
The General History of Repository of Plant Specimens

Harpreet Kaur, Hardeep Kaur

*Post Graduate Department of Botany, Dev Samaj College for Women, Ferozpur-
152002, Punjab, India*

Abstract

A herbarium (plural: herbaria) is a collection of plant specimens, which are dried, pressed, preserved on sheets, identified and arranged systematically, by family, genus and species, according to some approved system of classification for future reference and study by professionals and amateurs from many walks of life. The herbaria present a picture of the plant world through the representative specimens. It is of enormous practical use and a vital reference when one needs to identify a plant. The previous traditions of making herbarium collection or Hortus sicci have been found in Italy. Luca Ghini and his students were the first botanists who created herbaria around 1532. The idea of maintaining herbarium sheets and bound them into books to preserve them into cabinets was given by Carolous Linnaeus. There are about 3990 recognized herbaria in the world. In India there are 67 recognized herbaria. Herbarium of Royal Botanical Garden, Kew is the world's greatest herbarium. The Index Herbariorum is a global directory of herbaria published periodically by the International Association for Plant Taxonomy, became available on-line in 1997. Each herbarium in Index Herbariorum is assigned an official acronym (code) that is used as a standard for referring to the institution and its specimens.

Keywords: Data, Digitalization, Herbarium, Herbarium sheets, Plant, Taxonomy

The history of Herbarium

Herbarium is a collection of dried plant specimens arranged according to some accepted system of classification. It is an important source of data used by researchers in many plant related sciences and is most often used for taxonomic research. (Bridson and foreman, 1998). Herbaria are centres where plant taxa are studied which includes identification, nomenclature, classification, distribution and use. The Latin term "herba", which originally, means for grass/pasture was derived from Greek (forbh) which in turn appears to have been derived from Sanskrit root "bhar" (pasture/forage) (Lewis and Short, 1879). The word herbarium in its original sense referred to a book about medicinal plants. Joseph Pitton de Tournefort in about 1700 first used the term "Herbarium" to describe a collection of dried plants (Stearn, 1957). There are about 3,990 recognized herbaria in the world. In India there are 67 recognized herbaria. (www.bsienviis.nic.in/database/catalogue/Indian/herbaria-20496.aspx?format=print). The most primitive herbaria most likely were "physic gardens" where physician grow medicinal plants. These gardens were their pharmacies which provided plants for reference and for educating future physicians. Luca Ghini (1490-1556), a professor of botany at the University of Bologna, Italy, is thought to have been the first person to dry plant under pressure and mount them on the paper to serve as a lasting record (Sprague and Nelmes, 1931). The oldest preserved herbarium specimen which still exists in

Florence, Italy, was collected by the naturalist Gherard Cibo, a student of Luca ghini in 1532 in the University of Padua, Italy along with the establishment of the first botanical garden in the same year (Arber, 1938). It was Linnaeus who started mounting his specimen on a single sheet of paper and storing them horizontally instead of binding the mounted specimens into volumes (Dewolf 1968; Muller-wille, 2006; Stearn, 1957). In spite of the efforts of Linnaeus and his immediate successors, the binding of the herbarium sheets into volumes continued as late as 1830 when Asa Gray sold her many bound volumes of grass and sedge herbarium specimens (Dewolf, 1968). By the end of 18th century workers started depositing their specimens in established collections as well as exchanging them. This practice helped in saving some collections as many herbaria were destroyed by fire, insects, war and ignorance (Stockey, 1971). In US several herbaria existed in the mid 1700 of which many were brought to Europe. During the first 400 years of existence herbaria grew from personal collection to small local or regional collections to large institutions of national and international significance (Jones and Meadows, 1948; Stuckey, 1971). The functions of a herbarium is to store of reference material which requires adequate arrangements for preservation of specimens and a simple form of indexing (such as alphabetical) that enable them to be retrieved quickly (Mondal, 2005). Herbarium specimens as a means of identification, by matching unnamed plants with named specimens in the collections. The specimens must therefore be arranged in a way that bears some relation to their overall similarities. Herbarium sheets used as an arbiter of correct names (Johnson, 1991). Printed floras soon become out of date and it is upto the herbarium to maintain nomenclature standards (Allen, 1993). This entails keeping the names in line with current revisionary work, maintaining type collections and organizing exchanges of specimens with other institutes (Funk, 2002). Herbarium itself acts as comprehensive data bank. Its collections fully represent the diversity and distribution of the region and vegetation (Schmul *et al.* 2005). Most comparative studies for taxonomic purposes are made in the herbarium and laboratory. The newly collected specimens are identified by comparison of their morphology with the morphology of plants already preserved in herbarium. Some succulent plants lose their diagnostic features when dried and preserved so these are stored in some liquid medium such as 4% formaline solution or F. A. A. (5 parts formaline, 5 parts glacial acetic acid and 90 parts of 70% ethyl alcohol). For the preparation of herbarium specimens, the plants with flowering stage are selected and information about the locality, date of collection etc. are noted. The next step is pressing of plant in 'V' or 'N' shapes in between sheets of blotting paper. The blotting papers with plant specimens placed in field press for about 24 to 48 hours. The blotting paper was changed in alternative days. Poisoning of the specimen is done immediately after collection or after drying so as to free the specimens from different kinds of pathogens and preserve for longer periods. Some of the chemicals used for poisoning the specimens include mercuric chloride, lauryl pentachlorophenate (LPCP), formaline, methylbromide, carbon disulphide, carbon tetrachloride, paradichlorobenzene (PDB) etc. After drying and poisoning, the specimen mounted on herbarium sheets of standard size 11.5" x 16.5". These sheets are made up of heavy and good quality paper. After mounting the specimens on herbarium sheets, a label of standard size 4" x 2.5" is pasted on the lower right-hand corner of the herbarium sheet (Subramanyam, 2004). The basic element in a herbarium is the plant specimen with its label. Both the specimen and its

