

The top half of the image shows several fossil specimens embedded in a light-colored matrix, likely rock or plaster. The fossils are dark and show various plant-like structures, including what appear to be fern fronds and other leaf-like forms. The background is a solid yellow color.

## CHAPTER 8

# starting a new herbarium

*Do what you can,  
with what you have,  
where you are.*

*—Theodore Roosevelt*

When starting a new herbarium, it is useful to know what infrastructure, equipment, and supplies would be adequate for your needs. In this chapter, we provide guidelines for setting up and managing a new herbarium.

## Purpose

The main purpose of a herbarium is ongoing taxonomic research. This research relies on a collection of preserved plants—the herbarium—that is built up over a long period. There are many different activities associated with building up and maintaining a herbarium collection.

## Collecting, preserving and storing specimens

Collected specimens should be of a high quality and meticulously preserved. A standardised storing system should be used to ensure that specimens are easily retrievable. The arrangement of specimens could be based on a simple alphabetical system, or on a more complex system based on taxonomic relationships. A high standard of label information is also essential.

## Identification

Identification is based on taxonomic relationships. It is the matching of unnamed plants with named specimens in the collections, based on similarities between the specimens.

## Nomenclature

When naming plants, the focus is on maintaining nomenclatural standards. Names of specimens should be kept in line with any revisions done. A type collection must be maintained and exchanges of specimens with other institutions must be standard practice.

## Comprehensive collection

The aim is to work towards a fully representative collection, representing the diversity and distribution of the region's vegetation. This implies undertaking collecting trips to under-collected areas and ensuring that all taxa in the region are represented.

## Determining basic needs

Once the purpose of the herbarium is clear, an inventory of basic needs can be compiled. This would include the estimated size of the herbarium, staffing, cupboard and working space, and equipment required such as microscopes, plant presses, freezers, microwave ovens, and good quality card of a standard size for mounting. The system for the arrangement of specimens should be decided from the start as this could affect the layout of the herbarium. (For more information on filing systems, see "Filing specimens").

## Registering in *Index herbariorum*

The *Index herbariorum* (Holmgren *et al.* 1990) is a world-wide register of herbaria that provides concise information about a large number of herbaria. The staff of the New York Botanical Gardens maintains this useful publication. To be registered in *Index herbariorum*, a unique acronym (for example, GAB for the National Herbarium of Botswana, Gaborone) is needed, as well as information about the size, collections, staff, contact person, and address.

## Infrastructure and functional areas

The building housing a new herbarium should be given careful thought before work commences. Work areas, storage space, and offices should be incorporated in the layout. In this section, we also discuss cupboards, lighting, ventilation, and many other aspects of an efficient herbarium.

## W A R N I N G

### BEWARE OF FIRE

Do not use open flames.  
Do not leave heaters on unattended.

## Buildings

Buildings should preferably be custom-built and designed with the staff complement, as well as the size and layout of cupboards in mind. The layout should take into consideration whether or not the ancillary collections will be housed separately.

It is important that buildings are water and dust proof, and that pests can be controlled easily. A form of fire protection should be in place in every herbarium; this can be an automatic or manual system. Fire is potentially the most devastating disaster for a herbarium; care should be taken to follow international standards for fire protection. Be aware of possible flooding dangers, as this can also ruin the collection.

## TIP

Good housekeeping will keep fire hazards to a minimum—ensure electrical wiring is well maintained.

For more information on fire protection standards, contact your local fire brigade, Health and Safety organisation, or visit [www.nosa.co.za](http://www.nosa.co.za).

### Working areas, storage space, and offices

Ideally, members of the herbarium staff should have their offices outside the main herbarium to allow for minimum disturbance.

There should be enough work surfaces inside the herbarium for researchers and other workers to spread out specimens when working with them.

A packaging area may be required for sending and receiving specimens, books, and so on. This area is best kept separate and suitably equipped with a large working surface, easy access to wrapping materials, and a scale.

A mounting area should also be kept separate from the main collections to reduce insect contamination and to consolidate mounting activities and equipment.

Storage space would depend on the quantity of supplies that are kept, but should be suitably shelved and maintained for optimum efficiency.



Specimens stacked in different types of cupboards—wooden (above) and metal (below).

### Cupboards

Specimens are stacked on top of each other and stored in shelved cupboards. The cupboards are shelved with pigeon-holes that are a little wider than the standard mounting board, and deep enough to hold a moderate pile of specimens—not too many, otherwise the lower specimens could be damaged by the weight. Over the years, cupboards have had different designs; all cupboards should, however, comply with the following standards:

- Cupboards should ideally have shelves approximately 150 mm apart, with close-fitting doors to provide protection from insects and dust.
- Metal cupboards should have doors with magnetic sealing strips around the edges for the same reason.
- Wooden cupboards may not provide the same protection against insects, but in humid climates they are not subject to condensation to the same degree.
- In a fire, unless they catch alight, wooden cupboards may offer better protection to specimens, since metal may overheat and singe the contents.

