

A SPIRIT COLLECTION OF VASCULAR PLANTS AT THE MUSÉUM NATIONAL D'HISTOIRE NATURELLE HERBARIUM

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During the completion of the 2006–2013 renovation project of the Muséum National d'Histoire Naturelle herbarium in Paris, all fluid-preserved specimens were transferred to three storage areas on the fourth floor of the botany building in the Jardin des Plantes. This fluid-preserved spirit collection includes ca. 15,000 jars containing vascular plants, mainly angiosperms collected since 1900, many of which are linked to additional specimens and preparations (herbarium sheets, wood samples, and DNA samples) stored elsewhere, such as in the actual herbarium. These fluid-preserved specimens are essential for thoroughly studying and illustrating succulents and pulpy fruits as well as for the floral morphology of some families (e.g., Orchidaceae or Zingiberaceae) and are thus often sampled and sometimes further processed by visiting specialists. They are also primary sources for other collections, such as the anatomical microslide library (“Histothèque”) for examining cytological details and the pollen slide library (“Palynothèque”).

Maintenance and safety of the fluid collections were greatly improved by the addition of an extractor hood that made the practical work of fixation, preservation, rehydration, bottling, and rebottling of specimens easier. The use of effective fluids, such as the fixative FAA (formaldehyde 2%, acetic acid 5%, ethanol 67%, methanol 0.4%, water 25.6%) and the glycerol/ethanol/water mixture, along with standardized glass jars, greatly improved the storage and preservation of the specimens. While it is difficult to dispense with formaldehyde due to its good fixative properties (Buesa 2008) and its accordance with classical histological methods, it needs to be removed for health and safety reasons (e.g., it is carcinogenic and affects the lungs; see Goris et al. 1998) and to avoid long-term consequences, such as decalcification or pollen exine deterioration in preserved material. The use of any alternative to formaldehyde as a preservative fluid (Carter 2012) is a priority in collection areas such as algae but not necessarily for vascular plants and mushrooms. Histological studies may be carried out on dry samples after careful rehydration with dilute ammonia (5–10% aq.) or after heating at 60°C in heavily dehydrated tissues (Espinosa and Pinedo Castro 2018), recovering their original volume and outline but usually with clearing due to loss of tannins (Deroin 1994). Retrieval of preserved material in a continuously ventilated room (70 m³) is made easier by using three kinds of arrangements: unsorted field collections in stacking tanks, easily ordered arrays in chemical safety cupboards, and reference collections on shelves, free or in glass cupboards or drawers.

The reference collections fulfill different aims. Some of the specimens in this collection are reserve vouchers for phytogeographical and ethnographic exploration, such as Léon Diguët's samples of the useful Cactaceae from Mexico gathered in 1902–1904 (Fig. 1A–C). A book was published posthumously (Diguët 1928), giving numerous and detailed comments that enhance this reference collection, which is most likely to be used in temporary



Figure 1. Two kinds of spirit collections. (A–C) Reserve collection, still in original jars with flowers and fruits. Mexican *Opuntia*, Cactaceae (Léon Diguët). (D and E) Research collection, two views of type material of *Acropogon mertifolius*, a New Caledonian Malvaceae (Philippe Morat). (F and G) Published diagnosis and drawing made from the sample (© MNHN–T. Deroin).



Figure 2. The storage room of the active spirit collections. (A) Researcher's collection of Orchidaceae from Madagascar and Mascarene islands (Jean Bosser). (B) Service Forestier de Madagascar (René Capuron, with duplicates at the Centre National de la Recherche Appliquée au Développement Rural herbarium). (C) Plants of New Caledonia (Hugh MacKee, duplicates at the Institut de Recherche pour le Développement herbarium). (D) Reserve collection (H. Humbert, Madagascar, 1950–1960) (© MNHN–S. Lacoste). (E) Mixed reserve and research collections.

exhibitions. A contrasting collection is the collection of fluid-preserved flowers and fruits of *Acropogon* (Malvaceae) from New Caledonia, related to herbarium sheets kept at the Institut de Recherche pour le Développement in New Caledonia and in Paris, from which Morat and Chalopin described many new species between 2003 and 2008 (Fig. 1D–G; Morat and Chalopin 2003). Consequently, the fluid-preserved samples in this collection have high taxonomic value, as they include several types, but appear less appropriate for exhibitions or teaching purposes.

The most frequently consulted collections are the following (Fig. 2):

- 1) Orchidaceae from Madagascar and the Mascarene Islands (Fig. 2A), which were collected primarily by Jean Bosser (720 jars, in generic order in boxes, inside a glass cupboard, 36 linear m). Mainly flowers and fruits, small individuals, some cultivated plants, examined by ca. 12 botanists, including eight visitors each year.
- 2) Service Forestier de Madagascar (Fig. 2B): woody plants, collected mainly by René Capuron between 1960 and 1970 (1,376 jars, kept in drawers, in familial order, 28 linear m). Flowers and fruits, often of rarely gathered endemic species, examined by ca. eight botanists, including five visitors each year. A duplicate spirit collection is kept at the Centre National de la Recherche Appliquée au Développement Rural herbarium (Antananarivo, Madagascar).
- 3) Plants of New Caledonia (Fig. 2C): collected mainly by Hugh MacKee between 1980 and 2000 (1,680 samples, 14 linear m). Flowers and fruits, small organs in plastic bags, arranged in wide “Le Parfait” jars on shelves, examined by ca. four botanists each year. A duplicate spirit collection is kept at the Institut de Recherche pour le Développement herbarium (Noumea, New Caledonia).

At the present time, these three collections are the most frequently consulted sources by plant researchers at the Muséum National d’Histoire in Paris but constitute only a quarter of the jars housed in the herbarium. The other reserve collections (Fig. 2D, E) will undoubtedly be exploited in further studies and, while they need to be preserved, do not need to be available immediately and thus might be provisionally stored in another building or other storage facility. This collection arrangement is the best solution due to space constraints in old institutions.

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RÉSUMÉ

Depuis 2013, toutes les collections en fluides de l’herbier du Muséum National d’Histoire Naturelle ont été rassemblées au quatrième étage du bâtiment de botanique, dont env. 15 000 bocaliers contiennent des spécimens de plantes vasculaires—surtout angiospermes—récoltées depuis 1900, et souvent liées à des planches de l’herbier. Ces échantillons en fluides, indispensables à l’étude des succulentes, des fruits charnus, ainsi que pour la morphologie florale de certaines familles, comme les Orchidaceae ou les Zingiberaceae, sont régulièrement examinés par les botanistes de l’herbier et les visiteurs et souvent sources d’autres collections (préparations anatomiques et palynologiques). L’entretien d’une telle collection est grandement facilité par une ventilation continue et l’emploi de bocaliers standardisés de verre mince à joints résistants, tandis que sa gestion doit tenir compte du fait qu’un quart seulement des spécimens est activement étudié et doit rester très accessible.

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