

CHAPTER 7

scientific curation



Without taxonomy to give shape to bricks, and systematics to tell us how to put them together, the house of biological science is a meaningless jumble.

—Robert May

Succulent specimens preserved in spirits.

The quality of the specimens and label information, filed in the herbarium, determines the scientific value of the herbarium collection. Properly prepared, well-mounted, and scientifically curated herbarium specimens can survive for hundreds of years and remain scientifically valuable.

A sound knowledge of taxonomy and botanical literature is needed to enable identification and curation of the collection, so that the herbarium collection can be maintained according to the most recent taxonomic revisions.

Taxonomy and nomenclature

Plant taxonomy is “the science that includes *identification*, *nomenclature*, and *classification* of plants” (Lawrence 1951).

- **Identification** is the naming of an organism by reference to a known plant or description.
- **Nomenclature** deals with applying the correct scientific name to a known plant, according to a nomenclatural system. This naming is regulated by rules in the International Code of Botanical Nomenclature (ICBN).
- **Classification** (as a process) is the production of a logical system of categories, each containing any number of organisms with shared characteristics, which allows easier reference to its components (kinds of organisms).

Rules for naming plants

To be accepted by the ICBN, plant names have to be *effectively* and *validly* published to be *legitimate* and correct.

- **Effectively published** means published in printed form and made available to the public, or at least to a botanical institution.
- **Validly published** means the name was published in an approved form and accompanied by a description or reference to such a name.
- **Legitimate names** are those that follow all the rules.

Plant names

Plant taxonomy organises plants into a hierarchical classification system with the following ranks: families, subfamilies, tribes, subtribes, genera, subgenera, sections, species, subspecies, va-

rieties, and formas. Not all ranks are present in every classification; for example, a species may not have a variety, subspecies, or forma. All ranks are written in Latin or in latinised form, according to the rules of the ICBN.

The name of a species consists of two words, called a *binomial*, for example, *Poa annua*. The first part of the binomial is the name of the genus or *generic name*, for example, *Poa*; the second part is the species name or *specific epithet*, for example, *annua*.

The name of a family is usually based on the name of the type genus, for example, Poaceae from *Poa*. However, it is also acceptable to follow the older system that was in general use, for example, Compositae instead of Asteraceae, Leguminosae instead of Fabaceae, and Gramineae instead of Poaceae.

The genus, as well as all the ranks under it, are written in *italics* or underlined script. The genus name is capitalised, whereas the species name and other lower ranks start with a lowercase letter, for example, *Aristida scabrivalvis* subsp. *contracta*.

Authors

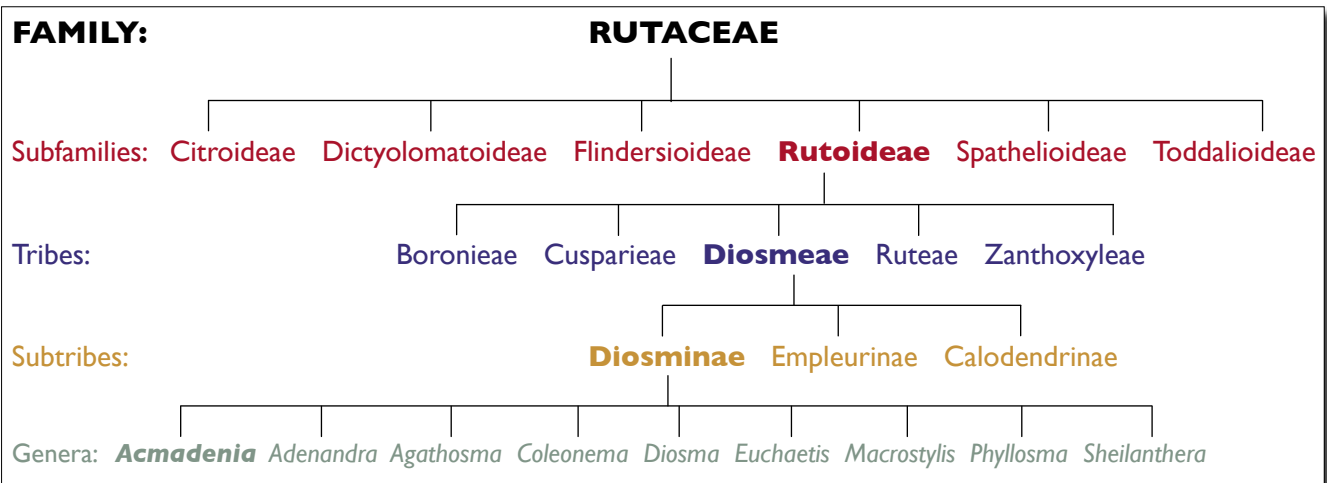
A plant name, when written in full, is followed by the author's name or authors' names. The author is the person who first validly published that name, for example, *Leersia denudata* Launert was first published by Georg Oskar Edmund Launert, and *Eragrostis acraea* De Winter by Bernard de Winter. (Note that author names are not italicised.)