### Lighting

Studying herbarium specimens with microscopes and hand lenses requires good lighting. In sunny countries, large windows may leave plant specimens exposed and vulnerable to direct sunlight. To avoid damage to plant specimens, use of artificial or indirect light is preferable. In colder climates, however, most use is made of natural lighting, for example, the herbarium of the Royal Botanic Garden in Edinburgh (RBGE, Scotland, UK) is large and has windows on the one side and a light shaft in the centre. This makes the best of natural lighting, thereby reducing the amount of artificial light needed.

### Ventilation

In some climates, atmosphere control by air conditioners and humidifiers is essential in a herbarium. Such control does, however, create an artificial working atmosphere for staff and is expensive to install and maintain. The decision to control the atmosphere should therefore be made with great care, taking into account the fumigation method used and compatibility with the fire protection system. In addition, ventilation should comply with Health & Safety standards.

### Telecommunications

Telephones offer an effective way of communication, for example, faxing, as well as access to the Internet and e-mail through computers. Careful planning is needed to ensure that the telephone points are placed in practical positions. Computers have

become indispensable in modern herbaria as they are used in many aspects of herbarium work. They may have to be placed near a telephone jack if a modem is required for electronic communication.

### Library

A library or access to a library is essential for herbarium staff. Although electronic literature searches are made easy through technology that is becoming more freely available, all herbaria should have at least the standard reference works. It is also important to keep all possible Floras for the region, and the most recent botanical works relevant to the area, or local families. (For more information on books, see "Recommended herbarium literature".)

### Laboratory

It is convenient to have laboratory facilities in the herbarium for researchers. Depending on the researchers' needs, laboratories can be relatively simple or very well equipped. In all cases, it is useful to have basic facilities available: a workbench, scale, fume cabinet, glassware, and necessary chemicals. Other research facilities can be created (for example, for cytological work); these are often driven by individual preferences and the nature of the research.

The use of open flames and corrosive chemicals, such as acids, necessitate a fire protection system and a cold-water shower facility in case of an emergency. For the health and safety of staff, there must be a special storage cupboard or room for chemicals. Flammable substances, such as alcohol, should be stored away from the main building. It is also a good idea to have a first aid kit.



Specimens being dried in plant dryers.

### Reception

A reception area for visitors is convenient. Some herbaria also have special working areas for visitors to control their access to the collections.

Specimen reception is separated from other herbarium collections to reduce insect contamination. Strict hygiene regulations should be followed and no new accessions should be allowed into the main collection, unless first decontaminated. It is best to have two separated spaces for working with incoming specimens: one for contaminated material (for example, specimens donated from other herbaria, or specimens being unpacked and sorted for drying after a field trip); the other for decontaminated plants, such as those being sorted for identification or mounting. For more information on insect contamination, see "Herbarium Pests".

### Equipment and supplies

As far as possible all herbaria that keep their specimens as archival records, should avoid using material of a temporary nature, such as sticky tape, masking tape, magic tape, plastic packaging tape, and self-adhesive labels. It is best to use only archival materials, such as methylcellulose adhesive, archival ink pens, and acid-free paper.

### Decontamination equipment

All new accessions and any insect-contaminated material need to be decontaminated. A freezer is the most essential piece of equipment; microwave ovens are very useful as well. Chemical methods used to be popular, but because of the potential health hazard, are not used much today. For more information on decontamination, see "Herbarium Pests".

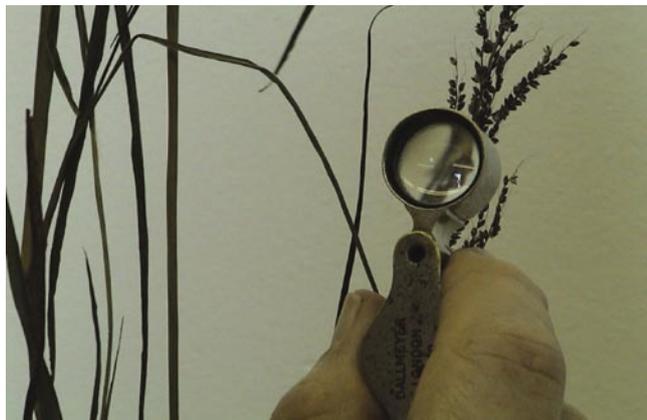
### Plant dryers

When choosing a plant dryer, take into account the number of specimens likely to be dried at one time. Many different kinds are available, ranging from a wooden box with a grid over a light bulb, to a walk-in oven; some advanced dryers even press and dry at the same time.