label are equally important. The care with which the specimen is collected and pressed gives essential clues to its morphology; the extent to which the label documents and describes features of the plant & its habitat, the exact collection locality, the name of collector, date of collection and the correct identification, ultimately determines a specimens' scientific value (Johnson, 1991). Herbarium is a most valued gold mine of information and foundation of comparative biology. Different Herbaria are used for teaching, research work and preservation of specimens (Type specimens) (Funk, 2002).

General or international herbaria- these are very large herbaria provides a global representation of a comprehensive range of taxa. These are very rich in type and other historical specimen. There is production of generic monographs checklist major floras (covering several countries) national and local floras.

National (or regional) herbaria- geographically these cover the country concerned and neighbouring or phytogeographically similar areas. These floras aids in assessment of threatened plants. Type material is often well represented especially among the more recently described taxa.

Local herbaria- These deal with a region within a country such as state, country or district or even a much smaller area such as game park or nature reserve. These contain few type specimens.

Special herbaria- There are several type of special herbaria depending on function:

Historical herbaria: These may be kept as a separate herbaria within a general herbarium (e.g Wallich herbarium at Kew or De Candolle herbarium at Geneva) or belong to separate institution (e.g or universities, museums or monasteries). These are usually arranged in their original sequence Linnean society and hence restriction governing consultation and loan.

Herbaria of limited scope: These are limited taxonomically (e.g cryptogamic herbaria) or ecologically (e.g. forest herbaria). These are often separately housed within general herbaria or other institutions such as university or museums.

Teaching herbaria: These are housed in university with more modest herbaria in college and schools. Teaching herbaria should contain specimens to illustrate morphological structures, the type of plants representative of community encountered in field studies.

Herbarium of Royal Botanical Garden, Kew is the world's greatest. It has a central role for research on plant and mycological biodiversity on earth, with 7 million specimens, including approximately 350,000 type specimens (<http://www.kew.org/collections/herbcol.html>). During the last over four hundred years a large number of herbaria have been established in all parts of the world. As of today there are nearly 4000 herbaria existing in the world (<http://sciweb.nybg.org/science2/IndexHerbariorum.asp>). Tables 1 and 2 list some important herbaria of India and the world respectively.

Table 1. Some important herbaria of India

S. No.	Name of Herbarium	Year of establishment
1.	Herbarium of Indian botanical Garden, Calcutta	1793
2.	Herbarium of Forest Research Institute, Dehradun	1874
3.	Herbarium of Agriculture College and Research Institute, Combatore	1874
4.	Herbarium at Botanical Survey of India,, Industrial section, Calcutta	1887
5.	Blatter herbarium, St. Xaviers College, Fort, Bombay	1906
6.	Herbarium at National Botanical Garden herbarium, Lucknow	1948
7.	Herbarium at Botanical Survey of India, Central Circle, Allahabad	1955
8.	Herbarium at Botanical Survey of India, Eastern Circle, Shillong	1956
9.	Herbarium at Botanical Survey of India, Western Circle, Poona	1956
10.	Herbarium at Botanical Survey of India, Northern Circle, Dehradun	1956

Table 2. Some important herbaria of the World.

