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Remediation of Mercury-Contaminated Former
Industrial Facilities in Urbanized Areas





Presentation Overview

- Mercury uses in manufacturing
- Case study
 - Manufacturing history
 - Assessment strategy
 - Remediation and facility dismantlement
 - In situ and ex situ mercury treatment strategies
 - Air monitoring



Mercury-Containing Product Examples



Ca. 1940s Ice Bucket



Mercury Vapor Lamp



Mercury Switch



Manometer (broken)



Vacuum Tube



Fire Sprinkler Head



Urban Revitalization – Bulb and Tube Factories

Former Lighting Complex (E.U.)



Proposed Reuse: Housing

Former Bulb, Tube, and Electronics Facility (South America)



Proposed Reuses: Technical School, Park, Housing

Former Mercury Vapor Lamp Facility (U.S.A.)



Initial Reuse: Residential Apartments

Former Vacuum Tube Facility (E.U.)



Proposed Reuse: Hotel



Case Study – Assessment and Remediation of Former Light and Tube Manufacturing Facility



- Three buildings: formerly part of a larger 26-building facility
- Planned redevelopment: residential apartments
- Mercury vapors detected in each building
- Project initiated in February 2016



Assessment Challenges and Strategy

Challenges

- Buildings last used for manufacturing in 1976
- Limited information on prior manufacturing activities
- No obvious (visual) mercury sources
- Concrete poured over former wooden floors



Strategy



Manufacturing History



Source: *The History of the Incandescent Lamp* (Howell 1927)

- Site was part of larger manufacturing complex
- Original factory established in 1880 for light bulb manufacturing
- Operations changed to production of vacuum tubes in 1927
- Original plant heated via central steam system



Light Bulb and Tube Manufacturing Equipment



Early Vacuum Pumps

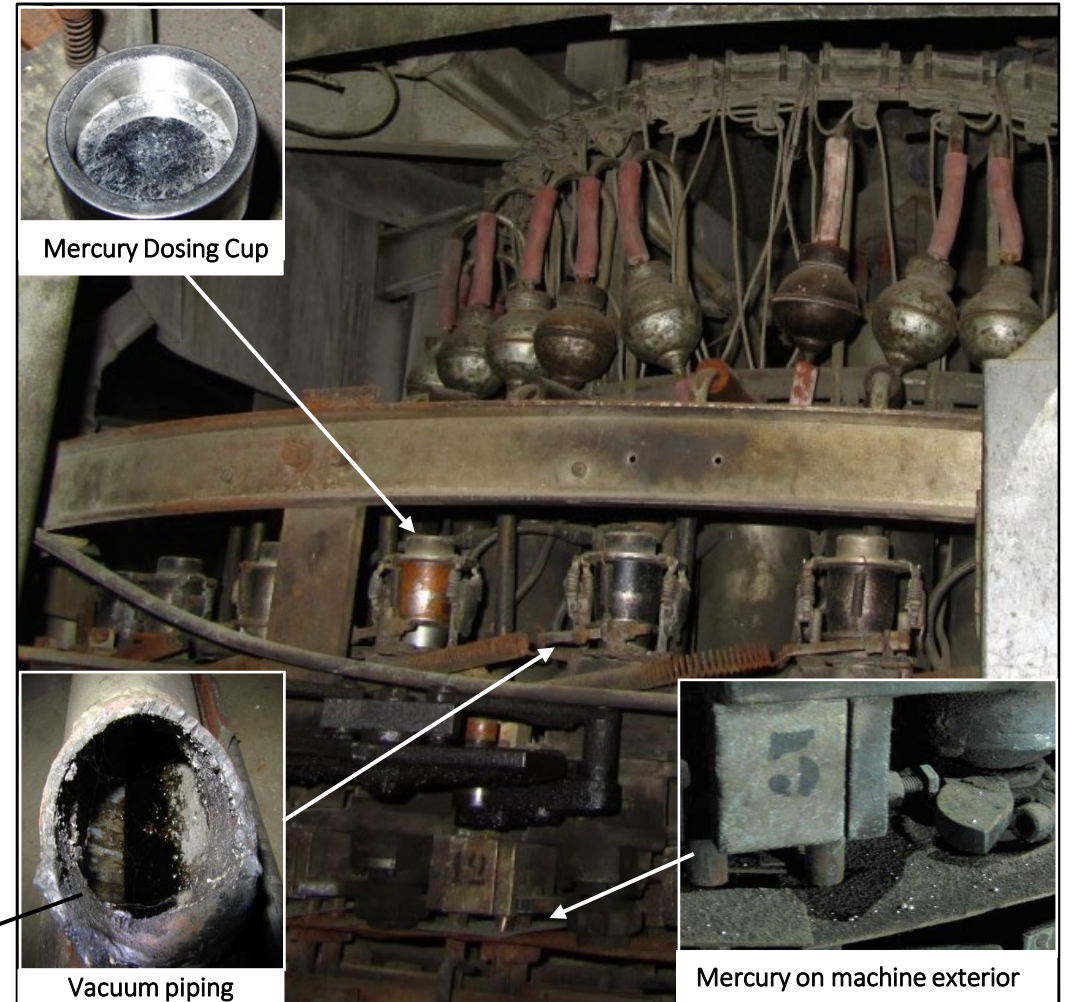
Source: *A Century of Light* (Cox 1979)