### Magnifying instruments

Most identification keys make use of characters that need high magnification; therefore, magnifying instruments are essential in a herbarium.

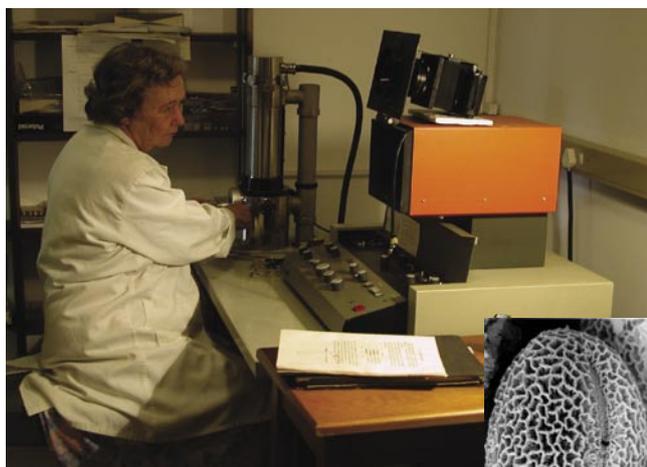
- **Hand lenses** (8–10x) are very useful for observing characters on specimens in the field, as well as in the herbarium.
- **Stereomicroscopes** have magnifications higher than 20x and are used to observe micro-characters on specimens.



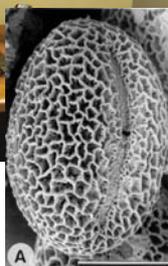
Hand lens being used to magnify grass spikelets.



Pollen grains viewed through a light microscope.



▲ Scanning electron microscope.  
▶ A pollen grain viewed through this instrument.



- **Transmission microscopes** are often needed to observe special characters such as cell structure in water plants and bryophytes. Preparations on microscope slides are required.
- **Microscope attachments**, that is, a camera and drawing tube, are invaluable (in the illustration of research papers) to herbaria active in research.
- **Electron microscopes**, transmission and scanning, are used for specialist research.

### Maps

Maps are essential for research and fieldwork. They are used for pinpointing localities, based on specimen label information and for supplying accurate locality data when new specimens are collected. Locality information, in turn, is used to establish the distribution range of a species.

Maps can be stored flat, folded, rolled, or hanging in special cabinets or drawers.

Preserve older and historic maps; they are often of great help when you are trying to find localities written on old specimens. This could, for example, be necessary when you are planning a field trip to collect a rare species, of which the only record is an old specimen with a locality name that is no longer in use. For more information, see "Maps".

### Camera

A camera is useful for botanical photography, both in the field and in the herbarium, as well as for recording incidents in the history of your herbarium.

The best camera to get is a single-lens reflex (SLR) camera, preferably one with optional auto focus. An additional lens for macrophotography, for taking close-up images of flowers, for example, is also very useful.

Digital cameras are becoming more affordable and popular and are very useful for photographing people, plants, and landscapes in the field, since one can immediately see the result and delete unwanted images. Special adapters are available for using a digital camera with a microscope. Digital cameras, however, have some disadvantages:

- There are capital expenses related to downloading or reproducing the images (for example, software and printer); however, one saves on film, processing, and printing costs.
- The quality of the image produced by an affordable digital camera is inferior to that produced by an SLR camera, but this may change as advanced technology becomes increas-

ingly affordable.

- Macro-photography is not of a high standard, unless you buy an expensive model.

### Other equipment

A herbarium also needs the usual office equipment, such as a photocopier, fax machine, telephone, and stationery. In addition, specialised equipment is necessary for collecting, mounting, preserving, and studying specimens. These are discussed in more detail in the other chapters of this book.

- **Plant collecting equipment.** See "Collecting Plants".
- **Mounting equipment.** See "Mounting Specimens".
- **Containers for spirit collection.** Plastic containers of different sizes to collect and store material in spirits. See "Spirit collection".
- **Packaging equipment.** For posting specimens or books: boxes, brown paper, packaging tape, string. See "Handling requests for loans".
- **Dissecting equipment.** See "Identifying specimens".

### Herbarium services

A herbarium can offer a wide range of services, both to scientists and other professionals, and the public.

#### Information service

A herbarium is the most likely place to contact if members of the public want to make an enquiry regarding the name of a plant. An information service can be introduced to respond to enquiries from the public, to make botanical information more accessible, and to improve public relations.