Often the author name will be abbreviated, for example, in *Aloe* L. the “L.” refers to Linnaeus. Brummitt & Powell (1992) provided a standard work for the abbreviation of author names. All herbarium workers and taxonomists are encouraged to use these standardised abbreviations. There is also an online version available at www.ipni.org/ipni/author_query.html.

If a species is moved to a different genus, the author's name is placed in parentheses, followed by the name of the author who made the new combination, for example, *Radinosiphon leptostachya* (Baker) N.E.Br. John Gilbert Baker first published this species in the Iridaceae as *Lapeirousia leptostachya* Baker, but Nicholas Edward Brown later transferred it to the new genus *Radinosiphon*.

“Ex” is used to connect the names of two persons, the second of which validly published a name that was proposed—but not validly published—by the first. It is permissible to omit the *first name*, although for clarity both authors are usually cited in Floras or formal checklists. An example is the grass species *Agrostis montevidensis* Spreng. ex Nees: Sprengel proposed the name—

P A useful reference to the endings of taxa:
I Family: -aceae
T Subfamily: -oideae
 Tribe: -eae
 Subtribe: -inae



Example of a hierarchical classification scheme.

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- 1a Plants terrestrial without pseudobulbs or corms, frequently with root tubers; very rarely growing on trees or rocks but then always having fleshy root tubers; leaves thin and soft, deciduous; anther erect, horizontally reflexed or pendent, not incumbent and not operculate; pollinia almost always sectile:
- 2a Anther erect and subequal to rostellum; plants terrestrial or occasionally epiphytic, without root tubers..... Subfamily SPIRANTHOIDEAE:
- 3a Leaves convolute, soft-herbaceous, often arranged ± rosette-like; inflorescence terminal Tribe **Cranichideae**
- 3b Leaves plicate; stems reed-like; inflorescences lateral or terminal Tribe **Tropidieae** (*Corymborkis*)
- 2b Anther erect, horizontally reflexed or pendent and rostellum much shorter than anther; root tubers almost always present; plants terrestrial or rarely epiphytic Subfamily ORCHIDOIDEAE:
- 4a Anther erect or suberect; median sepal unspurred; petals not clawed and fimbriate; lip often spurred, always without large appendage Tribe **Orchideae**
- 4b Anther horizontally reflexed or pendent; very rarely secondarily erect or suberect but then either median sepal spurred and large lip appendage present or petals clawed and fimbriate Tribe **Diseae**
- 1b Plants epiphytic, epilithic or terrestrial, rarely lianas, frequently with corms or pseudobulbs but not with root tubers; leaves thin and soft, leathery or succulent; anther incumbent or rarely suberect, operculate; pollinia soft-mealy, sectile or hard and waxy Subfamily EPIDENDROIDEAE:
- 5a Pollinia soft and mealy or sectile:
- 6a Pollinia 8, soft, but clearly defined Tribe **Arethuseae** (*Calanthe*)
- 6b Pollinia 2 and sectile, or mealy and ill-defined:
- 7a Terrestrial plants with 1 green leaf that develops after the flowers; plants arising from subterranean tubers; pollinia 2, sectile Tribe **Nervilieae** (*Nervilia*)
- 7b Plants not as above:
- 8a Saprophytes; pollinia 2, sectile Tribe **Gastrodieae**
- 8b Lianas with green stems; pollinia soft and mealy Tribe **Vanilleae** (*Vanilla*)
- 5b Pollinia firm or hard, not sectile:
- 9a Pollinia naked, without caudicles and stipes; sometimes with viscidia:
- 10a Inflorescence terminal; plants with or without pseudobulbs, terrestrial or epiphytic Tribe **Malaxideae**
- 10b Inflorescence lateral; plants with pseudobulbs, epiphytic Tribe **Dendrobieae** (*Bulbophyllum*)
- 9b Pollinia with caudicles, often with viscidia and stipes:
- 11a Plants monopodial Tribe **Vandaeae**
- 11b Plants sympodial:
- 12a Plants mostly terrestrial; if epiphytic then with long fusiform leafy pseudobulbs and large yellow resupinate flowers with brown blotches Tribe **Cymbidieae**
- 12b Plants always epiphytic; flowers small to medium-sized and not resupinate Tribe **Epidendreae** (*Polystachya*)

