New Uses of New and Old Technologies:

Marvelseal, Lugol's Iodine, and Scavengers for Mercury Mitigation in a Mineral Collection

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National Museum of Natural History

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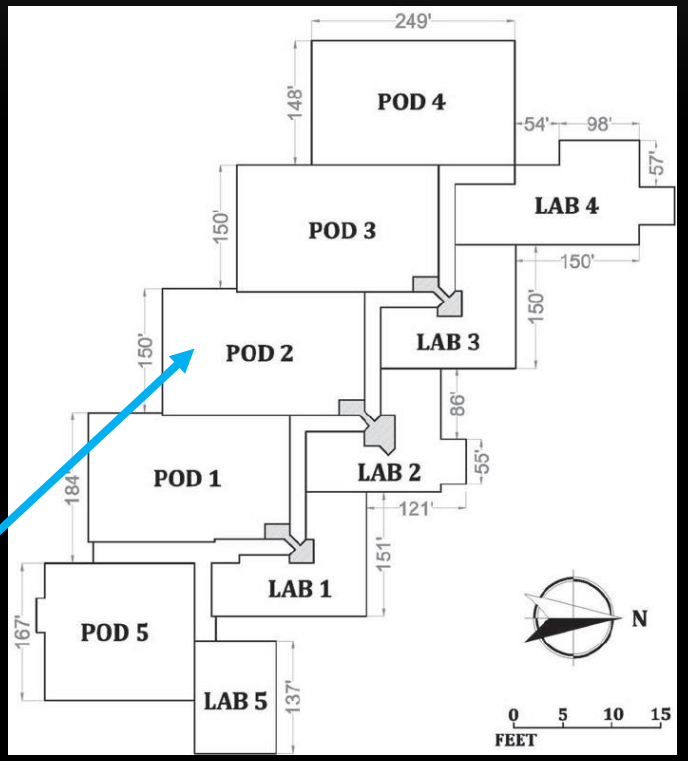

Mineral Sciences storage

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Powder-coated, metal storage cabinets

Mercury Vapor: Adverse Collection & Health Effects

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Initial screening 2010

Jerome Mercury Vapor Analyzer 431
Detection range: 0.003- 999 mg/M3

3 cabinets = 6 side-by-side drawer units

Case Interiors (direct-reading):
0.03 – 0.146 mg Hg/cubic meter air

Throughout aisles, cabinets fully open:
< 0.003 mg/M3

As a reference:
ACGIH TLV (8-hr TWA) = 0.025 mg/M3

Access Control Procedures

Keys maintained by collection manager

Respirators/Gloves

Reduction of vapor to augment case opening protocols

- **high air exchange rate in Pod**
- **opening doors and allowing cabinet to vent prior to access**
- **aisles <0.003 mg/M3 after doors opened**
- **use of Nilfisk mercury vacuum**

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Extensive Deposits on Cabinet Finishes

Mercury Absorption/Deposition on Storage Trays

Initial Mitigation Strategy

- **Specimen enclosure, Marvelseal**
- **Cabinets cleaned, Hg Absorb Sponges**
- **Tray replacement, new archival trays**
- **Scavenger sheets, MicroChamber**

Trial 1: Baseline, Cases Closed 5 months

- **3 cabinets = 6 side-by-side drawer units**

- **Direct-reading measurements**
  - **Range :**

    0.07 – 0.44 milligrams Hg/cubic meter air
  - **Median: 0.13 mg/M3**

Personal Exposure Sampling

- Conducted during specimen enclosure bagging.
- Work task of highest potential Hg exposure.

- 3 samples: Each < 0.002 mg/M3 - 8-hr TWA
- *ACGIH TLV, Elemental Hg = 0.025 mg/M3*

- *Media: SKC 226-17-1A (200 Anasorb C3)*
- *Method: NIOSH 6009*

Enclosure in Marvelseal

Vapor-impermeable material

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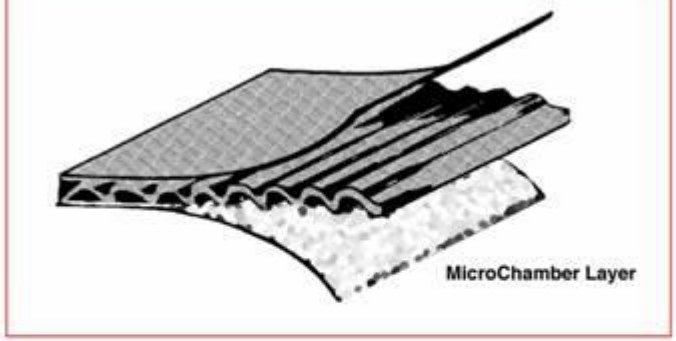
Cleaning


Hg
Absorb
Sponges
LAB SAFETY SUPPLY
PO Box 1368
Janesville WI 53547
1-800-356-0783
Reorder No. 20760
Lab Safety Supply Inc.

