

18 maart 2015



HAVE YOU BEEN WATCHING JURASSIC PARC?







... these animals all enter finally a Biodiversity Center!

18 maart 2015



NATURAL HISTORY COLLECTIONS / BIODIVERSITY CENTERS

- Aim
- to share knowledge of the natural world
- to enjoy the wonders of the natural world today
- to service scientists
- to gain knowledge
- to care about nature!







HOWEVER

> Behind the scene

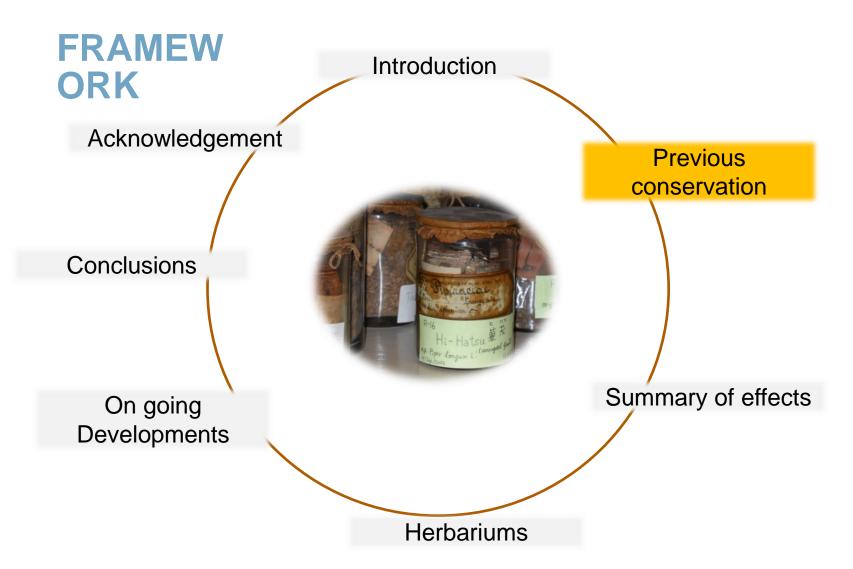














PREVIOUS CONSERVATION TREATMENTS

Conservation treatment needed to be sure, that the animals and plants were not eaten.



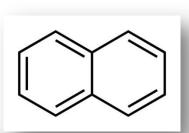
Photo: Preservation treatment of herbarium collections

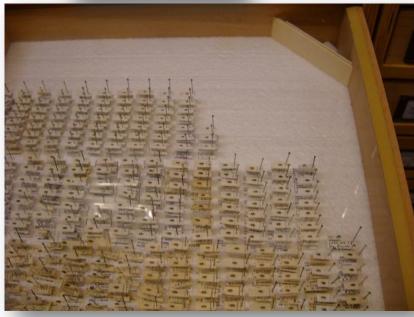


ENTOMOLOGY COLLECTIONS

Frequently used

- Naphthalene
 - Polycyclic aromatic carbon
 - Odour nose: 0.08 ppm
 - Sublimates at room temperature
- EU carcinogenic classification:
 now 3, will be 2 (dangerous)
- For NL: $TLV = 50 \text{ mg/m}^3$





Other known compounds: formaldehyde and Cyfluthrin



MAMMAL COLLECTIONS

- 1,4-dichloro benzene
- TLV (NL): 150 mg/m³







- Arsenic as:
- As_2O_3
- Pb₅OH(AsO₄)₃ alkaline lead arsenate
- Pb₅HAsO₄ acidic lead arsenate
- used up to the 20th century
- Soaps containing alum, arsenic, lime, camphor

Within EU: arsenic compounds as preservation are prohibited



ALCOHOL COLLECTIONS

- Previously used: formaldehyde
- Now: ethanol (technical, 96%)
- Periodically added to the collection jars
- \rightarrow NL: TLV = 260 mg/m³



