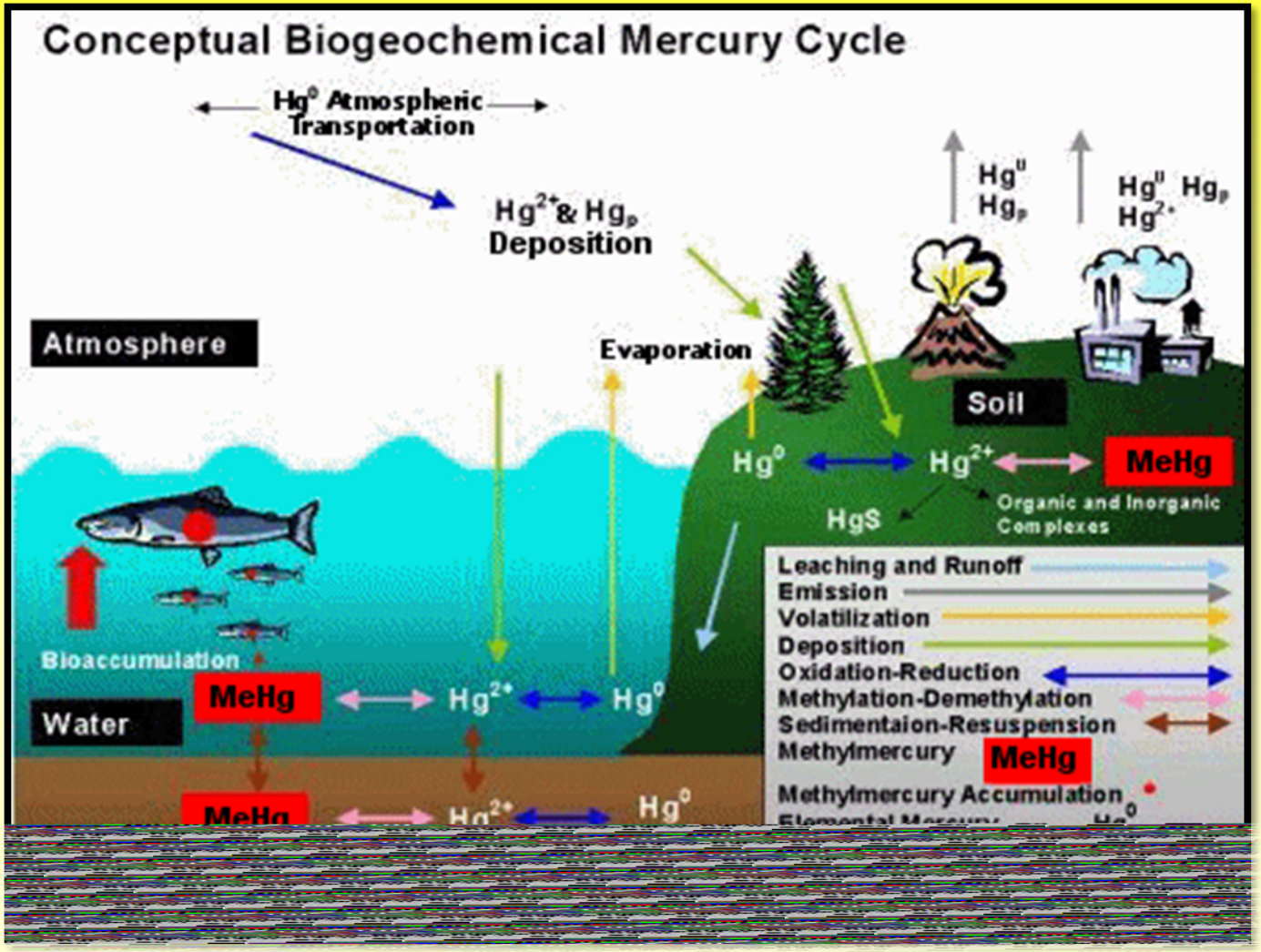
The Problem with Mercury

- Organic Hg
  - Found in fungicides and antibacterials (mercurichrome)
  - The main source of Hg poisoning is ingestion
    - Small ingestions rarely cause problems
    - Large ingestions or long term ingestions are
    - Hg primarily found in fish
  - Organic concentrations can be 1000x higher in the fish than in the surrounding water
  - Very damaging compounds that can attack all body systems

Methylmercury: More Risky In The Environment

- The EPA is most concerned about methylmercury in the environment.
  - It is a form of mercury which is more potent and more bioaccumulative than other forms of mercury.
  - Methylmercury is also the form to which humans are primarily exposed.
- Inorganic Hg has a high affinity for particles,
  - therefore, the fate of most inorganic mercury in aquatic systems is sedimentation.
- ……Methylmercury, in contrast, tends to be more soluble because of its affinity for organic compounds.

Methylmercury: How Is It Formed?

- When dental amalgam is released to the environment, the mercury component is transformed into methylmercury by microbial action.
- Methylation is a product of very complex processes that transform mercury into more reactive species.

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