Mercury Diffusion Pumps



Mercury Dosing Cup

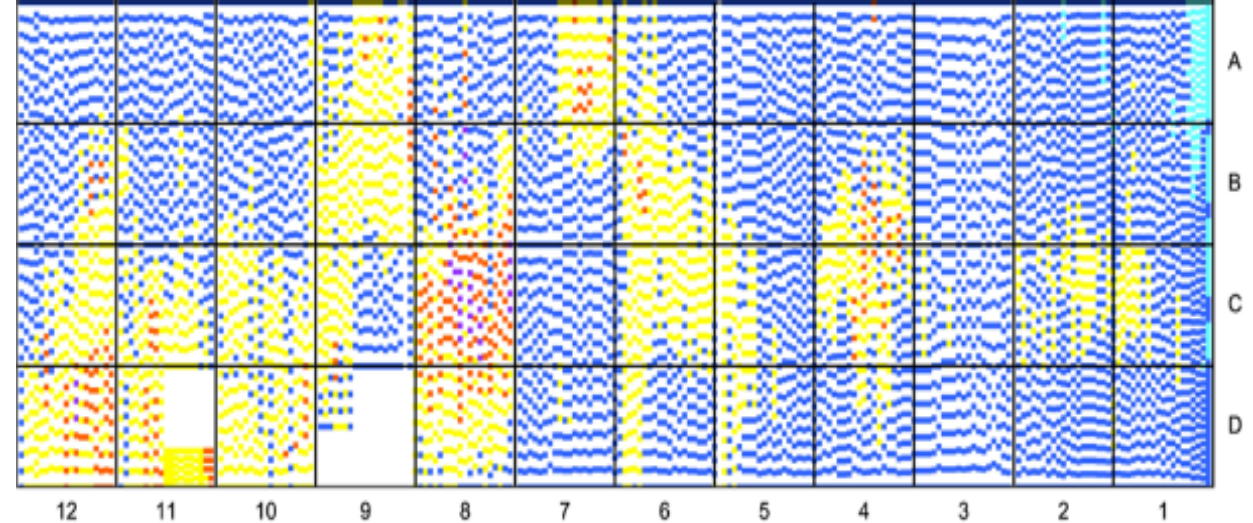


Vacuum piping

Mercury on machine exterior

Assessment Strategy – Vapor Mapping

- Screen each floor, wall, window opening using a mercury vapor analyzer
- Perform invasive sampling based on vapor “heat maps”





Assessment Strategy – Invasive Sampling

- Mercury found in between concrete and wooden floor layers
- Mercury found within “cinder” layers installed under wood floors
- Each building had visible mercury in areas predicted by vapor “heat maps” (and vice versa)