Yes: animals, plants stored under ethanol



NOT this type of collection



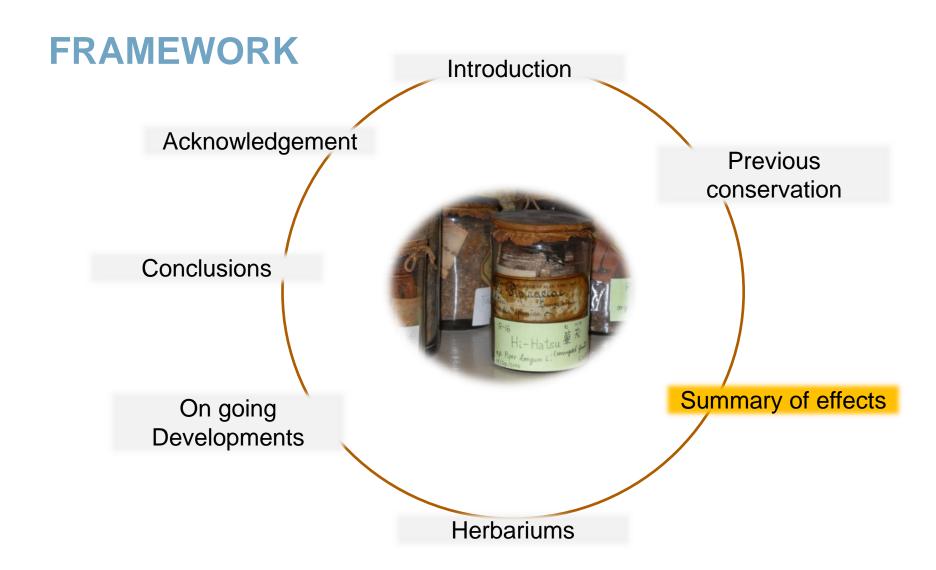


HERBARIUM COLLECTIONS

- Up to 1984... HgCl₂ was applied
- sublimate process
- brushing, soaking
- > TLV(NL): 20 μg/m³
- Max recommended WHO: 0.05 μg/m³
- Many recipes available e.g.,
- > 1940: HgCl₂ / Phenol / methylated spirits
- > Also added e.g.,
- Phosphine (PH₃), Methyl Bromide (Ch₃Br)









MAMMAL COLLECTIONS

-) In air
- Dichlorobenzene (max) 3.900 μg/m³
- Naphthalene (max) 760 μg/m³
- Arsenic < 0.02 μg/m³
- On the animal
- Arsenic found (using XRF, cal. Soil)
- · And Pb, Hg
- We suggest that lead arsenate and mercuric chloride were used
- Max concentration as found
 - 9.500 ppb





ALCOHOL COLLECTIONS

- Gas collection bags, DNPH, Tenax^(GR)
- $ightharpoonup C_2H_5OH (max): 47 mg/m^3$
- Everywhere present:
- Formaldehyde (39 μg/m³)
- Acetaldehyde (37 μg/m³)
- Acetic acid (11 μg/m³)
- Note
 - Alcohol forms acetic acid which deteriorates the Pb-kit used previously to seal the jars.







