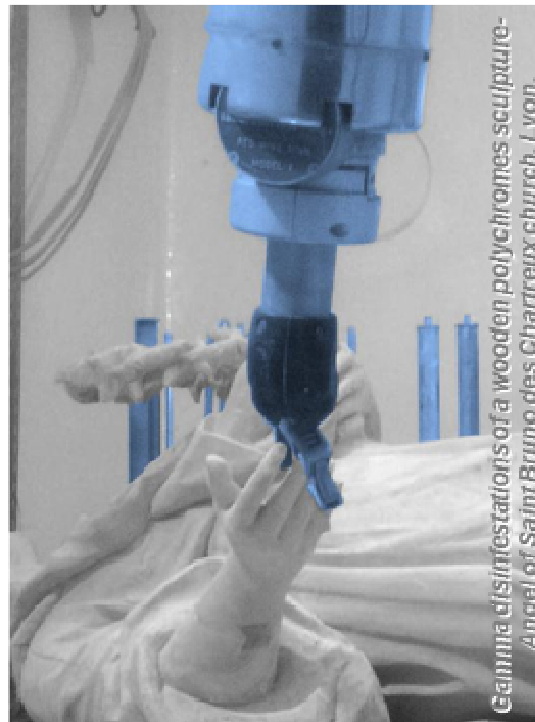
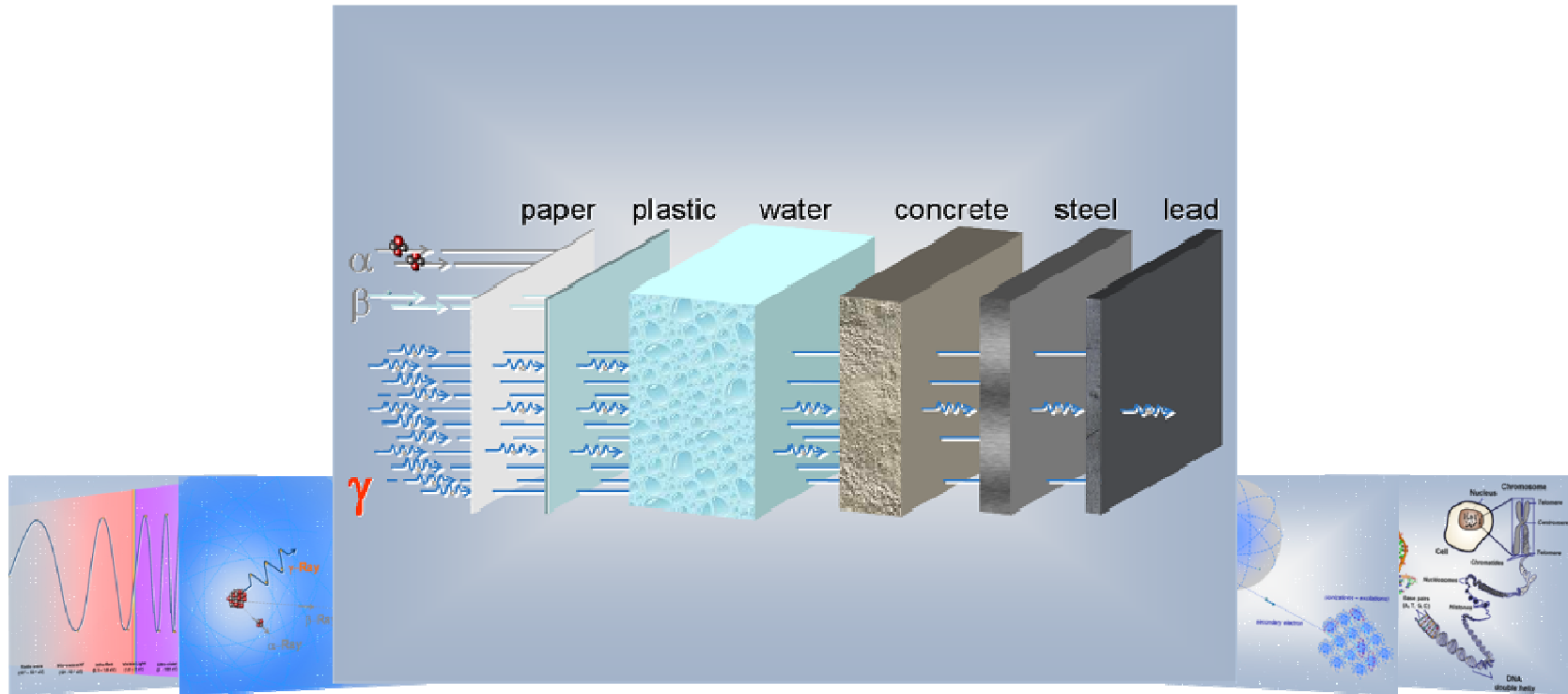


40 years of radiation chemistry and radiobiology as a tool for cultural heritage conservation