A herbarium staff member should be able to answer enquiries relating to plant identity and plant names (common names, synonyms, and so on). It is useful to keep the following books in a place accessible from the telephone:

- A book on common names, such as that by Smith (1966) for South Africa, or Cole (1995) for Botswana.
- A book on names of plants, such as *The plant book* by Maberley (1997), which has a worldwide coverage.
- Also helpful is a reference on poisonous plants, such as that by Watt & Breyer-Brandwijk (1962).

It is essential to deal with enquiries in a friendly and efficient manner. However, many questions directed at herbarium staff members are about subjects for which they are not necessarily equipped, for example, queries about plant diseases, horticulture, and even solutions to crossword puzzle questions! Unless the staff member knows the answer to the query, it may be best

to refer the enquirer to someone with the relevant knowledge. A list of useful telephone numbers next to the telephone makes referrals easier. If you are unable to refer the caller, tell them that the query is outside the scope of the knowledge of a taxonomist, or the function of that particular herbarium.

### Visitors

Visitors to herbaria are generally welcomed as they ensure contact with other institutions and can contribute positively to curatorial care. Some herbaria are open to visitors, either on a daily basis or by appointment. Visitors who have an interest in herbaria include

- Researchers
- Casual visitors
- Consultants
- Commercial business people

Some herbaria keep a visitors' book for recording visitors' information, their research interests, and reasons for the visit. The book provides a useful list of contacts for future communication, as well as a record of the use of the herbarium.

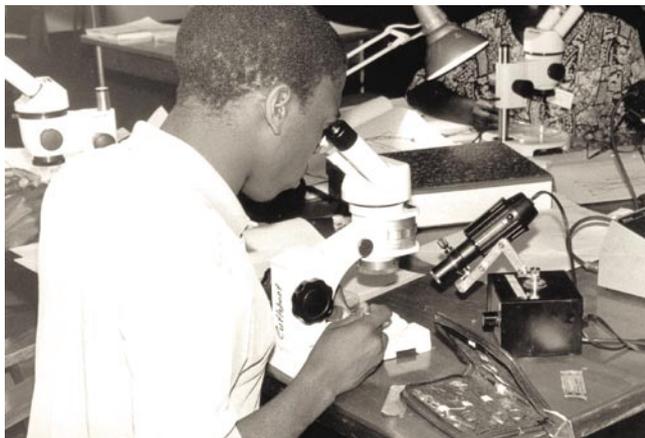
Herbaria often prescribe regulations for visitors on, for example, handling specimens, dealing with name changes, selecting loans, and so on. Visitors should always be informed about herbarium practices and should work under supervision.

### Plant identifications

Researchers, members of the public, and people with specific interests such as vets, herbicide companies, and consultants doing vegetation surveys, may all approach the herbarium to have plants identified. Although identification is a basic essential service provided by herbaria, a fee may be charged to cover the costs of processing and time involved. This fee may be waived if the person is not in a hurry for names and donates good quality specimens to the herbarium. Clients who need plants identified urgently are often charged a higher fee. If a herbarium has the capacity and chooses to provide an identification service, it is advisable to have a policy stipulating the conditions and charges for providing the service.

#### TIP

Keep the telephone numbers of doctors and poison information centres next to the phone. Ask callers to supply a sample of the plant material for correct identification.



A herbarium staff member identifying plants.

## Loans

It is a generally accepted practice for a herbarium to lend specimens to another herbarium for use by qualified researchers, studying particular taxonomic groups or problems. Loans make it possible to

- Assemble a greater, more varied amount of material of a group than is possessed by any one herbarium, thus providing a better basis for revisions and monographs.
- Compare specimens directly with types and other authentic material.
- Have specimens annotated by the monographer or specialist.

Loans are usually made between institutions rather than from institutions to individuals, and arrangements should be made through the correct channels. All correspondence should be addressed to the curator of the museum or herbarium. Conditions of loans should be included with the correspondence.

For detailed information, see “Loans”.

## Environmental Impact Assessments

Staff members of herbaria may be approached to take part in Environmental Impact Assessments (EIAs). Taxonomists may be very useful to an EIA team, because they are competent in naming plant species and may therefore assist with compiling species lists for vegetation surveys. A herbarium worker is, however, not likely to be qualified to do full EIAs and should be wary of getting too involved in large projects requiring specialist ecological knowledge. If asked to participate in an EIA, a herbarium worker should make it quite clear what skills are offered. A tax-

onomist may assist in some or all of the following ways:

- Collecting voucher specimens from the area under study.
- Identifying these specimens and providing the names.
- Consulting the herbarium collection and compiling a list of species historically found in the area under investigation.
- Studying the literature to determine the rarity and extent of distribution of the species.
- Highlighting the occurrence of rare or endangered species that are found during the collecting trip, or while consulting herbarium records or literature.
- Assessing whether development would be harmful to the distribution of rare species.
- Providing recommendations on the conservation of rare species.