ENTOMOLOGY COLLECTIONS

Note: this storage/working room does not exist any more





ENTOMOLOGY COLLECTIONS

Note: the old storage/working room does not exist any

more

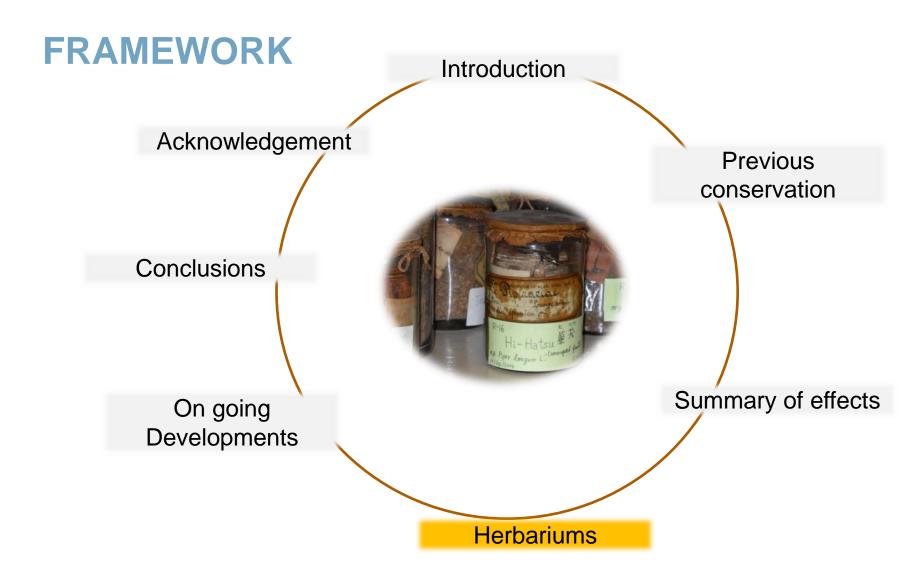
Old storage / working room		
Formaldehyde	169 μg/m ³	
Naphthalene	17.000 μg/m ³	
Dichlorobenzene	32 μg/m ³	

New storage / working room		
Formaldehyde	190 μg/m ³	
Naphthalene	7.300 µg/m ³	
Dichlorobenzene	n.a.	











HERBARIUM COLLECTIONS

- Special interest since MIP-Rome (2003)
- Some references found on Hg emission
- Priggs et all.; Felowes et al., Purewal et al., Kataeva et al., Oyarzun et al. Webber et al.
- Latest work by V. Purewal (PHD thesis, Lincoln U. 2012)
- They all concluded that Hg is present in indoor air



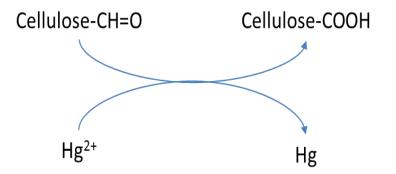


SOME MECHANISMS

- Two complexes suggested
- (V. Purewal)
- Hg²⁺-cellulose complex
- Hg+-cellulose complex
- **Thus**
- $Hg^{2+} + e^{-} \rightarrow Hg^{+}$
- Hg⁺ + e⁻ → Hg⁻
- $Hg^{2+} + 2e^{-} \rightarrow Hg^{-}$

Moist and reactive aldehyde groups (e.g. in cellulose, hemi-celllulose) (J. Havermans)

$$H_2O + R-C=O \rightarrow R-COO + 2H^+ + 2e^-$$

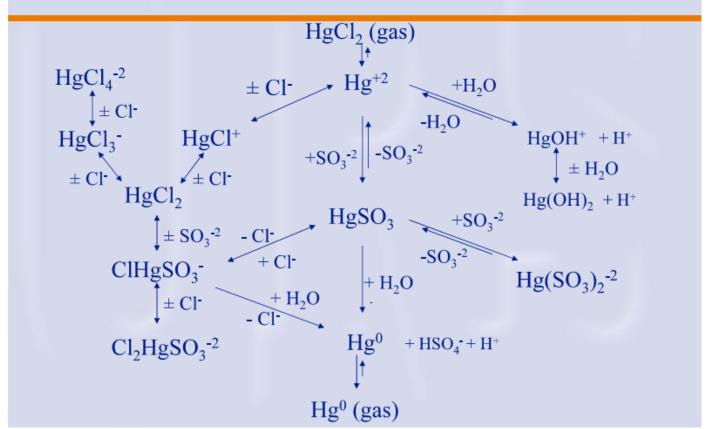




MORE REACTION PATHWAYS

G. Blythe et al. – Bench scale kinetics study of mercury reactions in FGD liquors

Diagram of Main Reaction Pathways in Kinetics Model









MERCURY IN AIR

- Using mercury detector
- Random walk

location	μg/m³
Cupboard	8
Office room	8.5
Corridor	11.2
Working place (repository)	13
Repository	10
TLV	20





