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Wet collections: preserving their values for the future!

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Abstract : Wet collections are rich in information to study the evolution of species or ancient pathologies. However, they are sometimes neglected, poorly documented and difficult to preserve. To keep these archives for future generations, we have inventoried in detail the degradations observed in the collections and undertaken research on the hermeticity of the jars. To top up the jars appropriately, the fluids is first identified without opening the jar and the impact of a change of fluid from the macroscopic to the microscopic scale was studied. The results of this research are shared through publications and exchanges with collection managers.

The fluid collections constitute a unique heritage, particularly because of their museological and scientific value. They are particularly important for international biological research concerning the comparison of species, organs and tissues but also for medical research, to study ancient pathologies and epidemics. Therefore, their preservation is one of the great challenges of this century.

The French Museum of natural History (MNHN) holds about 4 million specimens in its wet collections. Although the oldest specimens date back to the XVIIth century, each year, thanks to scientific expeditions, new pieces are added to the museum's reserves. Many universities, hospital or veterinary schools and museums also have wet collections. In the current context of species extinction, it is important to perpetuate these archives of nature, reflecting past biodiversity. Unfortunately, these collections are sometimes poorly known, poorly documented, or even forgotten within certain institutions. Consequently, their management and preservation are difficult, especially since these collections must be taken care of by very diverse actors within

institutions of very different sizes and functioning. The proper preservation of these collections is therefore difficult. In order to anticipate the risks that threaten these collections, research is undertaken to better understand their materiality and to propose both diagnostic tools and solutions to improve their conservation¹.

First, a systematic and automated condition report method was developed to make an exhaustive inventory of the degradations observed in the collections. The process was tested on three different collections of the Sorbonne University Alliance.

One of the most important conservation problems is the evaporation of the fluids. In order to act preventively, we are conducting research on the performance and durability of jar sealing technologies. Historical sealants were characterized by chemical analysis in order to know the old formulations, which are not well documented². Then, we developed several experiments (1) to measure the efficiency of the sealants against ethanol and water evaporation by performing model jars and (2) to test the resistance of these recipes against exposure to different fluids. To preserve the specimen when the fluid has partially or totally evaporated, the jar is then often filled. To act appropriately and to limit the harmful impacts of management operation on both the specimens and the staff (exposure to potentially hazardous chemical vapors), we implemented a non-invasive fluid identification technique that does not require opening the jar. This essential step uses Raman microspectroscopy through glass, as in the pharmaceutical, food industry or forensic, and allows to identify both the most classical fluids and more complex mixtures (*Figure 1*) such as Bouin's liquid or Kaiserling III solution³.



Figure 1: Identification of a fluid through the jar thanks to Raman microspectroscopy (piece of the MNHN comparative anatomy fluid collection: brain of *Sus scrofa domestica* in Bouin's solution – inventory number MNHN-ZM-AC-1929-211). © CRC-MNHN - S. Cersoy

In order to know the multi-scale impact of a change of conservation solution on specimens over time, we analyzed specimens that had been changed from one fluid

to another (e.g. ethanol to formalin) or always kept in the same one. Macroscopic changes are minor and the specimens can be displayed to the public. At the microscopic level, on the other hand, an efficient fixing solution, such as formaldehyde, is necessary to preserve the fine cellular structures. Finally, at the molecular level, the change and substitution of the fluid is not the main disturbance, but the acidification of the solution, linked for example to the entry of oxygen through the sealant, prevents the extraction of the DNA (if the pH became lower than 5.4)⁴. In addition, replacement of ethanol or formalin with the less toxic glycerol solution of Kaiserling III causes rapid and significant browning of the solution (*Figure 2*).



Figure 2: Color change upon fluid change – *Mus musculus* specimens' reference collection with (a) formalin fixation and storage, (b) ethanol pseudofixation and storage, and (c) pseudofixation in ethanol and then storage in Kaiserling III solution. © MNHN - M. Herbin

Most of results of this research have been published in the American professional journal *Collection Forum* and in analytical chemistry journals. Conferences are also regularly given to share our findings with collection managers, and the public. An international conference dedicated solely to the preservation of wet collections was organized for the first time in 2018 in Paris and brought together 140 actors from 17 different nationalities. This event allowed to identify the essential research fields to be explored in order to solve the problems encountered in wet collections and to constitute an international expert committee to look for solutions.

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