Scavenger

MicroChamber™

Activated carbon and a zeolite called SPZ, (the zeolite Conservation Resources developed for use in MicroChamber, papers, coatings, and other materials



MicroChamber®, Corrugated

outside liner and corrugated medium are Lig-free®, Type I (pH 8.5, 3% alkaline buffer, no lignin)
inner liner is MicroChamber General Purpose paper with a gray layer containing a special activated carbon and alkaline buffers, and a white layer containing our proprietary zeolites and an alkaline buffer.

Results - Initial Mitigation Strategy

Case interior measurements decreased

- **Range: 0.03 – 0.252 mg/M3**
- **Median: 0.04 mg/M3**

- **However, visible streaks left by Hg sponge.**
- **More intensive cleaning developed.**

Second Cleaning Of Cabinets

Modified Lugol's Iodine

- 0.5g iodine
- 1.0g potassium iodide
- 50ml deionized water (pH 7)
- dilute to 20% soln by addition of deionized water

Cleaning

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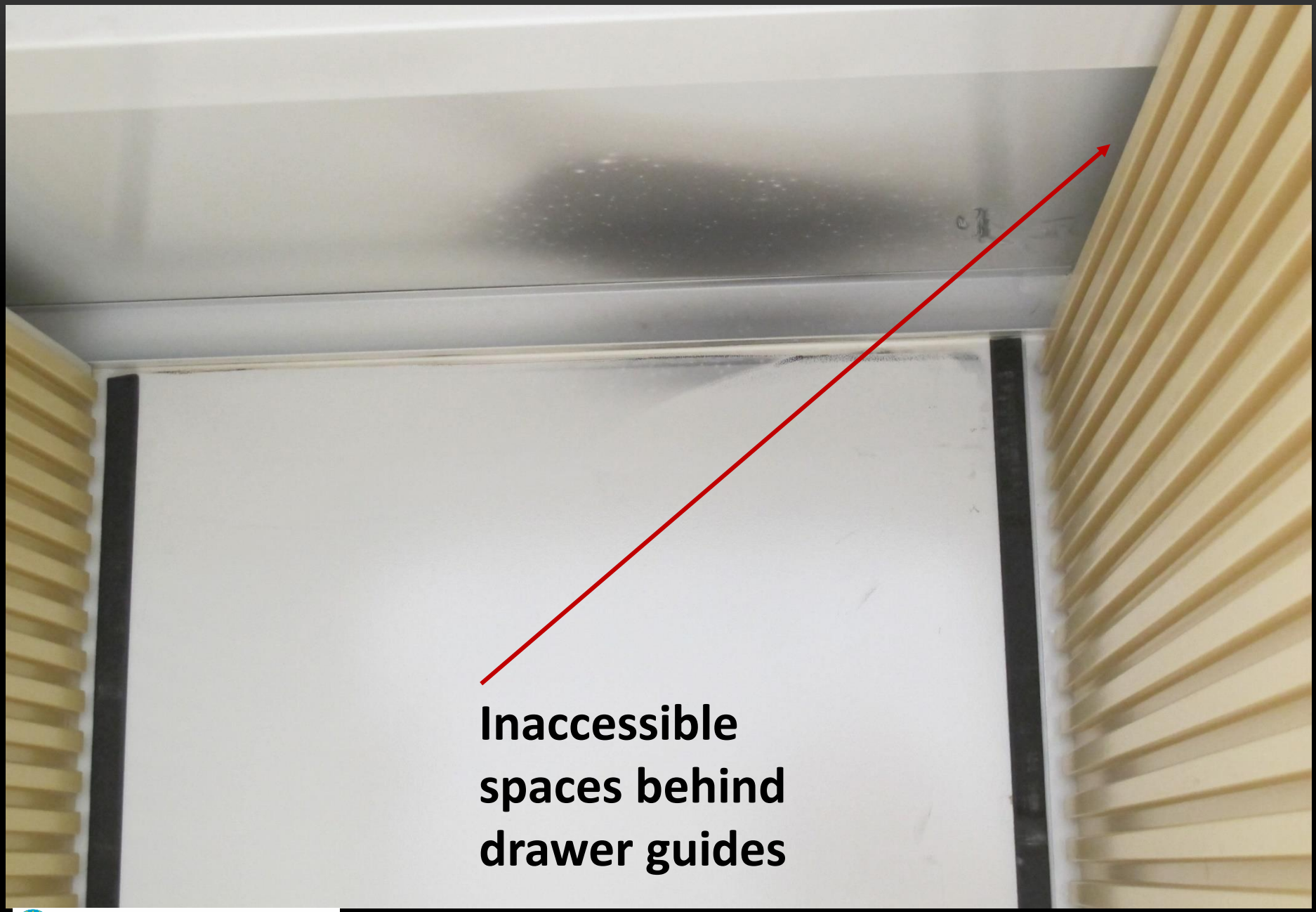
Results After Second Intensive Cleaning