MERCURY IN COLLECTION BOX

Using mercury detector

location	μg/m³
Repository A	7.8 ^(min)
	29 (max)
Repository B	13 ^(min)
	55 (max)
Repository C	12 ^(min)
	32 (max)
TLV	20



$$\frac{1}{C} = \frac{1}{C_e} + \left(\frac{1}{kxC_e}\right)x\left(\frac{n}{L}\right)$$



APPLICATION OF HOETJERS THEORIES ON EMISSION

$$\frac{1}{C} = \frac{1}{C_e} + \left(\frac{1}{k \times C_e}\right) \times \left(\frac{n}{L}\right)$$

C = steady state concentration [µg m⁻³]

Ce = concentration at no ventilation, $0 [h^{-1}]$

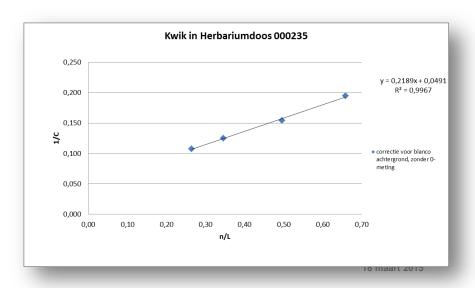
k = mass transfer constant

n = ventilation rate [h-1]

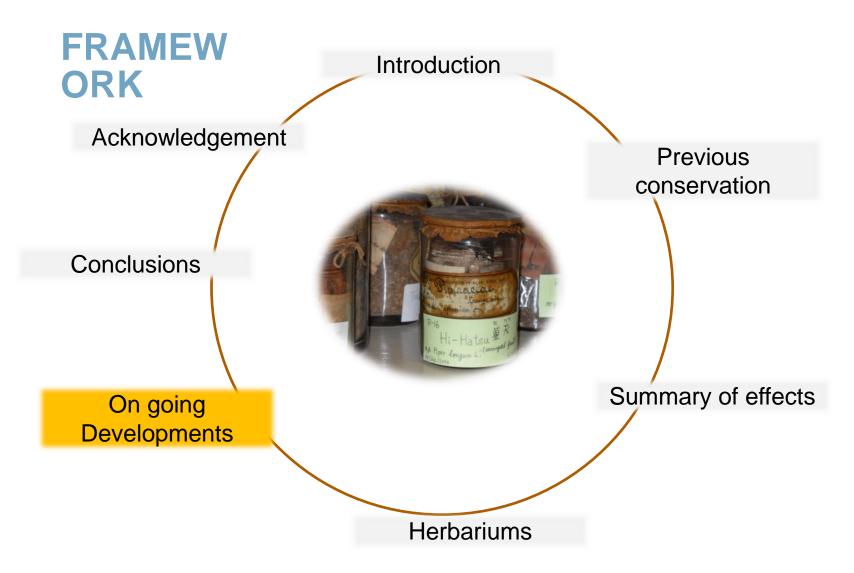
 $L = loading [m^2.m^{-3}]$













WHICH ACTIONS TO BE UNDERTAKEN

- Increase ventilation (use fresh air)
 - Outgoing air is chemically polluted!
 - Needs for air purification/temperature control
 - Large work on digitization
 - > (15.000 sheets/day)
- Use collections boxes in fume cupboards only
- Wear gloves
 - Workers do not like this



