

**ATTACHMENT REPORT AT THE NATIONAL
MUSEUMS OF KENYA**

**BOTANY DEPARTMENT
EAST AFRICAN HERBARIUM
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BY

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ABBREVIATIONS

E. A.	East Africa
N.M.K	National Museums of Kenya
F.T.E.A.	Flora of Tropical East Africa
E. A.H.	East Africa Herbarium
G.P.S	Global Positioning System
BRAHMS	Botanical Research and Herbarium Management System

ABSTRACT

A comprehensive report of a successful three months attachment at the National Museums of Kenya, Botany Department is given in this report. The main aim of undertaking this attachment was to attain experience in Herbarium techniques especially in the area of taxonomy.

The report contains information on the role of a herbarium in taxonomy, types of herbarium, and arrangement of herbarium specimens. Processing of herbarium specimens at different stages is also discussed i.e collection, pressing, drying, freezing, mounting, data-basing, sorting to various families, genera, and species, freezing, laying in herbarium cupboards, and post processing. In the Botanical garden, knowledge was also gained on the geographical distribution and uses of plants (especially medicinal ones). Field techniques of plant collection, and identification are emphasized in this report. For instance, during collection of plant specimens, if they are rare or critically endangered, one should make a modest collection of viable propagules accompanied by photographs.

Field techniques and identification of plant specimens are also discussed in the report. Emphasis is put on factors to consider such as having a good collection, e.g. the specimen must be fertile and have good data recorded (field notes). In addition voucher specimens should have accession number with one sequence of numbers. This could be by allotting numbers to existing plants in the collection and continue for later acquisitions.

CHAPTER 1

1.0 INTRODUCTION

National Museums of Kenya (NMK) was established in 1910. It is located along Museum hill road in Nairobi. It has grown to a Centre of excellence both locally and internationally since its establishment. As the custodian of the country's natural and cultural heritage, NMK has the responsibility to manage Kenya's numerous sites and monuments alongside the cultural heritage. The principle mission of NMK is to preserve Natural heritage for the benefit of Kenya and the world at large. It also displays Kenya's collections, which include mammals, birds, reptiles, insects and material cultures of Kenyan people among others.

1.1 DEPARTMENTS WITHIN NMK: -

- Archeology
- Centre for biodiversity
- Ethnography
- Paleontology
- Ornithology
- Molecular genetics
- Mammalogy
- Osteology
- Herbarium

1.2 GENERAL USES OF A HERBARIUM

ECONOMIC BOTANY

- Concerned with recording the uses and value of plants.
- Much economic information can be taken from data labels, while the specimens can provide valuable morphological data & phenological data.
- Voucher specimens are deposited in herbaria.

ECOLOGY

- Ecologists rely on herbaria for identification of plants making up the vegetation they are studying.
- Ecological data includes vegetation type, soils, topographic features, and successional status.

CONSERVATION

- Herbarium provides data on the pattern of distribution for each species with regard to range and possible rarity.
- Herbarium holds data on essential starting point for conservation action via checklist of threatened plants.

1.3 DEFINATION OF A HERBARIUM

- The word Herbarium in its original sense referred to a book about medicinal plants.
- Luca Ghini (C. 1490-1556) dried plants under pressure and mounted them on paper to serve as a lasting record.
- Tournefort (C. 1700) used the term for a collection of dried plants, a usage popularized by Linnaeus.

1.3.1 GENERAL PURPOSE OF A HERBARIUM

- A storage of reference material
- A means of identification
- An arbiter of correct names
- A comprehensive data bank.

1.3.2 ARRANGEMENT OF HERBARIUM SPECIMENS

- Alphabetic arrangement: -
Families are arranged alphabetically, also genera and species.

- **Systematic arrangement: -**

Families are arranged according to several phylogenetic systems, which place closely related families together. Similar families are placed close to one another. i.e. (arrangement is from family to genus down to species up to infraspecific rank.)

1.4 EAST AFRICAN HERBARIUM (EAH)

E.A.H. Nairobi is one of the largest and oldest tropical herbaria in Africa. The Germans established it in 1902 as part of the Biological research institute at Amani in the Usambara Mountain. It was then later transferred to Kenya as a constituent of the Kenya Agricultural Research Institute (KARI). In the year 1982, it was further transferred to the National Museums of Kenya (NMK) up to date. E.A.H. is used for writing the Flora of Tropical East Africa (F.T.E.A), checklists etc. The herbarium currently holds about 1 million specimens mostly of vascular plants with a few biological collections. E.A.H is the 2nd largest in Africa, and its mission is to collect, preserve, document, and research and disseminate botanical information in Kenya and East Africa Region.