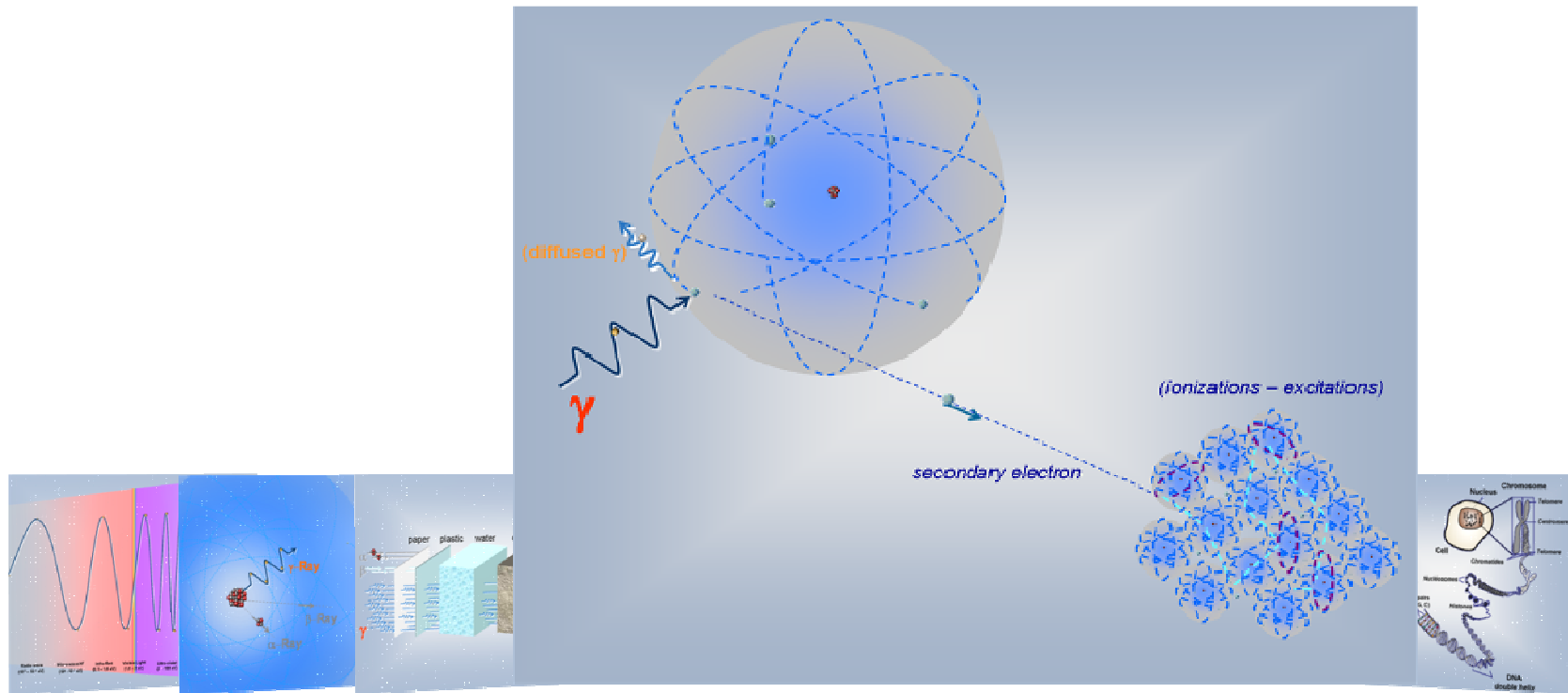


***Colloque Chimie sous Rayonnement
Paris, 15 et 16 novembre 2011***

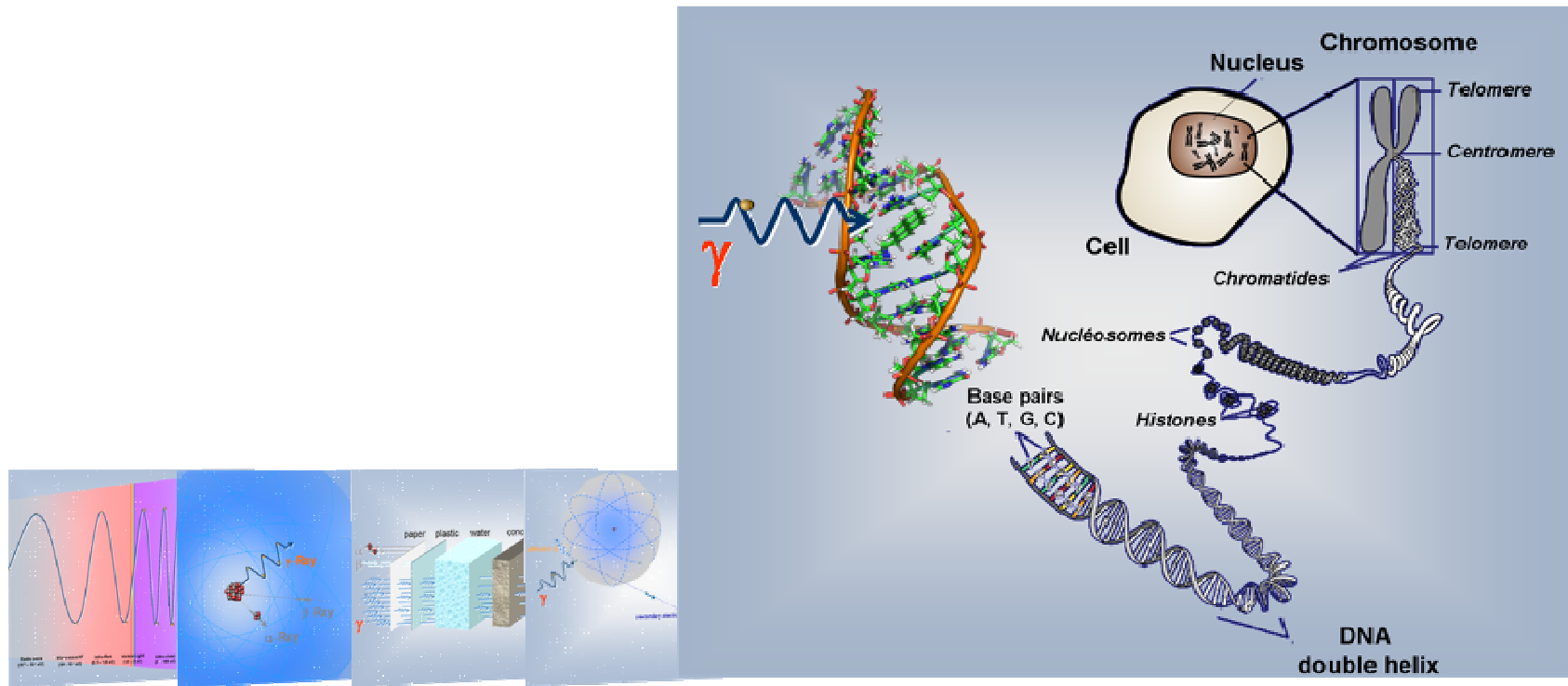
A photonic/electromagnetic, nuclear, *deeply penetrating*, ionizing and biologically active radiation



