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Botanical Spirit Collections

Presentation given by Emma Tredwell (Spirit Collection Manager, RBG Kew Herbarium) on 17th November 2005 to the NatSCA Botany Collections Seminar.

Overview

The aim of this presentation was to give a brief history of fluid preservation, discuss why and how botanical material is preserved in spirit, and explain how the RBG Kew spirit collection is managed.

History of fluid preservation

Spirit collections are also known as fluid-preserved or wet collections. Fluids consisting of oils and resins were used in ancient Egypt to preserve the organs of the dead as part of the process of mummification. Fluid preservation using 'spirit' began in the mid 17th century, when Robert Boyle (1627-1691) discovered that natural history specimens could be preserved in 'spirit of wine' (ethyl alcohol). Perhaps the next major event in the history of fluid preservation was the discovery of formaldehyde by Alexander Butlerov in 1859. Formaldehyde was found to be a much more effective chemical than ethanol for preserving plant specimens. In the present day there are a diverse range of chemicals used, including ethanol, methanol, glacial acetic acid, glycerol, formaldehyde and chloroform.

Why preserve in spirit?

The traditional method of preserving botanical specimens is to press and dry them, so why are some preserved in spirit? Wet preservation is of benefit for fleshy flowers and fruit that do not make good dried specimens. In particular the 3-dimensional arrangements of flower-parts are better observed in spirit specimens than pressed and dried ones. Measurements taken from spirit material can also be more accurate than those from dried material, where shrinkage may have occurred. A further important use of spirit specimens is for botanical illustration, as spirit material retains a life-like appearance. In addition to this, the collection of flowers and fruit in spirit whilst on expeditions can assist in the rapid identification of the material on its return to the Herbarium. This is particularly true for orchids, where identification often relies on being able to see the flowers in a 3-dimensional state.

How to preserve in spirit – fixation and preservation

The aims of fluid preservation are to keep the specimen in a life-like form, protect it from agents of decay and dehydration, minimise shrinkage and swelling and hence to preserve the specimen indefinitely for future use.

To achieve these aims you must first fix the plant tissue to prevent degradation, as plant cells will normally begin to break down following the death of the plant. A fixative such as formaldehyde or glutaraldehyde can be used to form covalent bonds (cross-links) between the molecules composing the tissue. Ideally, fixation should be done as soon as possible after the plant is collected.

Alcohols such as ethanol are known as 'pseudofixatives' as they do not form covalent bonds, but instead disorder the protein and alter patterns of hydrogen bonding.

After fixation it may be desirable to transfer the specimen to a preservative such as ethanol, isopropanol, glycerol or phenol. The preservative must be germicidal, as safe as possible to work with and have no adverse chemical reactions with the plant specimens. The preservative should also protect the specimen from becoming brittle and it may also be desirable if it can help maintain the colour of the specimen.

Spirit mixes

At Kew we store all botanical spirit specimens in 'Kew Mix'. This contains 5% formaldehyde (to fix the tissues effectively), 5% glycerol (to prevent the material from becoming brittle), 53% industrial methylated spirit (to act as a preservative) and 37% water (to achieve a desirable dilution).

Due to the toxicity of formaldehyde, we transfer specimens to a different mix when they are removed from the collection for study. This is called 'Copenhagen Mix' and contains 70% industrial methylated spirit, 28% water and 2% glycerol.

The RBG Kew spirit collection

Victor started the spirit collection at Kew in 1930. S. Summerhayes, who was the curator of the orchid herbarium at that time. As a result of the incorporation of existing collections, the spirit specimens themselves date back further than that, some as far as the 1830s.



The spirit collection currently consists of over 69,000 plant specimens preserved in fluid and stored in glass jars. The collection is rich in diversity, with 371 plant families represented. Jar sizes range from 70ml to 3,000ml, with some out-sized jars for specimens such as the flower and fruit of *Aristolochia grandiflora*, and the male cone of *Encephalartos hildebrandtii*. The RBG Kew spirit collection is probably the largest botanical spirit collection in the world. It is also one of the world's largest and most diverse collections of orchids in spirit.

The storage environment

The collection is stored at a constant temperature of 12-16 °C in order to minimise evaporation and to protect the specimens from extremes of temperature. The specimens are kept in mobile banks of drawers with larger jars on static shelves with sliding doors to protect specimens from daylight. The storeroom is fitted with sensors to allow 24-hour monitoring of both flammable and toxic gas levels. The specimens are given a unique number and arranged numerically to reduce the handling that would be involved in curating a systematic arrangement.

All work involving the opening of the jars is carried out in fume hoods in an adjoining laboratory.

Choice of materials

The jars currently in use are made of glass with straight sides and wide mouths. A variety of lids have been used within the collection, including metal (which can become rusty), glass stoppers and plastic screw-on and snap-on lids. Plastic snap-on lids have been found to be effective at preventing evaporation and are easy to handle, but those made of PET can split after some time in use. A UniPin fine line pen (black 0.8, from Mitsubishi Pencil Co. Ltd.) is used for handwritten internal labels. Archival paper is not used, although we are aware that Resistall has been recommended for this purpose.

Record keeping

Each spirit specimen is given a unique number and all the label data are recorded on the Herbarium Catalogue database. This is part of the electronic Plant Information Centre (ePIC) and can be accessed at <http://www.kew.org/epic/index.htm>. All label data are entered, including the plant name, location, collection details, plant description, and notes. This also includes links with dried herbarium specimens, the living collection, illustrations, photos and slides.

Spirit collection maintenance

The specimens are checked on a rotational basis for evaporation, breakage, and deterioration. A record is kept of all loans, both internal and external to Kew.

When plant parts are dissected they are placed in vials and returned to the jar for future reference. When new determinations are made they are added to both the jar label and the database.

Content and uses of the RBG Kew spirit collection

Orchid specimens currently account for about half of the collection (31,200 + specimens), but the following plant families also have a large presence in the collection: Asclepiadaceae (3,000 +), Lentibulariaceae (2,000 +), Araceae (2,000 +), Euphorbiaceae (1,600 +), Palmae (1,200 +) and Rubiaceae (1,100 +).

The collection is used predominantly for taxonomic research, by both local and international researchers. It is also used for other scientific study, for example in the fields of entomology, palynology, ethnobotany, plant anatomy and developmental biology. Botanical illustrators regularly use the collection as a valuable source of life-like material to make drawings from. In addition the spirit specimens are, on occasion, used for historical research.

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