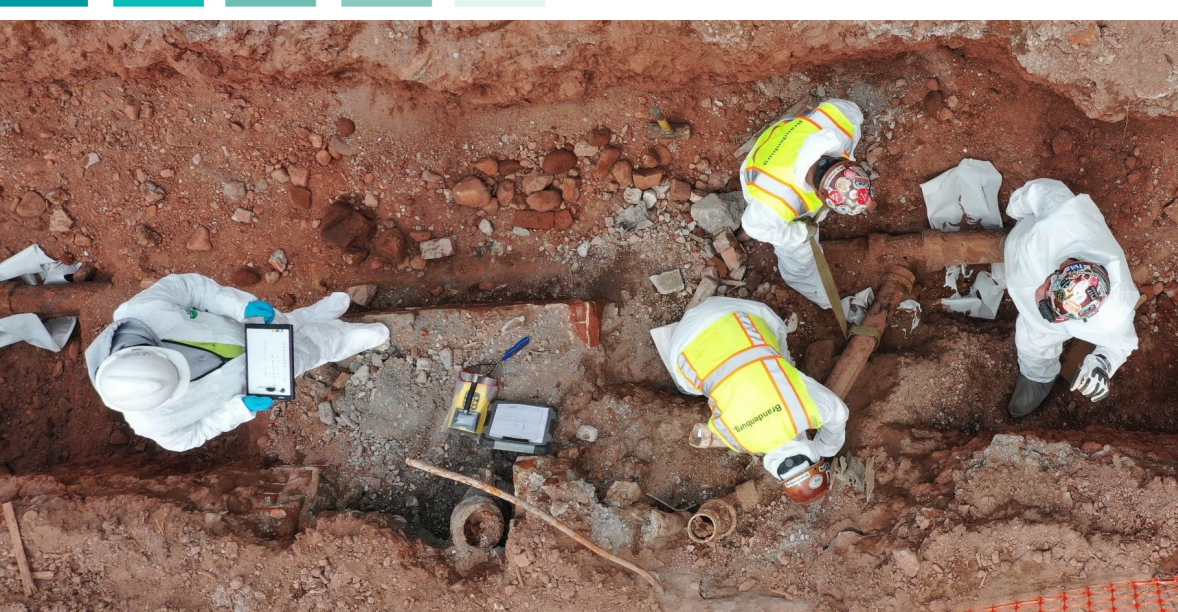
Remedial Strategy

- Objective: Building dismantlement without causing vapor release or impact to surrounding neighborhood
- Approach
 - Remove mercury contamination within buildings before dismantlement
- Challenges
 - Cinders: Cinder layers high potential for off gassing – customized solution to limit vapor generation without increasing leachability
 - Co-mingled PCB and mercury contaminated wastes – No disposal facility would accept!



Demolition



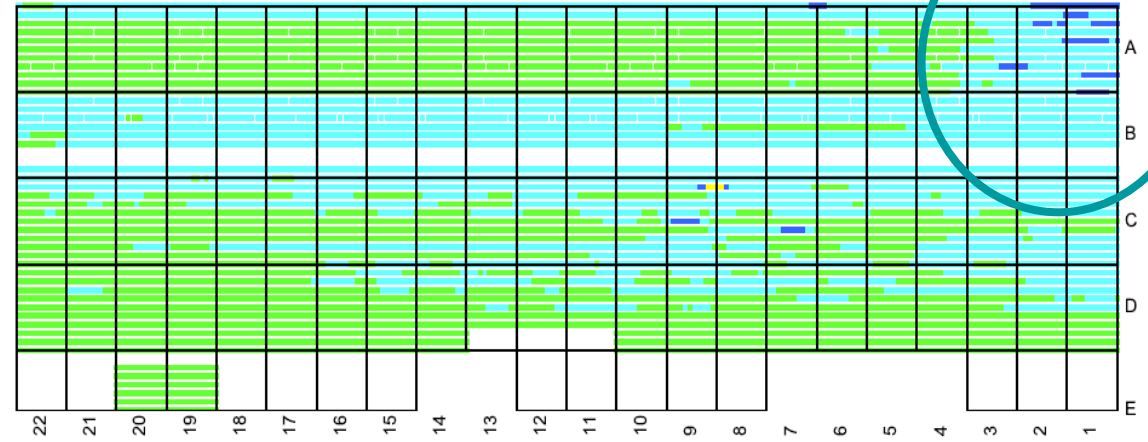


Post-Demolition Subsurface Investigation

- Subslab piping removal
 - Mercury impacts in subslab piping and soil beneath all 3 buildings
 - Mercury observed in steam distribution lines