For this work a fee may be negotiated; it should cover all direct costs, as well as time spent on the project.

## Herbarium management

Without active, hard-working, dedicated staff to record, research, and communicate the wealth of information contained in a herbarium, the collections are worthless.

The energy and enthusiasm of staff should be directed by management to reach specified outcomes.

## Staff management

Staff are the biggest asset to any herbarium. Many opportunities for staff to develop their knowledge and skills exist in any herbarium. Managers and staff must continually explore ways of creating challenges for staff to grow.

## Herbarium staff

**Managers** ensure that the herbarium functions effectively. The most senior manager of a herbarium can be a director, curator, or keeper.

**Researchers** generally research the flora covered by the herbarium. Their research is usually restricted to a small number of families, although they are also responsible for the quality of scientific curation. Researchers are often involved in larger collaborative projects.

**Technicians** are generally involved in the day-to-day activities of the herbarium, such as plant identifications and scientific curation. They are generally responsible for a large range of families. After retirement, many researchers continue their research and can contribute substantially in this way.

**Supporting staff** hold a wide range of positions. They can be dedicated to a specific position, or fulfil a variety of tasks including mounting, packaging, filing, preparing genus covers, and loan administration. They are often approached to help with specific tasks or to clear backlogs.

### Financial management

Every herbarium has a budget, however small. Budgets are drawn up annually and should be managed to cover priority spending without over-spending. It is useful to have an itemised, yet flexible, budget to guide annual spending. Since priorities change continuously, a budget should be able to accommodate emergencies. ▲



Taxonomists on a plant collecting expedition press plants at their base camp.

# APPENDIX I: HERBARIUM SUPPLIES

## Local suppliers

The Pretoria National Herbarium (PRE) offers a non-profit herbarium supply service to smaller herbaria. PRE stocks most herbarium supplies, which are bought in bulk; some items are custom-made for the herbarium.

### The following items are available to individuals and institutions:

- Plant presses (including straps)
- Single straps
- Drying paper (190 gsm, 450 x 280mm)
- Flimsies (unprinted newspaper, 550 x 420 mm)
- Genus covers (230 gsm, 570 x 430 mm)
- Species covers (230 gsm, 570 x 430 mm)
- Eltoro mounting boards (240 gsm, 270 x 420 mm)
- Acid-free mounting boards (300 gsm, 240 x 420 mm)
- Corrugated cardboard (280 x 450 mm)
- Field label notebooks
- Plastic zip bags (80 x 120 mm)
- Plastic zip bags (100 x 110 mm)
- White gummed paper (50 mm wide)
- Tarcroft paper
- Seed envelopes: small (45x 45 mm); medium (65 x 65 mm); large (90 x 90 mm)
- Raffia tails
- Boxes: size A (430 x 300 x 80 mm); size B (430 x 300 x 155 mm); size C (430 x 300 x 230 mm)
- Cardboard sheets (box inlets) (470 x 270 x 295 mm)
- Brown paper bags: sizes 35, 20, 12, 8, 4, 1

### You can request a current price list by writing to

Herbarium Supplies  
National Herbarium Pretoria  
Private Bag X101  
Pretoria  
0001  
South Africa

## International suppliers

Herbarium Supply Company  
3483 Edison Way  
Menlo Park  
CA 94025  
USA

University Products  
517 Main Street  
PO Box 101  
Holyoke  
MA 01041-0101  
USA







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## About SABONET

This publication is a product of the Southern African Botanical Diversity Network (SABONET), a programme aimed at strengthening the level of botanical expertise, expanding and improving herbarium and botanic garden collections, and fostering closer collaborative links among botanists in the southern African subcontinent.

The main objective of SABONET is to develop a strong core of professional botanists, taxonomists, horticulturists, and plant diversity specialists within the ten countries of southern Africa (Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe). This core group will be competent to inventory, monitor, evaluate, and conserve the botanical diversity of the region in the face of specific development challenges, and to respond to the technical and scientific needs of the Convention on Biological Diversity.

To enhance the human resource capacity and infrastructure available in the region, SABONET offers training courses, workshops, and collaborative expeditions in under-collected areas. The programme produces a newsletter, *SABONET News*, and a series of occasional publications, the Southern African Botanical Diversity Network Report Series, of which this publication is part.

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