Example of a key (from Leistner 2000).

by writing it on the label of the specimen, mentioning it in an article, or even suggesting it in a letter—but did not publish it validly. Subsequently, Nees von Esenbeck published the name validly.

“In,” on the other hand, is used to connect the names of two persons, the second of which was the editor, or overall author, of a work in which the first was responsible for validly publishing a name. In this case, the opposite rule is applied: for the sake of brevity, the *second name* may be omitted. An example of this use is *Tricholaena* Schrad. in Schult.—here Schrader validly published the genus name in a publication by Schultes. The name is, however, often cited as *Tricholaena* Schrad.

Type specimens

A name is permanently attached to a taxon by means of a type specimen (or sometimes an illustration), which is the specimen (or illustration) used for the original description. There are various kinds of type specimens:

- **Holotype:** Specimen designated by the author as the type specimen.
- **Isotype:** Duplicate of the holotype.
- **Lectotype:** Specimen chosen to act as a type from the syntypes.
- **Neotype:** Specimen chosen to act as a type when the original material has been lost.
- **Syntype:** Any one of two or more specimens cited by the author when no holotype was designated, or any one of two or more specimens simultaneously designated as types.
- **Topotype:** A specimen of a named taxon collected, usually later, from the original type locality, or from the area where the species was described.
- **Iconotype:** An illustration used by the author when no specimen was available.

Descriptions

For a plant name to be valid, it needs to be published with a description. The description consists of the following parts:

- An obligatory diagnosis in Latin, describing the main characters that distinguish that species from other, similar, species.
- An optional, full description in an international language.

The descriptions are often followed by a discussion of certain characters and further comparisons with other species. The geographical distribution and a list of some or all of the specimens seen are also given. Many specimens seen by the author are not cited, because of limitations imposed by the journal; these are often available from the author on request.

P I T

Types are extremely important specimens and should be handled as little as possible and with utmost care. They have to remain in a well-preserved state for future generations of botanists to use in defining the concepts of particular taxa.

Taxonomic publications

A taxonomic publication can take one of several forms:

- **Checklists** are simply listings of plants of a specific area, sometimes with brief notes.
- **Brief Latin diagnoses** accompany a slightly more expanded list of names.
- **Descriptions of new taxa** are complete and often contain illustrations.
- **Revisions** treat a family or genus in a specific smaller geographical region, or involve only part of the taxon.
- **Monographs** are major revisions that deal with a whole family or genus on a worldwide basis.
- **Floras** have descriptions, keys, and illustrations of all or some of the plants of a particular area, for example, a nature reserve, country, or subcontinent, or any designated area.
- **Field guides** aim to give easily observable characters in the field, usually with short descriptions, and often illustrations, of the most common plants found in the area.

Identifying specimens

Identification should be done using keys and descriptions as a first step, followed by comparison with authenticated material. Matching, which is using comparison as a means of identification, is not ideal *when used on its own*, as it does not necessarily lead to correct identification. This may happen because:

- Specimens used for comparison have not necessarily been identified correctly.
- Different species may be morphologically similar.
- Sometimes characters separating species are not immediately obvious, but are highlighted in keys.
- You may be trying to identify a species not yet in the collection.

Equipment and materials

- Keys, descriptions, and glossary.
- Dissecting microscope or hand lens. A long-arm microscope allows you to examine mounted specimens. A black microscope stage is useful for identifications, especially for grasses.
- Dissecting needles, scissors, and forceps.
- Small and large rulers for measuring. For some groups such

as bryophytes and grasses, you will need a micro-measuring device, such as an ocular micrometer.