A photonic/electromagnetic, nuclear,
deeply penetrating, *ionizing*
and biologically active radiation



A photonic/electromagnetic, nuclear,
deeply penetrating, ionizing
and *biologically active* radiation



Ionization have direct and indirect effects on DNA

- ☼ may lead, according to their number, the non-renewal of cells, which itself can lead to the death of the living organism.
- ☼ a biocide effect studied a lot ... and rather well known.

Joint FAO/IAEA Programme
IAEA

International Database on Insect Disinfestation and Sterilization or IDIDAS

Search

Browse through the Taxonomic Tree | Advanced Search

Full Record

Stegobium paniceum

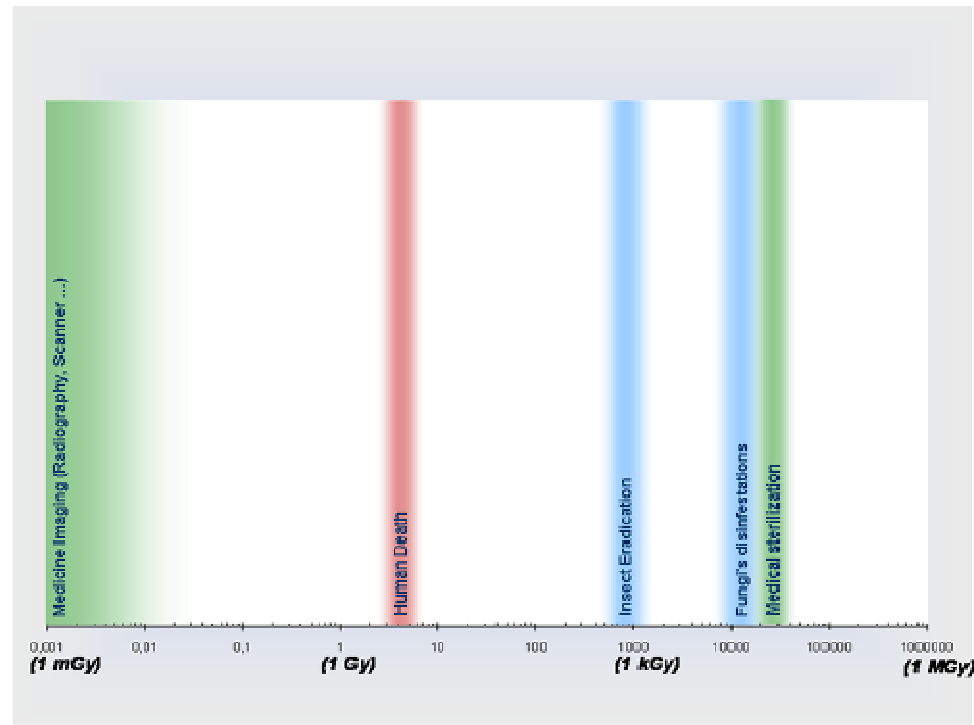
ID: 2132
 Class: Insecta
 Order: Coleoptera
 Family: Anobiidae
 Genus: Stegobium
 Species: paniceum
 Synonyms:
 Common names: drugstore beetle

Life stage	Disinfestation			Sterilization		
	Treatment dose (Gy)	Efficacy	REF	Dose	Induced sterility	REF
Egg	90 no progeny		5034	25 Gy	prevent development	837
Larva	120 no progeny		5034			
Pupa/Phanox	120 no progeny		5034			
Adult	210 sterility		5034	30 Gy	sterility	837 838
Unspecified						

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 Telephone: (+43) (0) 1 26000-6 Fax: (+43) (0) 1 26000-7 E-mail: iaea@iaea.org