E.A.H is arranged systematically (Bentham and Hooker System) into 4 wings namely:

(i) **Wing A: -**

It comprises of lower plants (i.e. Algae, fungi, lichens, bryophytes and pteridophytes).

It also consists of family Number (No.) 1-130.

Family number 1 is Magnoliaceae, and family number 130 is Sterculiaceae.

(ii) **Wing B: -**

Contains of dicotyledonous plants listed from Number. 131- 196.

Family number 131 is Bombaceae, and 196 is Burseraceae.

(iii) **Wing C: -**

Dicotyledonous from number 197-264.

Family number 197 is Meliaceae, while 264 is Labiatae/Lamiaceae

(iv) **Wing D:** -

(v) Consists of monocotyledons e.g. Graminae, cyperaceae etc.

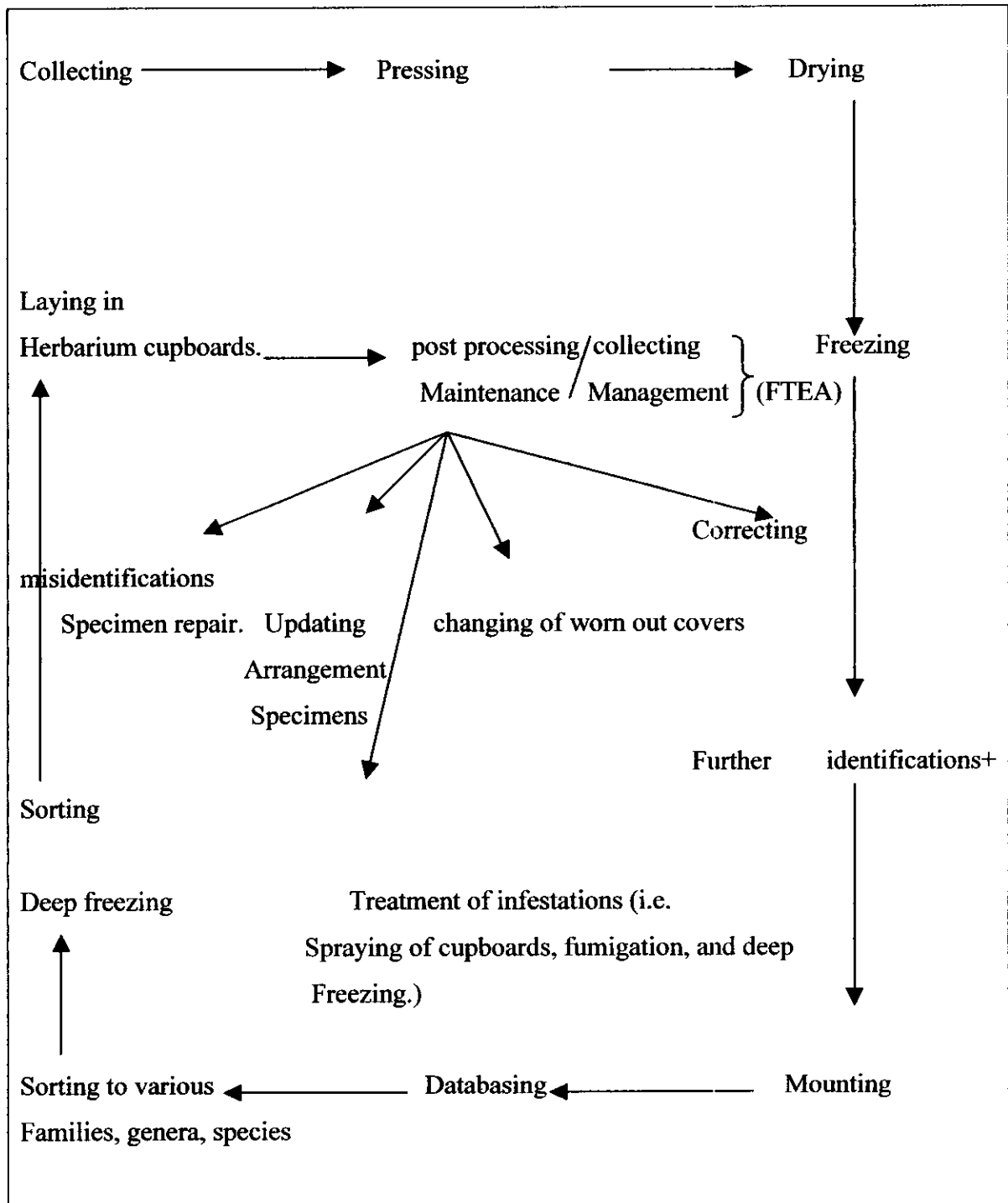
Listed from family number 369-469

Family number 369 is Discoraceae, while 469 is Pandanaceae.

NOTE:

Orchids family no.416 are also found in Wing C. i.e. Orchidaceae

1.4.1 A FLOWCHART SHOWING SPECIMENS PROCESSING IN THE HERBARIUM



1.5.1.1 TYPES OF PLANT COLLECTIONS

- Carpological collection
- Spirit collection
- Illustration and photos
- Fleshy flowers
- Dry specimen collection

There are other collections that may not be kept in a herbarium due to certain reason like security this are:

- a) Historical collection
- b) Type specimen

Carpological Collections

This is the collection of certain parts of a plant for further investigation about it in various ways, like in identification and uses or its usefulness (Ethnobotany). i.e. seeds, barks of trees etc.

Spirit Collection

This contains plants specimen, preserved in fluid and stored in glass jars. Much of the materials consist of fleshy flowers and fruits that do not make good dried pressed specimen. In particular the 3-dimensional arrangements of flower-parts are better observed in spirit specimen. The spirit used in the storage of specimen may be as follows: industrial menthylated spirit, water, formaldehyde solution and glycerol. Formaldehyde acts as a fixative: this is to retain the specimen's colour and shape as it appears on the ground, alcohol as preservative while glycerol helps prevent the specimen from becoming brittle. The collection should be stored in a control temp. Room, at 12-16°C.

Illustration Collection

This is a collection of specimen, which has been photographed or has been drawn by an artist. This collection is very useful for specimen that has lost it original appearance from the field in terms of colour or shape.

