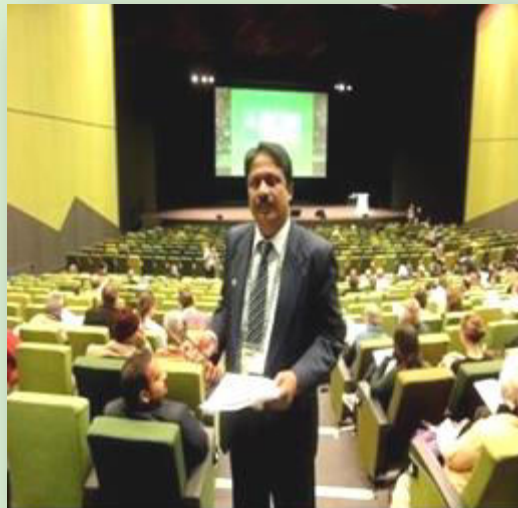




VIDYASAGAR UNIVERSITY

Lecture for 4th Semester Special Paper
(BOT -403 A) : Molecular Systematics

6. Herbarium: *Digital Herbarium: Concept & application*



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Vidyasagar University

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6. Digital Herbarium: Concept & application

What Is a Herbarium?

It's not uncommon for someone to take a flower and press it between the pages of a book in order to preserve it. The paper absorbs the water in the flower and pressing prevents the petals from curling up as they dry.

It was Luca Ghini who initiated the art of herbarium making by pressing and sewing specimens on sheets of paper.

This art was disseminated throughout Europe by his students who mounted sheets and bound them into books



OBJECTIVES OF HERBARIUM

- ❑ To provide facilities for determination of any material including new taxa.
- ❑ To enable preparation of new monographs and floras.
- ❑ To preserve specimens of historic importance.
- ❑ To assemble data for working out ranges and ecological distribution.
- ❑ To bring together in a relatively permanent form of specimens for comparative morphological or phylogenetic studies and
- ❑ To provide material for specific research as in plant anatomy, palynology and ethnobotany and also for molecular research.

HERBARIUM SHEET

- ❑ The general size of the mounting board or herbarium sheet is 42 x 28 cm.
- ❑ The label with the size of 12 x 8 cm is generally pasted on the bottom right hand corner of the mounting board.
- ❑ The specimen is pasted as far as possible in the middle, field number at middle of left margin and accession number and/or barcode at right top of the herbarium sheet.



❑ Herbaria are collections of preserved plants specimens, some of which date back to the 16th century.

❑ They are essential to botanical research, especially in systematics. They can also be important historical documents.

❑ Once dried, the flower will last indefinitely because the lack of water inhibits bacteria and fungi from causing deterioration.

❑ This practice is similar to that used in preparing herbarium specimens which are pressed and then mounted on acid-free paper, most often with glue or linen tape, utilizing more sophisticated equipment.

❑ Some specimens cannot be preserved in this way.

❑ For example, Fruits, may have to be stored in alcohol and large nuts in boxes; they simply cannot be flattened between two pieces of paper.

❑ However, all specimens must be carefully labelled as to species, date and place of collection, and name of collector.

The great taxonomist Carolus Linnaeus saw four qualities as particularly significant:

- I. The form of the elements of the organism, the quantity of the elements, the manner in which they are distributed in space relative to each other, and the relative magnitude of the elements.
- II. For a plant, all these are usually present on a herbarium sheet.
- III. It might be argued that a clear photograph of a plant would be an excellent substitute for a herbarium sheet and actually provide more information, such as that on position of elements in space and color, particularly for the flower which is usually the part of a plant that varies the most in

IV. Indeed, photographs are very useful in plant identification guides. However, photographs often misrepresent scale, may not display all of a plant's identifying features, and obviously aren't sources for chemical or microscopic analysis.

➤ **Collecting specimens is a major part of what biologists have done in the past and what they do today.**

➤ **Amassing plant and animal specimens is key to taxonomic and anatomical work, and collecting gene sequences obtained from specimens is central to present-day biological inquiry.**

❑ Though in many ways these two approaches are different ways of doing biology, it's becoming more common for both sequence data and organism specimen data to be stored electronically and accessed via the Internet which allows for interesting comparative work that would have been difficult, if not impossible, in the past.

❑ Having data accessible online means that it's available not only to researchers but to students as well.

Many resources are available for dealing with gene sequence data; however, the focus here is on herbaria, collections of preserved plant specimens, which were first created in the 16th century, often became neglected in the 20th century, and are experiencing a resurgence, in part because of efforts to digitize these collections.