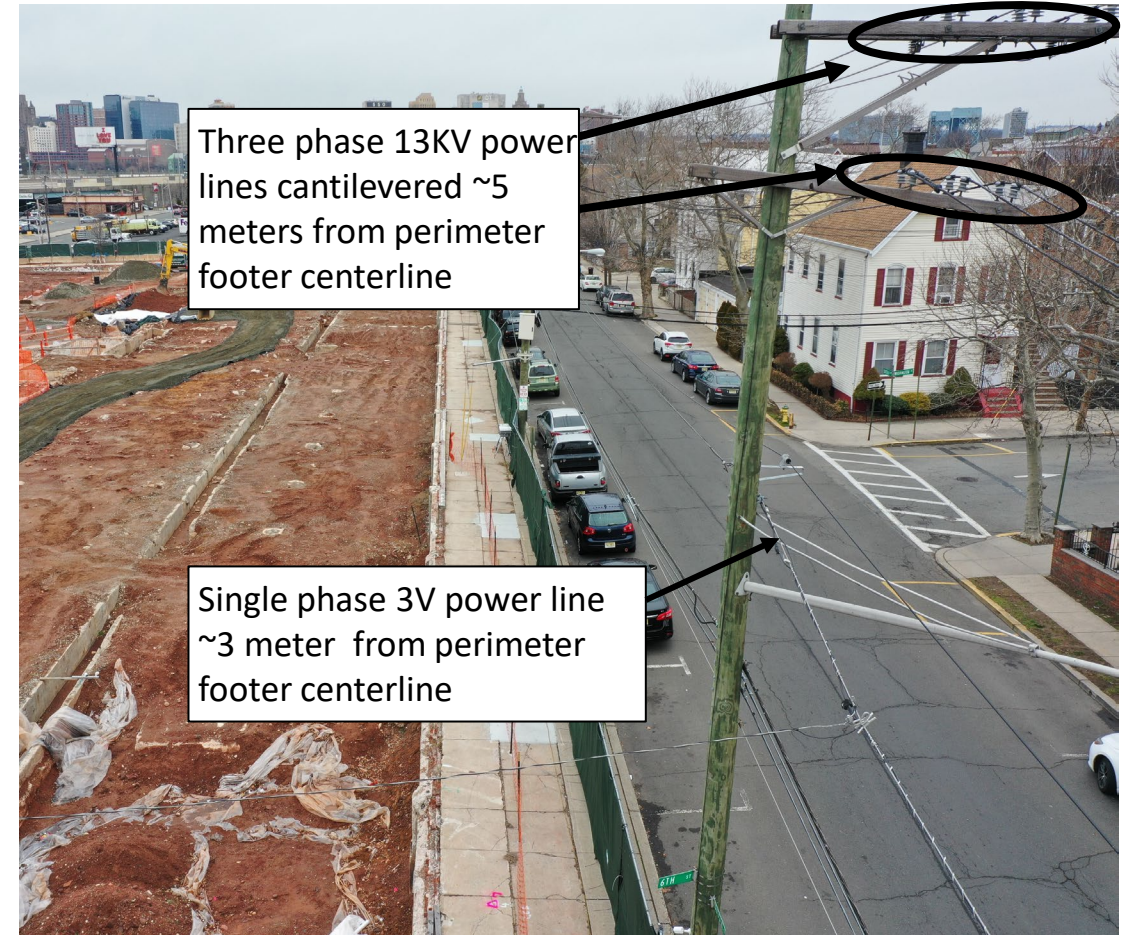


Post-Demolition Subsurface Investigation



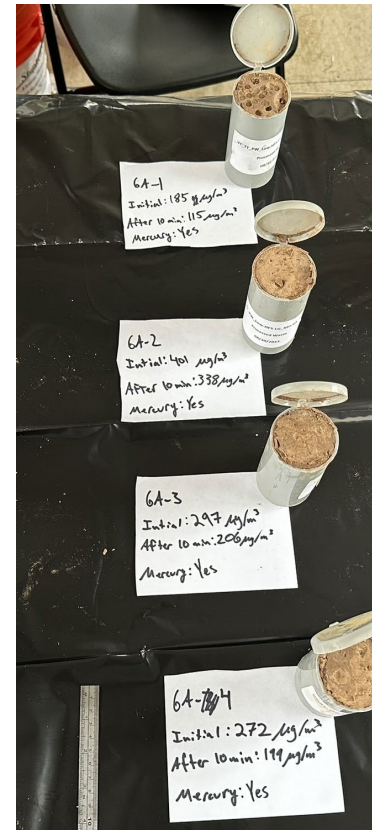
Footer Treatment

- Each column footer investigated via drilling and or vapor screening
- Footers with mercury impacts removed except along roadway
- Removal not possible due to proximity to power lines and subsurface sewer connections
- We proposed to stabilize the mercury contamination using in-situ methods

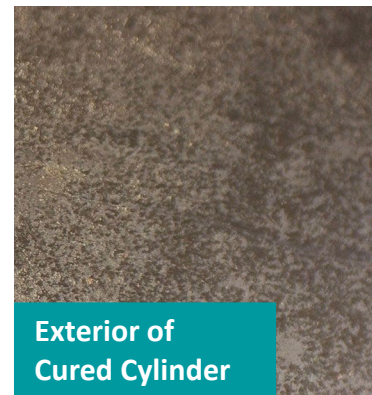


Footer Treatment

- Pilot tested mix design for in situ treatment of contaminated footers
- Successfully demonstrated a grout treatment mixture of MercLok, portland cement, and sulfur-bentonite
- Treatment to be applied via jet grouting starting in August