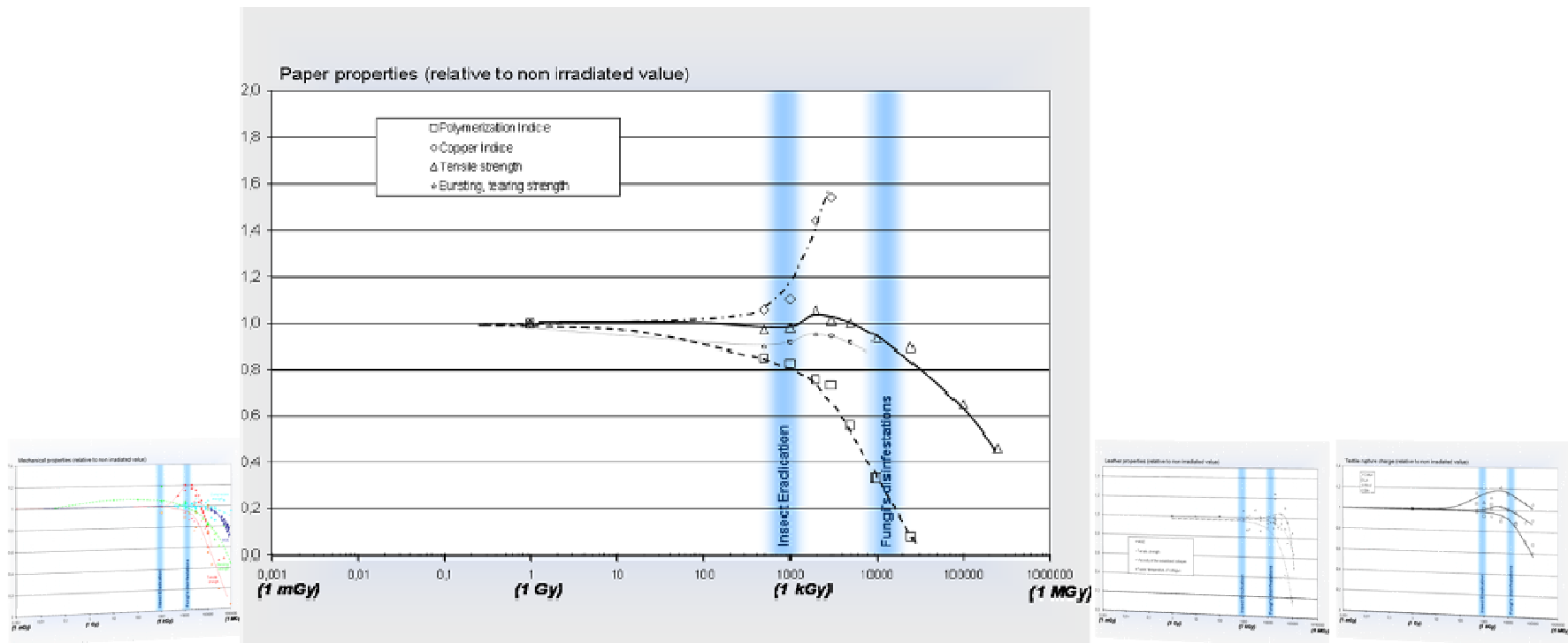
A matter of dosage

- ⊗ by simple exposure to gamma radiation emitted by radioactive sources



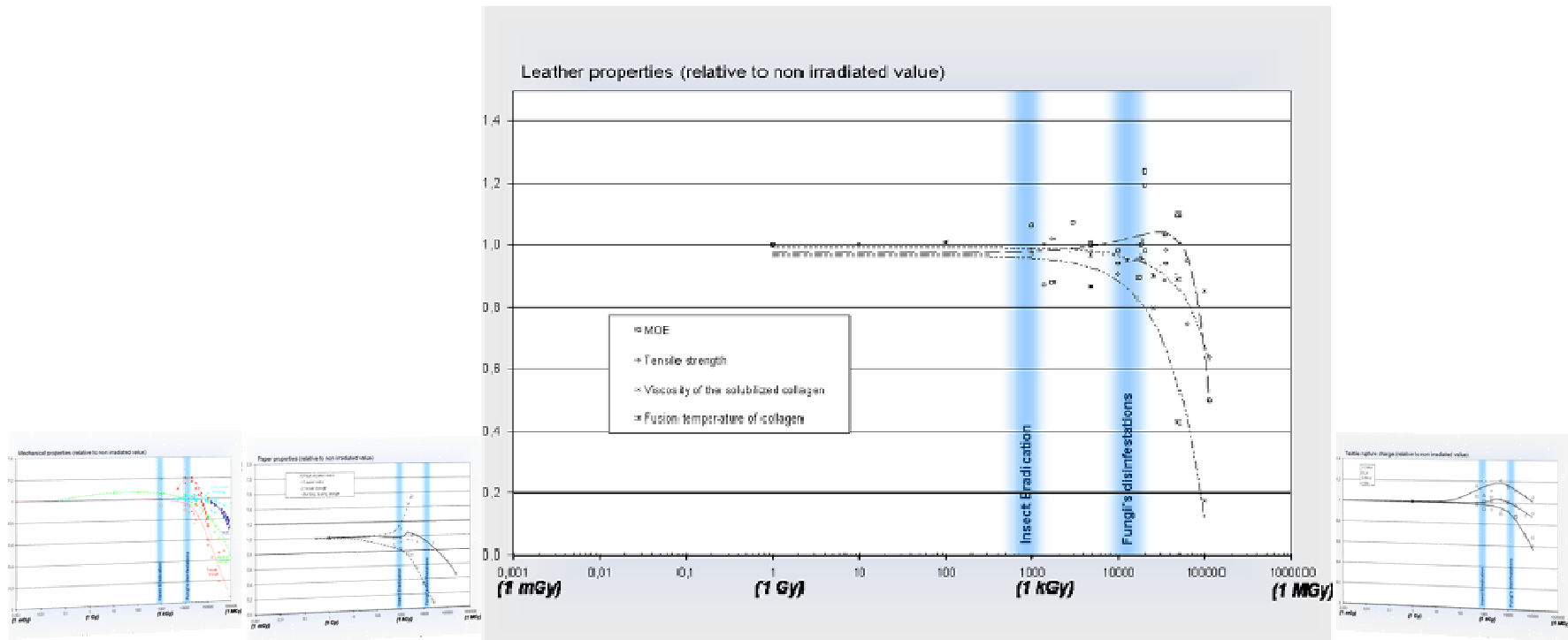
A matter of dosage

⚙ effects on the integrity



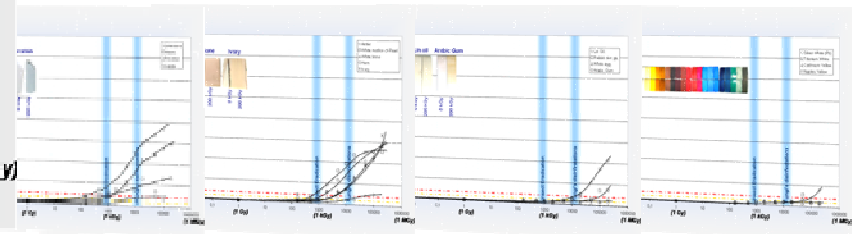
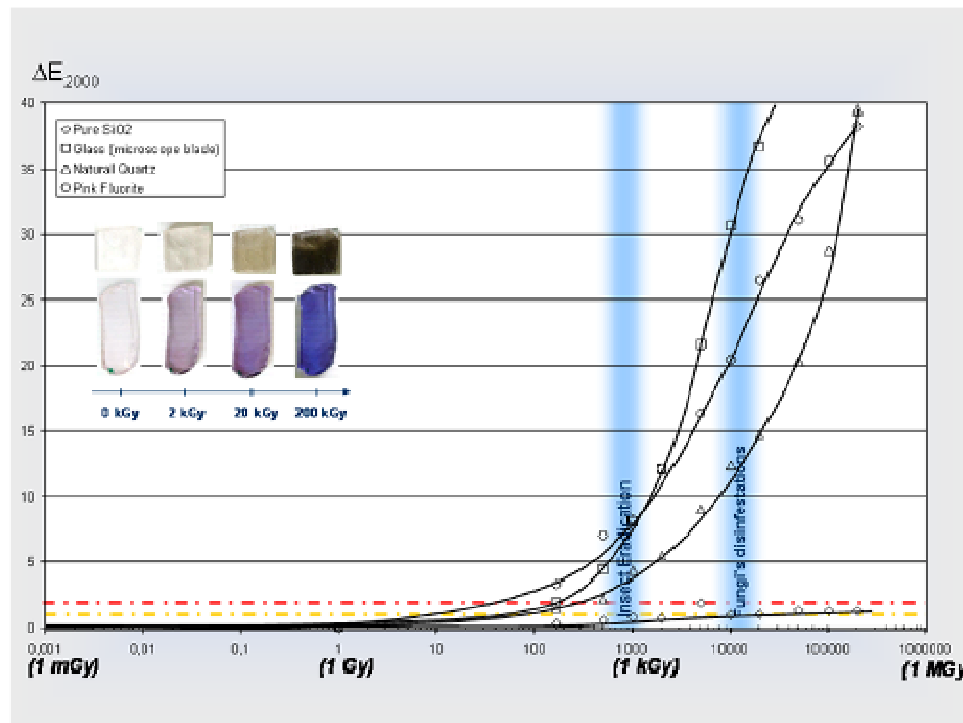
A matter of dosage

⚙ effects on the integrity



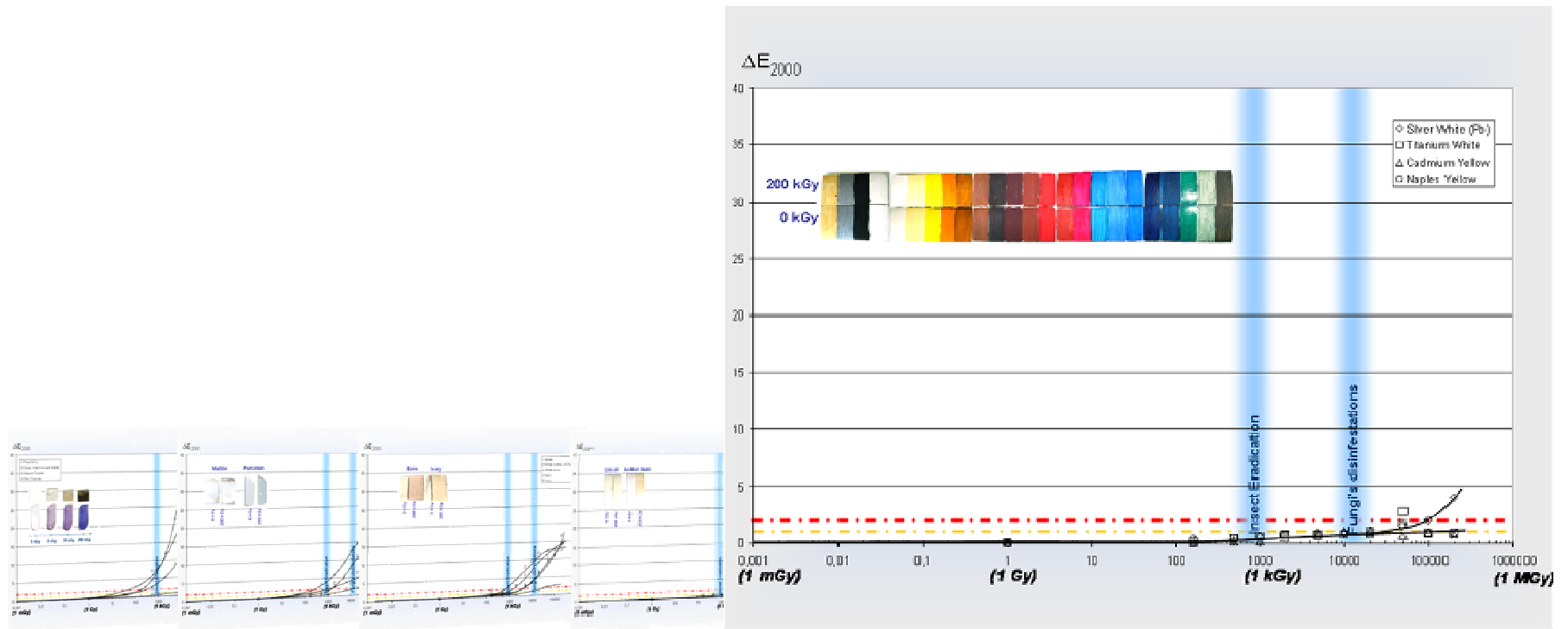
A matter of dosage

☼ effects on the appearance



A matter of dosage

☼ effects on the appearance



The most popular application of gamma rays

Many thousands of cubic meter of wooden objects desinsectized since the 70's in ARC-Nucléart workshop

(about 100 to 200 m³ a years):

- ⚙ Furniture
- ⚙ Statues
- ⚙ Ethnologic objects
- ⚙ Music instruments
- ⚙ ...