- Identification is made easier by restoring flowers and other plant parts to their approximate original form. This can be done by boiling the material in water until it is soft. An alter-



Different hand lenses.



Dissecting microscope used for plant identification.

P Try using a small black or white ceramic tile when working under the microscope—the tile is easy to move around and you won't damage the microscope stage with your dissecting tools.

native, quicker method is to soak the material in "Windolene" (a window cleaner), or an equivalent ammonia-containing liquid for a few minutes.

- Petri dish or glass slide for laying out reconstituted material.
- Small paintbrush for teasing out delicate flowers or brushing off scattered pollen when looking for glandular hairs on flowers.
- *Det.* and *conf.* labels.
- Archival ink pen.
- Gummed paper and envelopes for mounting dissected flowers.

TIP

When using a hand lens, move the object to be viewed, rather than the lens.

How to identify a specimen using a key

Keys are found mainly in floras, revisions, and monographs. It is useful to have a glossary handy when using a key. Generally, a key is an orderly arrangement of a series of contrasting or directly comparable statements, usually paired. Each pair, or couplet, offers contrasting possibilities in characters, called leads.

1. Read both leads of a couplet before making a choice about which one to follow.
2. Wherever possible, measure or observe several required structures before deciding.
3. If you cannot decide, for example, when the specimen does not show certain characters, follow both leads and check whether the next lead describes characters present in your specimen.
4. Eventually, you will reach a lead giving the taxon name. Now check herbarium specimens and descriptions of that taxon.
5. If the plant does not key out, try identifying by matching and reading species descriptions. If it is not possible to identify the specimen, it may possibly be a new record for that area, an unusual variation, a new species, or in a different genus. Some keys are old, and do not have all the known species of the genus.

When you have identified a specimen by means of a key and description only, without matching, you should add the words *e descr.* or *ex descr.* (*ex descriptione* = from the description) on the *Det.* label.

TIP

Make notes on the characters of the plant and the steps you have followed in the key, in case you have to start again.

TIP

Keep notes on diagnostic characters and distribution with Quick Guide specimens to make identification easier.

How to identify a specimen by matching

1. Consult the Quick Guide and select the species closest in both appearance and distribution to the unknown specimen.
2. Compare your specimen with material from the main collection. Take special note of other material from the same area. There may be a wider range of form in that species than is shown by the Quick Guide.
3. Read the description to ensure that it matches the unknown specimen.
4. Check that the distributions correspond.

Note: Matching specimens should *never* be the *only* procedure used to identify specimens.

Library and literature

Taxonomic literature is essential in a herbarium. It is used to

- Organise the herbarium collection
- Assimilate new species
- Facilitate name changes and taxonomic revisions
- Obtain keys and descriptions for identification

The herbarium staff should scan all new publications to keep informed about research concerning the flora of their region.

If books and journals are not locally available, affiliations can be arranged with inter-library network systems, such as the South African-based TISAB and SABINET, through which interlibrary loans can be requested. Interlibrary loans are subject to strict copyright legislation and are becoming increasingly expensive. Despite the cost, it is still more economical to link with an interlibrary network system than to subscribe to a wide range of taxonomic literature, as the cost of subscriptions escalates annually.

Most of the larger regional libraries, such as the NBI's Mary Gunn library and some university libraries are linked to regional or international search facilities. Should you not have access to search facilities, photocopies of essential reading material can be requested from these libraries.

Recommended herbarium literature

The two most essential literature references are a Flora of your area or nearby surrounding areas and a dictionary of botanical terms.