After describing what herbaria are and how they are used, this paper will explore how herbaria, both real and virtual, can play an important role in teaching about biology and its history.

Changing Perspectives

- ❑ By the end of the nineteenth century, the great age of exploration was coming to an end.
- ❑ While there were still many plant species yet to be discovered and many collectors still at work, biology began to move away from taxonomic work as its center to experimental research in cell biology and physiology.
- ❑ Now many of these herbarium specimens are being scanned and the images are freely available on the Web.

❑ Daniel Crawford (2001) argues that with the eventual shift to DNA work, there was less fieldwork and population sampling, and therefore fewer herbarium specimens were created.

❑ However, there is now a renewed interest in herbarium collections for a variety of reasons.

- ❑ **1st Ecologists are coming to appreciate herbaria as essential archives for documenting biodiversity;**
- ❑ **The only way to know how many species there are and where they can be found is with reliable records such as those in herbaria and other natural history collections.**

Secondly, herbaria are vital for documenting environmental change.

For example, flowering plants are usually collected when they are in bloom because flowers are **key to identification.**

If a specimen in flower is collected from a locale in April, and a herbarium specimen of the same species, also in flower and from the same area, was collected 100 years ago in May, then this could represent one more piece of evidence for climate change.

Thirdly, entomologists have used herbarium specimens to discover when a particular beetle species first invaded an area:

Specimens collected before a certain date contain none of the anti-beetle chemicals present in later ones.

Recently, herbaria are also receiving attention from molecular biologists:

❑ *Many plant specimens harbor intact DNA that can be used in genetic studies.*

❑ *Even 200-year-old sheets have yielded DNA which could be sequenced.*

❑ In addition, in herbaria today, researchers are systematically preserving plant samples for use in sequencing: fresh material is dried in silica gel and then stored at low temperature.

❑ This is one more kind of plant specimen found in herbarium collections along with boxes of pinecones and jars of alcohol with fruits or flowers floating in them.

There may also be a seed bank where seeds are stored for future germination as a way to preserve the genetic diversity of species.

If possible, all these specimen types should remain together in part because the different kinds of collections mentioned at the start of the article specimens and sequencing data are like reference libraries where researchers come to consult plant material instead of books.

Digitization

- ❑ Just as libraries have been at the forefront of digitizing information about their books and the books themselves, the same thing is true of herbaria;
- ❑ Both types of institution are dealing principally with two-dimensional material, which makes creating digital images relatively easy.
- ❑ This is a massive undertaking and data on labels are more often digitized than images of specimens.

On an international scale, the Global Biodiversity Information Facility (GBIF) has created a portal where almost 400 million records about species of all kinds are available electronically.

However, there is a threat to herbaria that underlies such massive digitization efforts.

As early as 1990, it was suggested that once a herbarium sheet had been imaged and its information digitized, the sheet was no longer needed; it would only be necessary to retain type specimens.

- ❑ Databases are amazing resources not just for botanists, but for teachers and students as well.
- ❑ They can serve as virtual museums of plants and as libraries of information about plants.
- ❑ Because of their fragility and value, herbarium collections are closely guarded, with access sometimes limited to researchers in the field.
- ❑ This is a major reason why collections are being digitized so the sheets and the information on them can be accessed without damage to the originals. There are also other accessibility issues.

Teaching with Digital Herbaria

- **There are many different ways to incorporate digital herbaria into biology classes.**
- **For ecology courses, digital herbaria are useful in investigating biodiversity, environmental change, and phenology.**
- **LifeMapper (2013) is a website which provides geo-referencing data for many species worldwide. As with most of these global sites, some of the information is sketchy, but that in itself is a good lesson for students that ecology, biodiversity studies, and biodiversity informatics are all developing enterprises.**

- ❖ As an exercise, students can collect plants, identify them, create specimen sheets, and geo-reference them using Google Earth (2013).
- ❖ They can then compare their specimens with online examples of the same species.
- ❖ There are also two national digital projects, examples of Citizen Science, in which they can participate.
- ❖ Collecting plants in the field and identifying them are ways of developing this skill, as are exercises in comparing specimens of the same species collected at different times or in different locations.

- Large digitized plant collections available to students include those at the Smithsonian Institution (2013), New York Botanical Garden (2003), Royal Botanic Gardens, Kew (2013), and the Muséum National d'Histoire Naturelle (2013).
- Most digitized specimens are of high quality and can be magnified, so students can inspect texture and fine structures.
- It is also valuable for them to compare specimens with photographs of the same plant, and with illustrations.