Case measurements decreased again; still significant interior concentrations

- **Range: <0.004 – 0.182 mg/M3**
- **Median: 0.024 mg/M3**

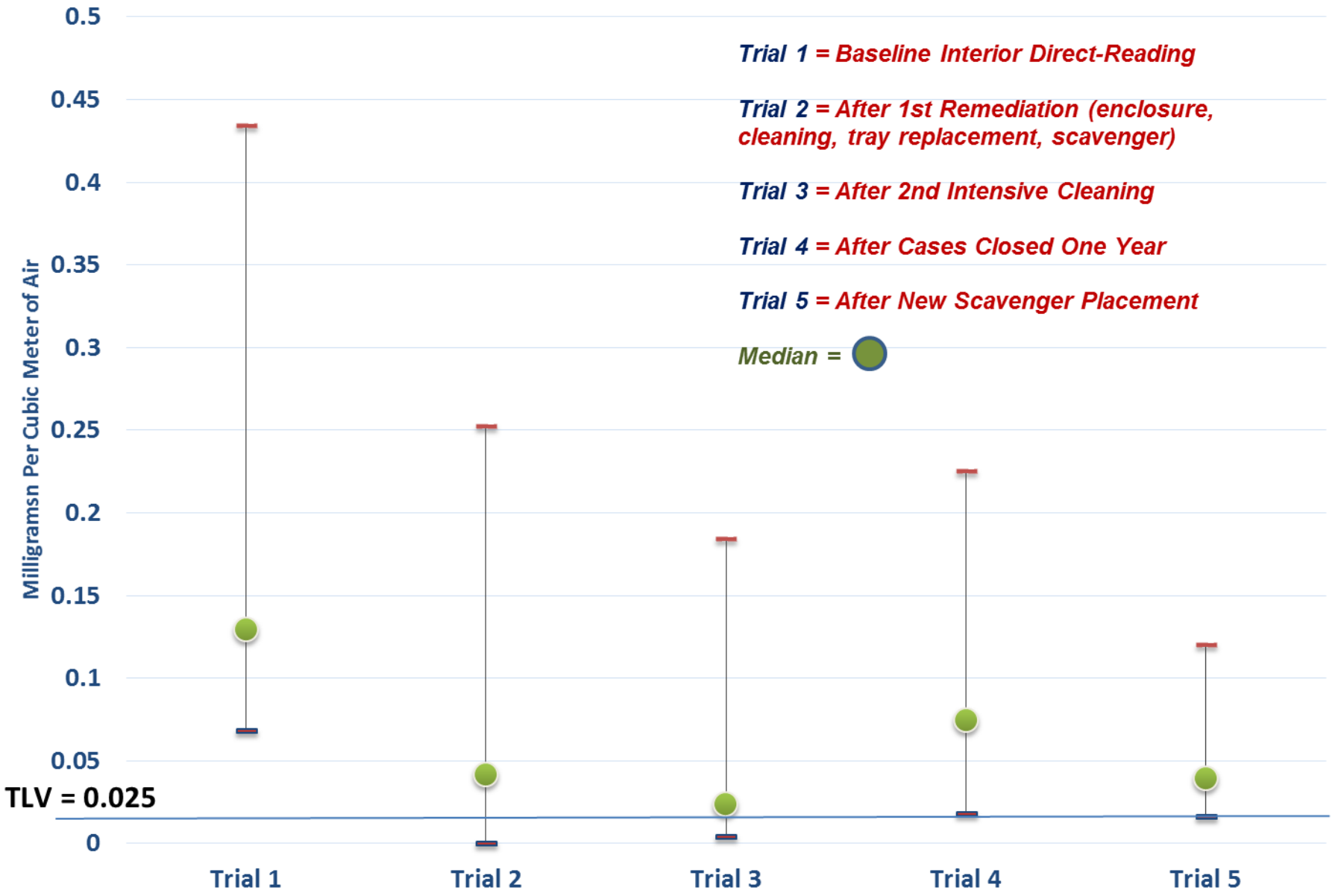
Visual Observations revealed Hg mirroring + deposition in case surfaces inaccessible for cleaning.