Drying is the first method to control fungi growth

Irradiation must be done when drying can not be undertaken ... or is not sufficient. Examples are few but sometime very relevant.

In such a case, it is sometimes a very appropriate method:

- ⚙ very efficient
 - ⚙ the only competitive method as efficient
- chemical treatments tends to be prohibited in Europe.



Virgin and the Son, XVIIIth century, Digne (France) stolen and abandoned in a canal for several months.

Ramses II and Khroma, two “exotic” cases



Ramses II and Khroma, two “exotic” cases



Benefits and drawbacks

A practice limited:

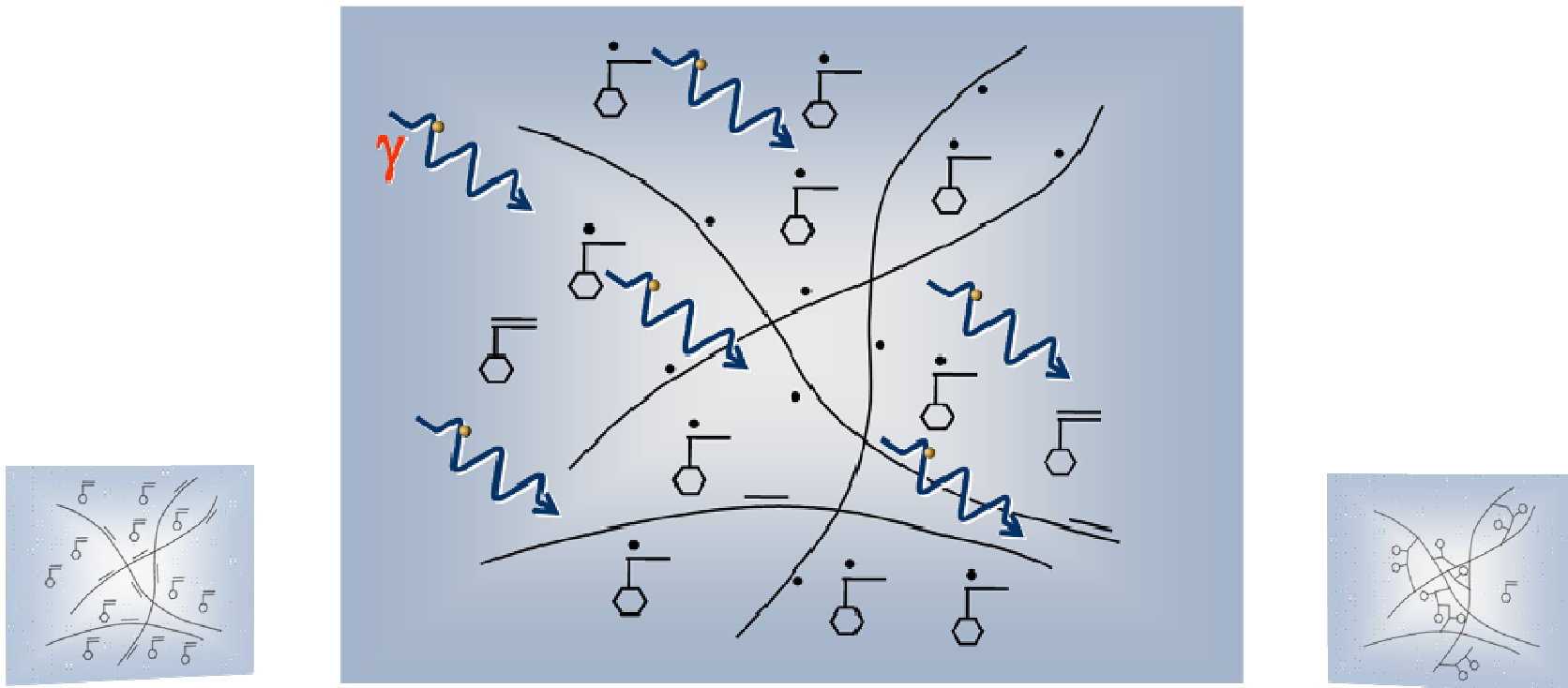
- ⊗ because some material cannot be (or better be avoid) irradiated, as, according the dose, they could change color, be oxidized or partially depolymerized...
- ⊗ because it is not always well accepted (as a “nuclear” technique)

A solution very suitable for volume processing:

- ⊗ the penetrating power of gamma radiation gives a excellent efficiency and a excellent reliability, even processing on large volumes or on in packaged artifacts,
- ⊗ a very good level of harmlessness on a large range of material,
- ⊗ no danger at all after treatment.