S. No.	Name of Herbarium	Year of establishment
1.	Museum National Historie Naturelle Laboratoire de Phanerogamie, Paris, france	1635
2.	Vienna Botanischer Garten, Vienna, United States	1748
3.	Herbarium of Royal Botanical Gardens, Edinburgh, England	1761
4.	Herbarium at New York Botanical Garden New York, United States	1801
5.	Gray Herbarium, Cambridge, United States	1807
6.	Herbarium at Havard University, Philadelphia Academy of Sciences, Philadelphia, United States	1812
7.	Conservatorie et gordin Botaniques, Geneva, Switzerland	1817
8.	Herbarium at V. I. Komorov Botanical Institute, Leningrad, Russia	1823
9.	Herbarium at Zurich Botanischer Gaertn, Zurich, Germany	1834
10.	Herbarium of Royal Botanical Gardens, Kew, Great Britain	1853
11.	National Herbarium, Melbourne, Australia	1857
12.	Herbarium at Missouri Botanic Garden, St. Louis, United States	1859
13.	Herbarium at U. S. National Museum, U. S. Smithsonian Institute, Washington, United States	1868
14.	Herbarium at Arnold Arboretum, Boston, United States.	1872
15.	Herbarium at National History Museum, Chicago, Austria	1893
16.	Herbarium at Garden College, Rawalpindi, Pakistan	1893

Digital herbaria

In this era of globalization of information, the need to make the information on biodiversity globally available by digitalization is also being recognized worldwide. Globalization of information is possible by digitalization of different kinds of information. Digitalization is the process of converting any type of data to digital format for processing by computer. Essentially it changes data from one format (analog) into another format (digital). Among different kinds of globally distributed information on biodiversity, importance of digitalization of different herbaria in the world is strongly felt in recent years. This ever growing storage issue has prompted several herbarium institutions to digitize their collections and create online database systems called Virtual Herbaria. The term "Virtual

Herbarium" refers to a herbarium which has its entire collection in digital, indexed form integrated with other digital resources such as world wide web, online biodiversity databases and search engines (Guala, 2000). This system, though not new in concept but new in implication, has the potential to reduce floors of specimen collections to a room of database servers. Digitalization of herbarium is necessary to meet the needs fulfilled by notes on labels, to make such information easily accessible, to save the actual specimens from avoidable handling, for easy record keeping, reducing cost & time and for communication and comprehensive work. Digitalized assets change the way we perceive our planet (Schmull *et al.*, 2005). Digitalization includes collection of data and creation of databases. Database is a collection of related data stored in one or more computerized files in a manner that can be accessed by users or computer programs via Data Base Management System. The sustainable use and management of biodiversity will require creation of well-structured and user friendly databases. A database is also an important resource for conservation & management programs (Greene, 1972). The components of a database system are Data, Hardware, Software and Users. A number of activities have been started at various places around the world to set up biodiversity databases. A world catalog of public herbaria, Index Herbariorum, is published periodically by the International Association for Plant Taxonomy and is available at:

<http://sciweb.nybg.org/science2/IndexHerbariorum.asp>. Each herbarium in Index Herbariorum is assigned an official acronym (code) that is used as a standard for referring to the institution and its specimens. Some digital/ virtual herbaria of the world are Botanical Research Institute of Texas (BRIT) Virtual Herbarium, Australia's Virtual Herbarium (AVH), United States Virtual Herbarium (USVH), Louisiana State University Virtual Herbarium (LSU), The George Safford Torrey Herbarium (CONN)/ University of connecticut virtual herbarium/ CONN Virtual Herbarium, The C. V. Starr Virtual Herbarium, vPlants: A Virtual Herbarium of the Chicago Region, Seagrass-Watch's Virtual Herbarium, MBLWHOI Library Digital Herbarium, Harvard University Herbaria (A, ECON, GH), University of British Columbia.

Herbarium (UBC), Oregon State University Herbarium (OSU), Missouri Botanical Garden's Herbarium (MBG). Objectives of a database include improved accuracy and consistency, sharing data among all users, eliminating redundancy, simplifying the use of data files, incorporating changes easily & quickly, providing data security from an unauthorized use. Numerous efforts are also going on in India to develop databases. National Botanical Research Institute (NBRI) is the first organization in India who took initiative and leadership in South Asia to document the biodiversity by developing database (www.nbri-lko.org). Digital herbaria or the virtual herbaria are the herbaria in a database form containing all the information of plants including photographs of all plant specimens housed in a herbarium in an electronic form.

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