Inaccessible
spaces behind
drawer guides

Periodic Monitoring of Marvelsealed Specimens <0.003 mg/M3

Data suggest secure containment mitigated the specimen source.

High-Low Range Mercury Vapor Levels in Storage Cases



Mitigation Research Critical for Collections with Inherent Hg

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And for Collections with Acquired Hg Hazards

Mercuric chloride used for pest/mold control

Items from US Exploring Expedition 1838-1842

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Millions of Botanical Specimens

Treated with mercuric chloride solutions from the late 1700s to the 1980s, and still used today in some herbaria

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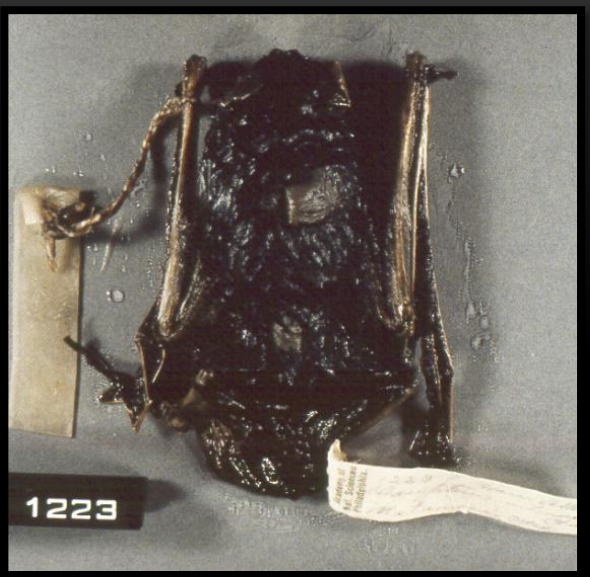

Mercuric chloride used as a tissue fixative

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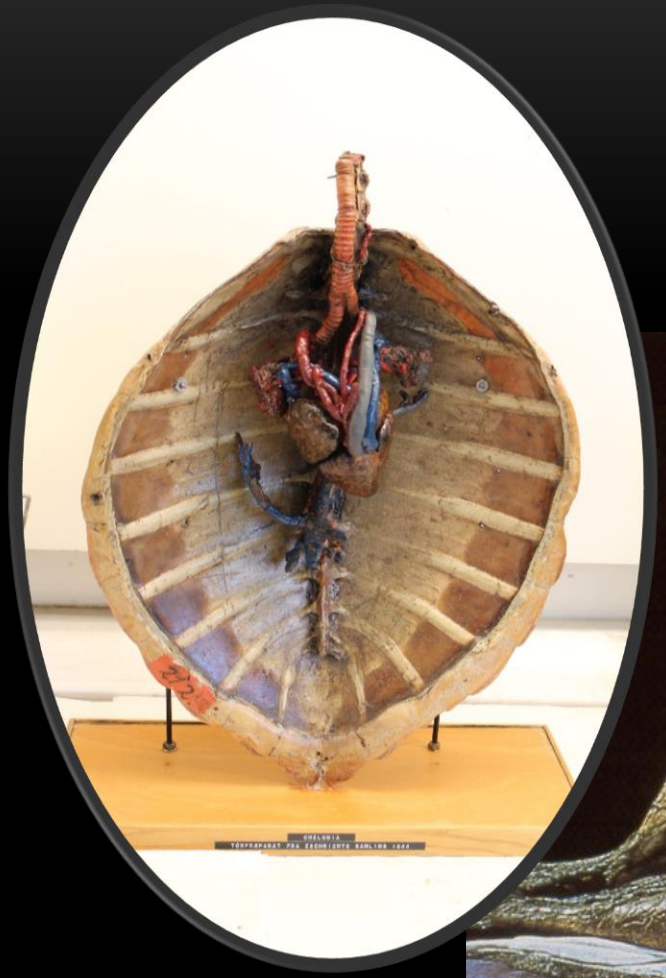
Anatomical specimens with metallic mercury perfusions



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Further Research – Suggestions Welcome!

- **Possible improvement on MicroChamber?**
- **Inclusion of End-of-Life indicator in any scavenger**

- **Technology transfer from industrial Hg remediation of amalgams/deposition on metal surfaces**
- **NASA's Molecular Adsorbent Coating (MAC)**

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