Interior of Cured Cylinder



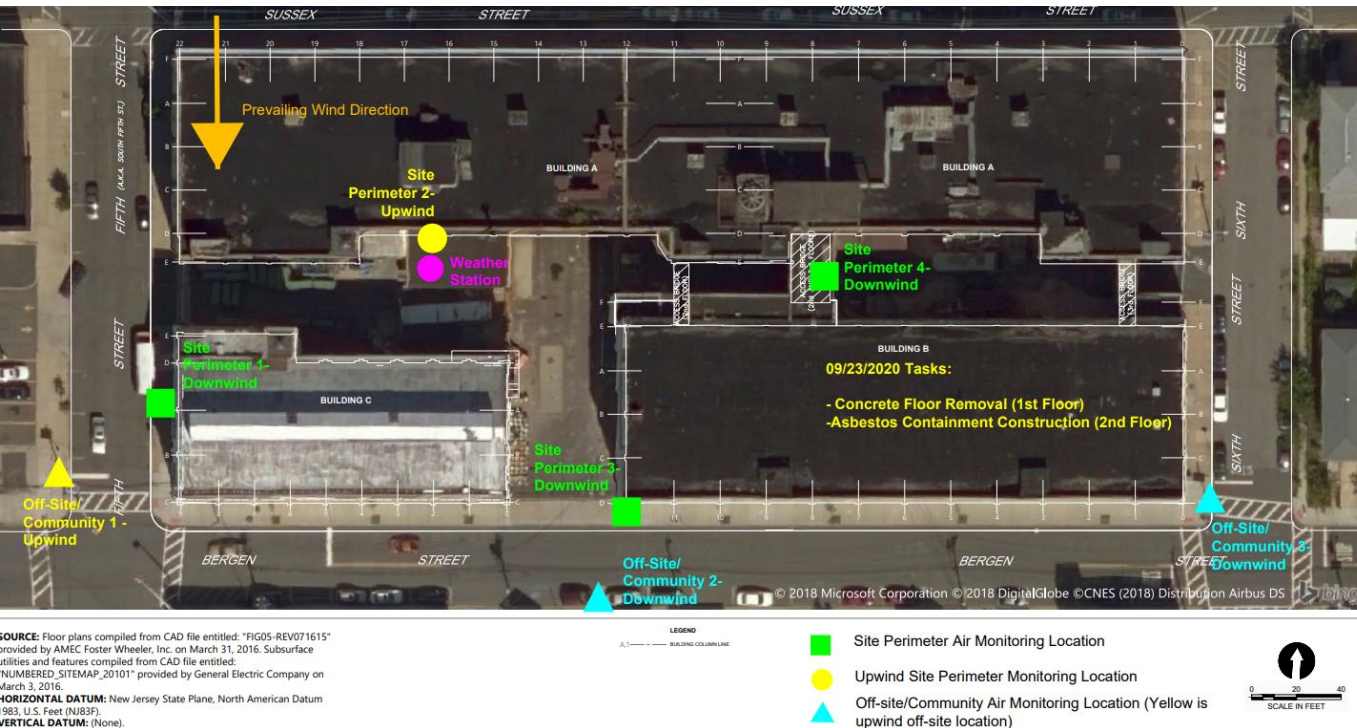
Exterior of Cured Cylinder





Air Monitoring

- Three-tier community air monitoring program for particulates and mercury vapor
 - Work area
 - Site perimeter and fenceline
 - Off site (community)
- Real-time and 8-hour samples collected