❖ Each approach has advantages and disadvantages in communicating information about a plant;

❖ It's useful for students to investigate these differences and describe them.

❖ And as an ultimate exercise in visual literacy, they could draw plants from life and from herbarium specimens.

ACRONYM

❑ An acronym (from Greek *acro-* in the sense of extreme or tip and *onyma* or name) in a strict sense is an abbreviation of several words in such a way that the abbreviation itself forms a pronounceable word.

❑ But for herbarium, the acronym is an abbreviated form to denote a particular herbarium and it is assigned by the Index Herbariorum (IH), in which each institution is assigned a permanent unique identifier in the form of a one to eight letter code, a practice that dates from the founding of IH in 1935.

❑ For example, Central National Herbarium, (Calcutta) Howrah – CAL, Madras Herbarium, Coimbatore – MH, Royal Botanic Gardens, Kew – K, Natural History Museum, London – BM.

TYPES OF HERBARIA

Herbarium ranges from small personal collections, mostly of a few hundred specimens to large collections of colleges, universities, private foundations and government agencies. There are different types of herbaria and they are being used for various activities and generally the following types of herbaria are categorised.

- International herbaria (e.g. Royal Botanic Gardens, Kew)
- National herbaria (e.g. Central National Herbarium, Howrah)
- Regional herbaria (e.g. Andaman and Nicobar Regional Centre, BSI, Port Blair)
- University herbaria (e.g. Calcutta University Herbarium, Kolkata)
- Medicinal plant herbaria (e.g. Central Institute of Medicinal and Aromatic Plants, Lucknow)
- Economically important plant herbaria (e.g. Industrial section Indian Museum, Kolkata)
- Local herbaria (e.g. Malabar Botanical Herbarium, Calicut)
- Agricultural herbaria (e.g. Tamil Nadu Agricultural University Herbarium, Coimbatore)

Role of Herbarium

- To act as a repository of dried plant specimens, safeguard them against loss & destruction by Fungi, Insects, etc. and make available for study and Research.
- Several herbaria of repute, keep Type Specimens the principal proof of the existence of a species, in safe custody, often in rooms with restricted access.
- As original documents upon which knowledge of taxonomic characters rests, herbarium specimens greatly help in developing floras, manuals and Monographs.

➤ Those engaged in taxonomic studies, can personally identify their engaged collection by comparison with already identified herbarium specimens.

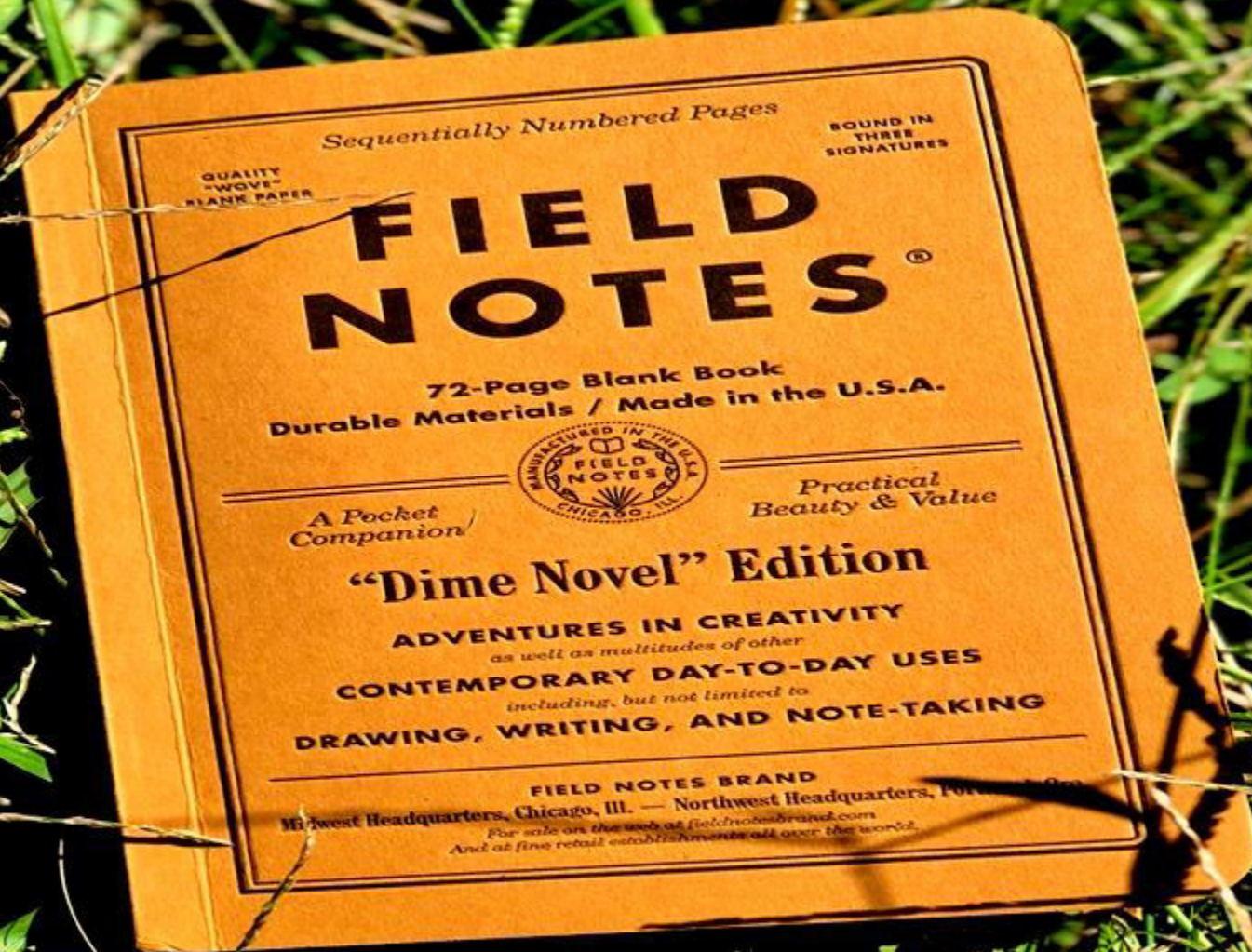
➤ Voucher specimens preserved in various herbaria, provide an index of specimens on which studies on chromosomes, photochemistry, ultra-structure micro-morphology, etc. have been undertaken