- B) Species naming updates using F.T.E.A, Kew Bulletin & others journals.

1.5.2 PRESSING

Definition of a plant press:

A plant press is a tool that has overlaying plant specimens in blotting sheets or newspapers where plants are placed inside to dry up when they are flattened up and placed between two boards secured with straps. This also prevents the plant from being infested by insects and other microorganisms.

Note:

Drying and pressing them in folds of absorbent paper prepare specimens. A simple method is to place each freshly collected plant in a fold of newspaper, with a sheet of blotting papers added before adding the next newspaper and specimen. The pile of alternating specimens and blotters thus built up is then subjected to pressure. In the field inserting them between two boards or frames secured with straps would do this. When working at home the pile can be pressed under a board with a heavy weight on top. The pile should not be too thick or the specimens nearer the centre will not dry. It is useful to change the blotters once or twice during the drying.

1.5.3 DRYING

Alternating pieces of corrugated paper sheets are put in between the specimen drying papers to shorten the time required for drying. The presses are arranged over a source of heat with the corrugations vertical to allow air circulation through the press. Too much heat may bake the plants thus making them too brittle to handle during mounting.

1.5.4 MOUNTING

This refers to sticking the specimens to the mounting sheet. Wood glue is used to stick the specimen while gum Arabic sticks the labels. Polythene bags are placed in between specimens to prevent from sticking to each other.

Materials needed for mounting are: -

- Wood glue: - This is for sticking the specimen.
- Gum Arabic: - This is for sticking the specimen labels.
- Labels: - This is where the information of the plant is written down.
- Polythene cover: - They are put between the mounting sheets.
- Cardboard: - This is for flattening.
- Mounting sheet: - This is where you place the specimen and the labels.
- Brush: - This is for applying the gum Arabic.

The aims of mounting are: -

- To display the specimen and data to allow maximum observation.
- To preserve the specimen by securely attaching it to strong mounting paper or card, but at the same time allowing for the removal of small portions for more detailed study.