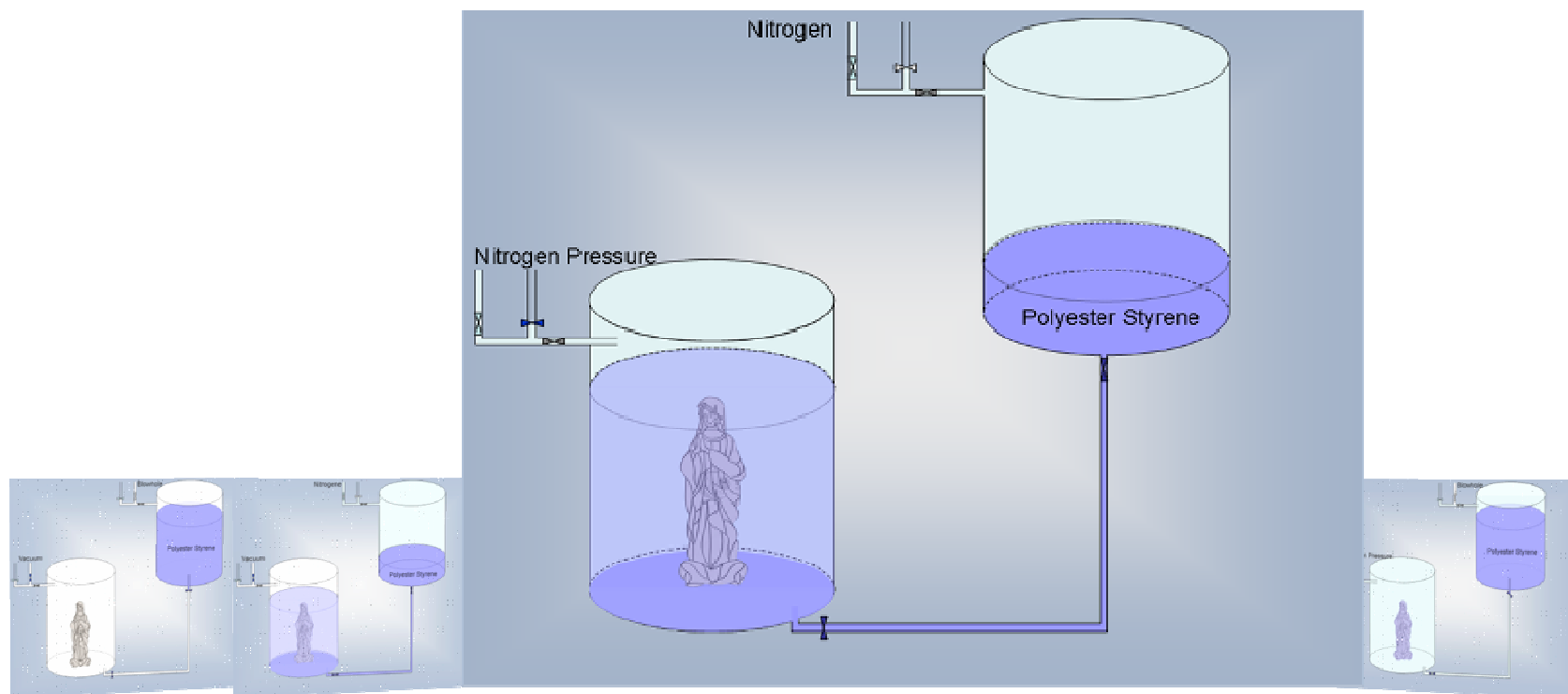
From liquid to solid

Ionisation by gamma irradiation

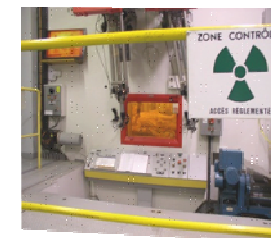
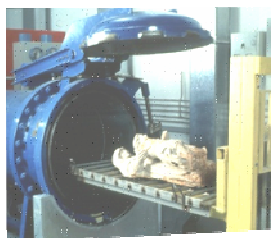


- ⊗ Crosslinking velocity controlled by the dose rate (from 0.5 to 1.0 kGy/h), and temperature

The impregnation in 4 steps



Impregnation – Cleaning – Irradiation



Dry porous “Nucléart” consolidation

- ⚙ Historically, the first application for cultural heritage at Grenoble
- ⚙ A very efficient but irreversible method

Must be justified:

- ⚙ The last chance for very degraded artifacts (polychromed sculpture)
- ⚙ When the function of the artifact have to be preserved.

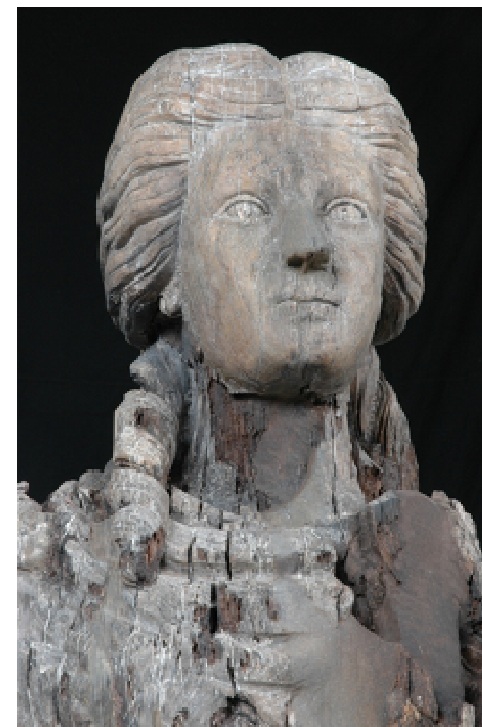
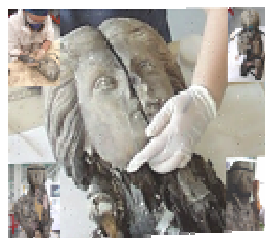


A figurehead of a schooner of the end of the 19th century.



⚙️ Dismantling and preparation, impregnation, irradiation, restauration...