The following Floras and checklists are indispensable when working with plants from the southern African region:

- *Flora of southern Africa*
Includes South Africa, Swaziland, Lesotho, Namibia, and Botswana.
- *Flora of Tropical East Africa*
Includes countries such as Kenya, Uganda and Tanzania.
- *Flora of Tropical West Africa*
Countries such as Nigeria, Ivory Coast, etc.
- *Flora zambesiaca*
Includes Zambia, Zimbabwe, Malawi, Mozambique, and Botswana.
- GERMISHUIZEN, G. & MEYER, N.L. 2003. Plants of southern Africa: an annotated checklist. *Strelitzia* 14. National Botanical Institute, Pretoria.
Enumeration of species and subspecific taxa that occur in *Flora of southern Africa* region.
- LEISTNER, O.A. (ed.) 2000. Seed plants of southern Africa: families and genera. *Strelitzia* 10. National Botanical Institute, Pretoria.
Descriptions and keys for all families and genera that occur in the *Flora of southern Africa* region.
- LEISTNER, O.A. (ed.) 2004. Seed plants of south Tropical Africa: families and genera. *SABONET Report* No. 26. SABONET, Pretoria.
A supplement to Leistner (2000), this book provides keys and descriptions for all families and genera that occur in the southern African countries outside of the *Flora of southern Africa* region.

We also recommend the following publications:

- *AETFAT Index* (1953 to date). [Association pour l'étude

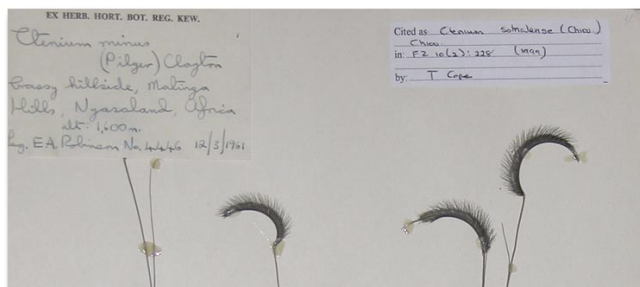
taxonomique de la flore d'Afrique tropicale]

Deals with tropical African names of flowering plants of all ranks.

- BRUMMITT, R.K. & POWELL, C.E. (eds) 1992. *Authors of plant names: a list of authors of scientific names of plants, with recommended standard forms of their names, including abbreviations*. Royal Botanic Gardens, Kew.
A comprehensive list of authors of plant names, with their accepted abbreviations and dates of birth and death.
- BRUMMITT, R.K. 1992. *Vascular plant families and genera*. Royal Botanic Gardens, Kew.
A listing of the genera of vascular plants of the world according to their families as recognised in the Kew Herbarium, with analysis of relationships of the flowering plant families according to eight systems of classification which are summarised. Compiled by R.K. Brummitt, in collaboration with the Kew Herbarium staff and with the assistance of botanists elsewhere. Gives accepted generic names and selected synonyms with their accepted families. Also lists the accepted genera in each family.
- FRODIN, D.G. 1984. *Guide to standard Floras of the world*. Cambridge University Press, Cambridge.
An annotated, geographically arranged systematic bibliography of the principal Floras, enumerations, checklists, and chorological atlases of different areas.
- HOLMGREN, P.K., HOLGREN, N.H. & BARLETT, L.C. 1990. *Index herbariorum*. International Association for Plant Taxonomy, New York Botanical Gardens, Bronx, New York.
Gives information of world herbaria and their staff and publications etc. Important for communication and arranging loans. Includes herbarium acronyms (for example, K = Kew), often found in taxonomic literature and on labels.
- *Index Kewensis* (1893 to date).
A comprehensive work with many supplements, lists all binomial and generic names of flowering plants from Linnaeus (1753) onwards, and all names at rank of family and below from 1971. Because it does not always follow current rules on nomenclature, it should be used as a guide only. A CD-ROM (1993) is also available.
- *Index muscorum* (1959 to date).
Includes all names of mosses with basionyms, synonyms, and references. Updated in the journal *Taxon*.
- GREUTER, W., MCNEILL, J., BARRIE, F.R., BURDET, H.-M., DEMOULIN, V., FILGUERAS, T.S., NICOLSON, D.H., SILVA, P.C., SKOG, J.E., TREHANE, P., TURLAND, N.J. & HAWKSWORTH, D.L. (eds) 2000. *International Code of Botanical Nomenclature* (Saint Louis Code). Koeltz Scientific Books. Königstein, Germany.
Rules and procedures for publishing new names.
- JACKSON, B.D. 1928. *A glossary of botanic terms*. 4th ed. Duckworth, London.
Very useful to find definitions of botanical terms used in keys and descriptions.
- *Kew Record of Taxonomic Literature* (1971 to date).
Regularly lists recent world literature on vascular plants.
- MABBERLEY, D.J. 1997. *The plant book 2nd ed.* Cambridge University Press.
A comprehensive small dictionary of flowering plants, conifers, and ferns.
- SMITH, G.F. & WILLIS, C.K. 1999. *Index herbariorum: southern African supplement*. 2nd edn. SABONET Report No. 8. SABONET, Pretoria.
A useful supplement to the international Index herbariorum; lists herbaria for the entire southern African region.
- STAFLEU, F.A. & COWAN, R.S. 1976–1988. *Taxonomic literature: a selective guide to botanical publications and collections with dates, commentaries, and types*. 2nd edn. Bohn, Scheltema & Holkema, Utrecht.
Gives much information on authors, their publications, location of herbaria and types, ranging from 1753 to 1939.
- STEARN, W.T. 1992. *Botanical Latin: history, grammar, syntax, terminology, and vocabulary*. 4th ed. David & Charles, Newton Abbot, Devon.
A dictionary of Latin with many drawings illustrating the terms.
- WILLIS, J.C. 1985. *A dictionary of the flowering plants and ferns*. 8th edn. Cambridge University Press, Cambridge.
Gives names, authors, number of species, and geographical range of vascular plant genera. Also has descriptions and internal classification for family names.