1.5.5 SORTING

It is done based on families, genus and species classifications. The specimen is given index from each of the above. This makes the identification and reference work easier.

Some of the factors used in identifying plants, include:

Leaf arrangement, leaf shape, leaf margin and inflorescence.

1.5.6 DATABASING AND INFORMATION MANAGEMENT

This is categorized into two departments

Library department

(i) This is where information found in books and articles are kept and arranged in an organized way to easily access them.

(ii) **Data Basing Department**

It is a management system, which allows items of data concerning a subject to be stored in different fields and for these fields to be accessed and organized in various ways. Once plant specimens are ready for permanent storage, the information about them is fed on a computer to provide easy future reference.

It deals with acquisition of information of plants specimen for the cabinet into a computerized form. The system is called BRAHMS (Botanical Research and Herbarium Management System). Most data is derived from field data sheets and labels of voucher specimen (i.e. record of collected specimen and more information about plant). Databasing has been developed for the professional botanist, herbarium manager and for those working in disciplines such as forestry and conservation institutions. Individual researcher or herbarium handling large volume of data can use it.

Data basing system has features to encourage data sharing exchange and can export data to text, files, word processor and other packages directly or indirectly.

1.5.7 LAYING IN

This is the process of putting the specimens in storage folders for future reference specimens are protected and taxonomically grouped by placing them inside folders. The folders must be clearly marked with the necessary information e.g. genus covers, species cover, etc.

N.B.

Genus covers: - Family name and number, genetic name, author and number, species epithet and numbers.

Species covers: Country, species epithet and number, any infraspecific taxa.

Type covers: This describes the type of specimens where the plant is classified; if it is a synonym then the currently accepted name should also be shown. The procedure involves laying in the files in their respective places in to the cup board. At the door of every cup board there is an indication of family, its number and the genus name. This makes it easier to lay the specimen in to its correct folder. This makes it easy in accessing a specific specimen or folder when it is in needed.

TREATMENT TECHNIQUES

Freezing

This is a process that is usually done after the drying procedure to kill the microorganisms so that they do not introduce pest and diseases to the specimens, that have already been preserved (to sterilize).

Fumigation

This is spraying the specimen storage room with a certain chemical to kill any insect that might have carried itself to the specimen. It is done when persons are out of the room. Any live insect found in the room after fumigation it is a sign of resistance and measures are taken to provide the appropriate chemical.

1.6 TYPES OF HERBARIUM

(i) Large Herbarium (International)

Functions: -

- Reference for botanists and Researchers.
- Publication of flora
- Major research and production of various flora.

(ii) Regional (National Herbarium)

Functions: -

- Contribution to major flora (covering several countries)
- Production of national and local flora.
- As a center of education for all students at all levels of learning.
- As a major tool in crime detection through the forensic e.g. pollen found with a suspect matching with pollen in the crime area.
- Services include: - loans, identifying specimens relevant to the country and dispatching determination lists, collecting material from the field and distributing duplicates.

(iii) **Local Herbarium**

Smallest herbarium that serves a small area for a specific use. May be found in University or colleges, or in institute for research purposes.

(iv) **Special Herbarium**

These are often but not always purpose. There are several types namely: -

- Historical herbarium.

These may be kept as separate herbarium within a general Kew De candolle herbarium at Geneva.

- Herbarium of limited scope.

These may be either limited taxonomically e.g. cryptogamic herbarium, forest herbarium.

- **Teaching herbarium**

These are housed in Universities, with more modest herbarium in colleges and schools. They should contain specimens to illustrate morphological structures, the types of plants representative of communities encountered in field studies.

CHAPTER 2

2.0 FIELD TECHNIQUES AND IDENTIFICATION

2.1 FIELDWORK ACTIVITIES

It involves collecting, identifying, bringing materials to the herbarium. The collection should fulfill the following requirements:-

- Must be as representative as possible of the population or show as wide a range of variation as possible and be accompanied by an unambiguous collection number.
- The specimen must be fertile and have a good collection data recorded (field notes).

2.2 FIELD NOTES

Collections should not be made under moist condition because they might be attached by fungus. It is important to know all the information about the plants you want to collect i.e.