➤ Most herbaria have specimens collected from different parts of the world herbaria and thus their scrutiny can provide information on the geographical distribution of taxa.

FIELD NOTE BOOK (FIELD DIARY)

While preparing herbarium specimens close attention should be given to recording all necessary data concerned with the plants, which may not be present or detected after drying. The following points to be noted during plant collection in field notebook:

1. *Colouration of foliage and floral parts.*
2. *Corolla venation.*
3. *Anther colouration before and after dehiscence.*
4. *Viscosity of parts.*
5. *Pollinating agencies.*
6. *Texture of foliage and perianth parts.*
7. *Colour and nature of fleshy matured fruit.*
8. *Habitat.*
9. *Exact location; use proximate object near the site.*
10. *Waxed pattern of shoot and root system.*
11. *Insecticides and repellents.*
12. *Branching pattern of shoot and root system.*
13. *Type of soil, moisture content, slope and light conditions.*



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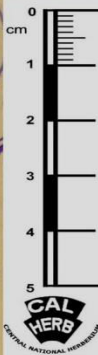
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Handwritten notes below the three illustrations on the right page.

A “**voucher specimen**” is an animal or plant specimen, or a part thereof, that serves as a basis of study and is retained as a reference. The number allotted to such specimen is called voucher number. This number can be used to access the “voucher specimen”

An “**Accession number**” is the number allotted to any specimen (not necessarily a voucher specimen) by an Institution in order to access it for future studies.



TYPE

Friday, April 10, 2020

Acknowledgement:

I would like to thank our *Honourable Vice Chancellor* **Professor Ranjan Chakaraborti** for giving me the opportunity to contribute in E-learning process which will be very much helpful for our students during unprecedented situation due to **CORONA Virus (COVID-19)**.

We shall overcome!!!!!!!

#SAVE FROM CORONA

Stay Home

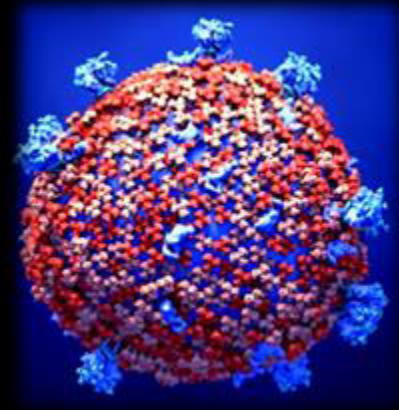
Save your Life

Save your Family

Save your Society

Save your Country

Save your beautiful Planet





Thank you

4/10/2020