- System designed to provide notifications and warnings before reaching action levels
- Weekly reports provided for distribution to stakeholders

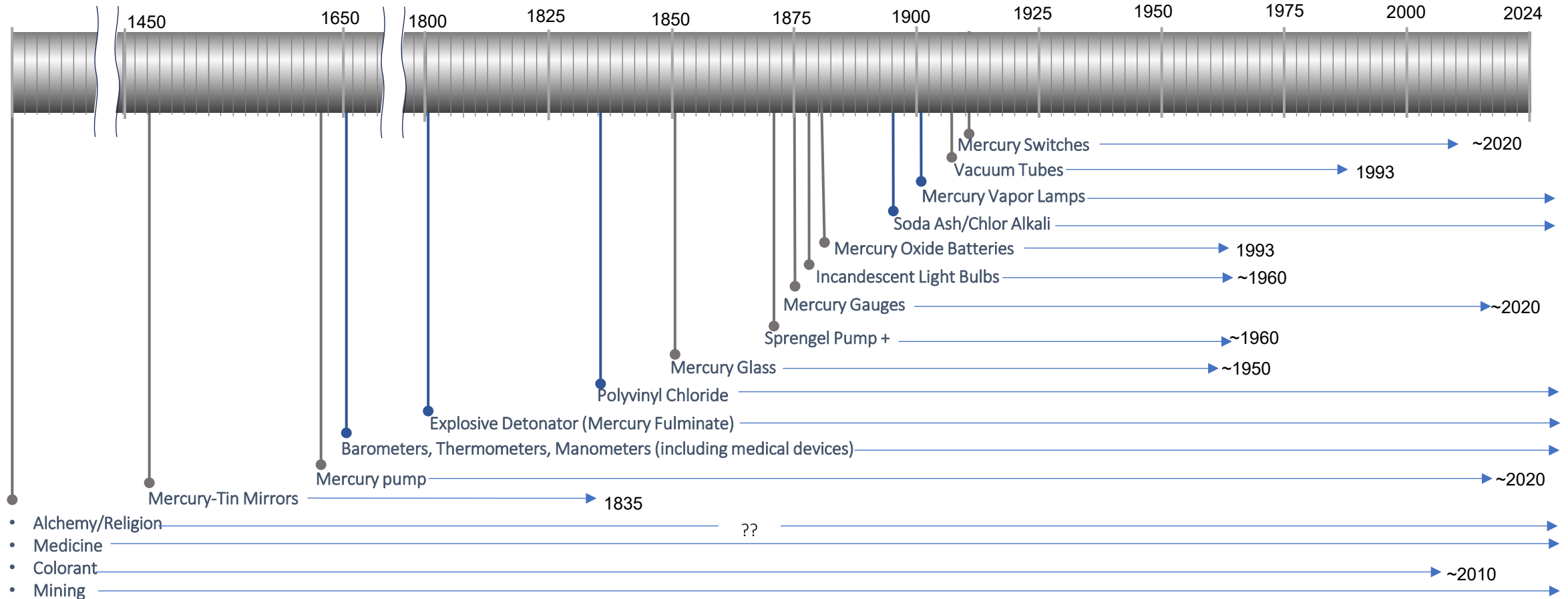


Questions?



Historical Uses of Mercury

4th Century BC



Note: This is a partial list, many more applications