- Family of the plant, Genus, species.
- Country, major area, minor area
- Gazetteer
- Flora region (Give country and province)
- Latitudes, longitudes and altitude.
- Local notes, (locally): - Reference to the nearest permanent village, town or river or mountain)
- Botanical name
- Vernacular name – Accompanied by a note of the language from which it comes.
- Habitat: Give vegetation type e.g. type of soil etc.
- Description: Growing characteristics, smell, venation, colour etc.
- Frequency: locally common, locally rare.
- Economics: Importance of specimen e.g. medicinal value, food, edible, poisonous.

2.3 COLLECTING TOOLS AND EQUIPMENT

- Secateurs
- Name tags
- Field note book, pencil, rubber
- Polythene collecting bag.
- Altimeter (for altitude) and blotter's (hard white paper) traps and newspaper
- Dryer preserving techniques
- Pocket knife
- Long bladed knife
- Scissors
- Long handled pruner
- Pruning saw
- Axe (bow saw)
- Spade
- Trowel
- Chisel
- Plant press
- Staples
- GPS

2.4 FACTORS TO CONSIDER WHILE COLLECTING SPECIMENS

- The whole plant including foliage and underground parts should be collected.
- If the plant is small, abundant and wide spread, collect a number of plants to show the range in size and phenotypic variation.
- If rare or critically endangered make a modest collection of viable propagules accompanied by photographs.
- If plant is extinct in the wild or its population is determined to not be viable in the wild or habitat collect for offsite cultivation (ex-situ conservation).
- If plant is too big to be collected whole, e.g. trees and shrubs, collect mature seeds for propagation.
- If there are no wildings, collect vegetative material from parent plants for propagation.

RECOMMENDATIONS

1. KEFRI scientists and technical staff should integrate collection of good voucher specimens, while undertaking routine fieldwork. Good voucher specimens should preferably contain:-

- Family of the plant, Genus and Species
- Common name
- Vernacular name – accompanied by a note of the language from which it comes.
- Locality – country, major area, minor area.
- Habitat
- Economics – importance of the specimen e.g. medicinal value, food, edible, poisonous.
- Frequency
- Collector's name
- Latitudes, longitudes and attitudes
- Description – growing characteristics, smell, venation, colours, e.t.c.
- Collection number.

2. KEFRI should implement measures to preserve collected voucher specimens. These measures include:-

- Procurement of tools and equipment needed for processing plant specimens. These include a plant press, blotting sheets, a drier, corrugated paper sheets, mounting sheets, polythene covers, cardboards and labels.
- Provision of an institutional herbarium. This is a major requirement as a herbarium serves as a store of reference materials, a means of identification and a comprehensive data bank representing the diversity and distribution of the vegetation in various regions. In addition, specimens preserved in a herbarium provide valuable morphological and phenological data. This makes plants identification work easier.

NOTE:

It is important to know all the information about the plants you want to collect, the label shown below can be used:



KEFRI HERBARIUM

FLORA OF:

Name:

Vernacular name:

Locality:

Altitude.

Habitat:

Description:

Economics/uses:

Frequency:

Date:

Collector:

Number:

3. As KEFRI enhances its capacity to implement recommendation (2) above, all voucher specimens collected in the meantime should undergo appropriate processing. The standard processing entails:

- Pressing
- Drying
- Freezing
- Correcting misidentified plant specimens
- Sorting specimens into families, genus and species
- Mounting

- Data basing
 - Post processing maintenance
 - Specimens repair
4. Deliberate effort to properly identify tree species should be done by KEFRI scientists and technical staff, as it is possible to misidentify plants. For instance, *Polyscias kikuyuensis* is often confused with *Polyscias fulva*. On the other hand, *Prosopis* genera has been misrepresented in Kenya where *Prosopis juliflora*, *P.chilensis* and *P. pallida* are used as synonym

CONCLUSION

During my attachment period, I learnt identification techniques that are carried out in a herbarium. I also obtained knowledge on how plants get their botanical name by using detailed keys of common plants in various regions. The keys give full description and illustrations of species.

I also became aware of the Kew bulletin and other journals are researched articles, which are used to name new species that have not been identified. They also indicate discoveries of plant kingdom and even renaming/regrouping of species, which are placed wrongly in relation to genus, species or families.

The herbarium techniques I learnt gave me hands-on experience and this will be of great benefit to my career development and to the institute as a whole. However, I can assist in proper naming and identification of plants and where necessary liase with NMK herbarium.

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