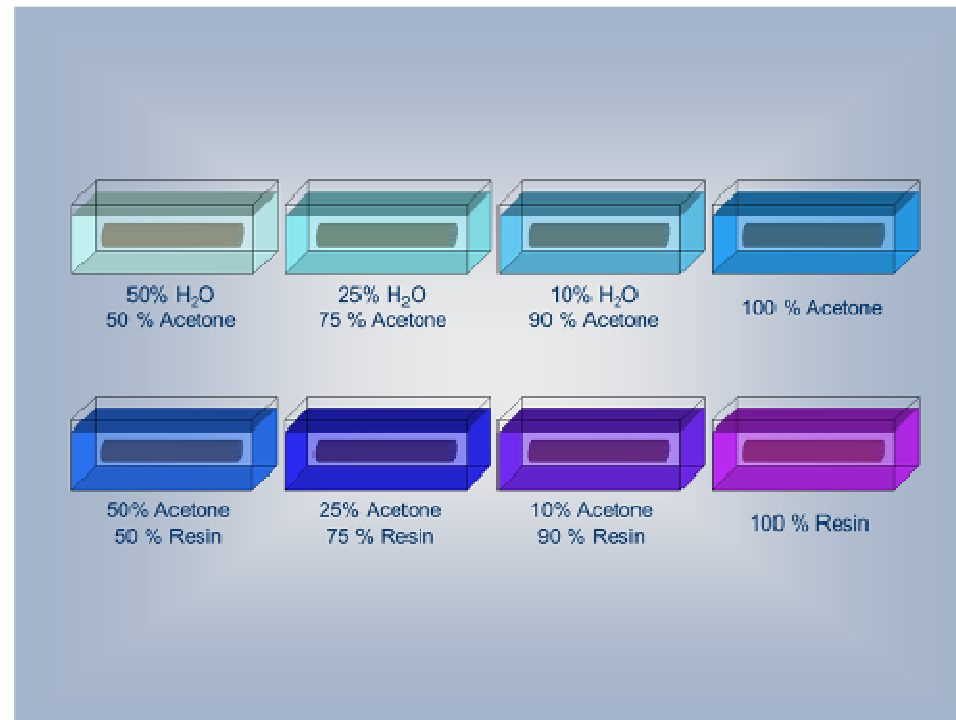
A figurehead of a schooner of the end of the 19th century.



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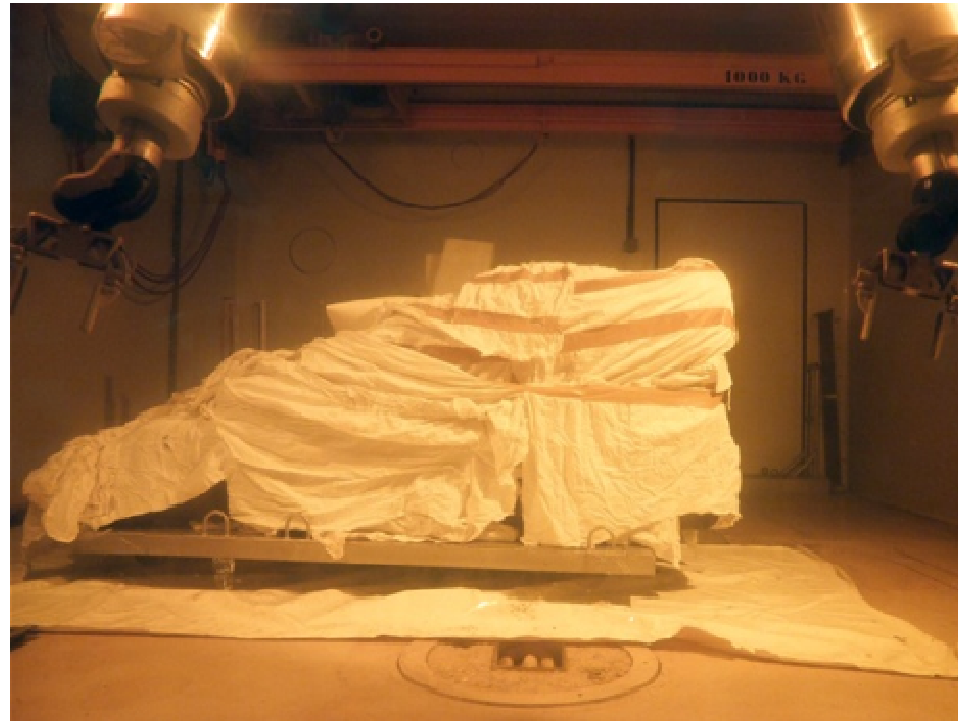
The historical osmotic double exchange:

- ⚙ *Successive baths, at atmospheric pressure, with different concentration.*



Waterlogged Wood “Nucléart” Conservation

- ⚙ Handling after impregnation, irradiation, removing traces of resin on the surface before the end of the complete polymerization



« Tirez les premiers, messieurs les anglais ! »*

* *“Mr. Englishmen, please shoot first...”*

Cannon carriage from the wreck of the HMS Stirling Castle, 17th c.



« Tirez les premiers, messieurs les anglais ! »*

* *“Mr. Englishmen, please shoot first...”*



French canon, 16th c. Le Havre

A long and complex technique:

- ⊗ 1 to 2 years of impregnation,
- ⊗ explosive risk,
- ⊗ lot of waste,
- ⊗ expensive.

This method is:

- ⊗ still the best in terms of conservation of the initial volume of waterlogged wood,
- ⊗ very efficient to avoid corrosion when metal is present near the wood,
- ⊗ the only technique to provide encouraging results in the presence of sulfide compounds.



A combined treatment PEG / Freeze-drying and the Nucléart method.



- ⚙️ classical impregnation and freeze-drying of 20% PEG,
- ⚙️ followed by vacuum-pressure impregnation and irradiation with radio-curable resin.

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