Incorporating new research

It is important to keep the herbarium up to date with current research. Incorporating a revision means reorganising the specimens, files, and filing system according to the most recent publication. Assess all publications and determine whether they are acceptable, given the knowledge you may have of the group. If, on the other hand, you are not able to evaluate a revision effectively and publish a more acceptable account, it is best to incorporate the publication and accept the authority of the author. ▲



A specimen showing “Cited as...” label; it includes the plant name, publication reference, author, and date of publication.

How to evaluate taxonomic revisions

The ability to evaluate a revision depends largely on experience with, and knowledge of the taxa concerned. The assessment of a revision should include the following steps:

1. Determine whether the author studied ample material from African herbaria, especially from your own collection.
2. If the author took loans from your herbarium, study all the specimens cited and identified by the author in order to form an idea of the species concept.
3. Evaluate the key by using it to identify cited material.
4. Examine the taxonomic limits of the taxa: are they clearly delimited from each other, or do they overlap? (For example, “leaves 5–10 cm” is not clearly delimited from “leaves 7–15 cm”).
5. Keep in mind that the author may be a “lumper” or a “splitter”. A “lumper” sets rather wide margins for the taxa, hence joining several together as one. On the other hand, the “splitter” allows very small differences between taxa, thus retaining many species as distinct. (You will have your own idea of how much difference is “enough” between species. It may not coincide with the author’s.)
6. Consult other herbaria as to their acceptance or rejection of the paper.
7. If the curator of a plant group does not accept a revision, they should write detailed notes justifying the decision. File the notes with the taxon.

TIP

To become acquainted with the newly revised genus, take cited material and work “backwards” through the key. This will enable you to become familiar with the terminology of the important character states.

How to incorporate a taxonomic revision

Once you have accepted a publication for incorporation, you can start reorganising the specimens and files in the herbarium.

1. Search the collection for cited material, looking at the existing species, *spp.*, and *aff.* species covers. Don’t forget the Quick Guide.
2. Give such specimens each a *Cited as* label; include the plant name, publication reference, author, and date of publication. Duplicate material not actually seen by the author is labelled *e num.* or *ex num.* (*ex numero* = from the number).
3. Search the collection for type specimens, both for accepted taxa and for synonyms. Place them in type covers.
4. In the publication, a reprint or photocopies, mark the collector’s name and number, thereby indicating that you have that specimen in your collection.
5. Where necessary, change filing numbers on specimens according to the new arrangement.
6. Re-identify all specimens not cited by the author.
7. Where formerly accepted taxa have been placed into synonymy, change the name on all the genus and species covers.
8. Re-file the specimens, rearranging the order of the files according to the publication.
9. Mount the publication on a mounting board and file this in a species cover marked *Notes* or *Literature* at the beginning of the genus or species concerned.
10. Update the cupboard list.
11. Update the computerised (specimen and taxonomic) databases.
12. Update the Quick Guide using authenticated specimens where possible.