- Close the collection
- 26 > Owner does not like this



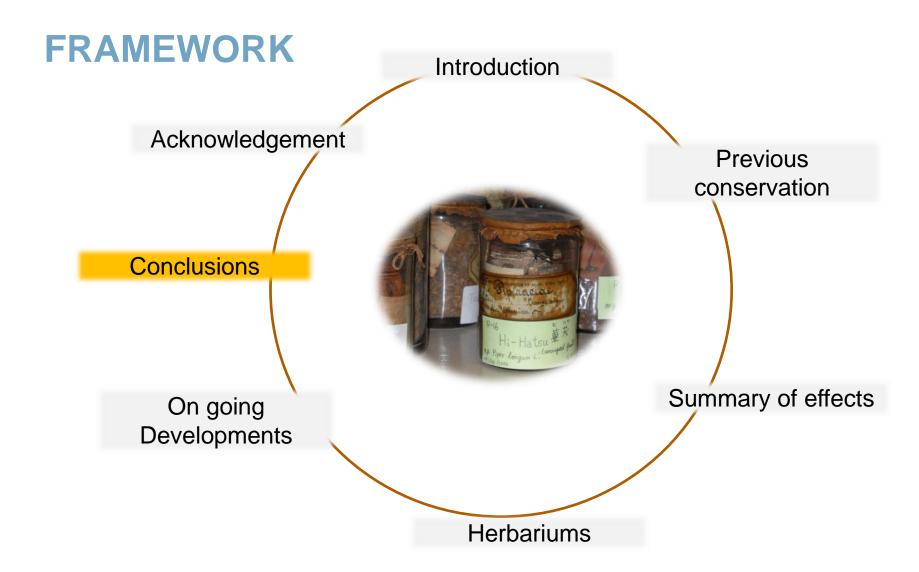
MORE ACTIONS POSSIBLE

> As done in Wales?

- Remove all paper and put the collection on new sheets. Often a lot of work and does not remove Hg from species
- Novel solutions are needed and being developed
- On going research
 - TNO with
 - Papermill Coldenhove (specialties)
 - Ron Sportel
 - We develop a price affordable and simple solution









CONCLUSIONS

- Jurassic Parc is fantasy
- Danger in historical
- collections exist



Interpretation

- > EN 689 is an important tool do carry out an interpretation on IAQ
- Use 10% TLV when a momentaneous measurement is done
- Redo the measurement over a longer period of time
 - New interpretation using 25% TLV
- Undertake the needed actions / precautions for safeguarding the occupational health



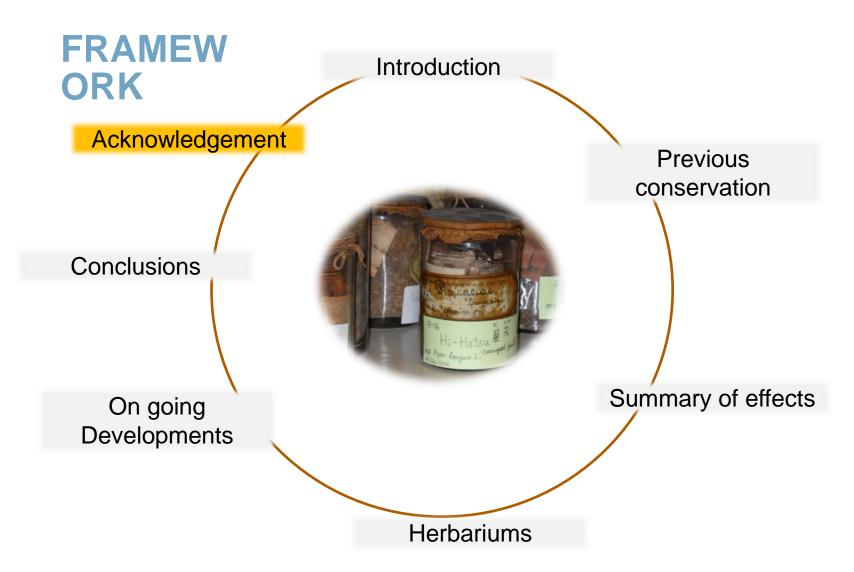
CONCLUSIONS

On collection level



- Mammal/bird collection: heavily polluted. Emission to air is low.
 - Contains As, Pb and Hg compounds and paradichlorobenzene!
- **Alcohol collection**: pollutes the air moderate. Reactions with the sealing of the jars are considered as realistic.
- Entomological collections pollute the air severe.
 - Naphthalene and formaldehyde at high levels observed. Risk for the occupational health.
- Herbarium collections pollute the air moderate to severe.
 - Mercury in air present and a risk for the occupational health.







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