Plant Taxonomy (II)

Course Prof.

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Prepared by

Plant Taxonomy & Flora Staff Members

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رؤيـة ورسـالـة الـكـلـيـة

رؤية الكلية

التميز في تعليم العلوم الأساسية والبحث العلمي للمساهمة فى التنميه المستدامة.

College Vision

Excellence in basic science education and scientific research to contribute to sustainable development.

رسالة الكلية

تقديم تعليم مميز في مجالات العلوم الأساسية وإنتاج بحوث علمية تطبيقية للمساهمة في التنمية المستدامة من خلال إعداد خريجين متميزين طبقا للمعايير الأكاديمية القومية، وتطوير مهارات وقدرات الموارد البشرية، وتوفير خدمات مجتمعية وبيئية تلبي طموحات مجتمع جنوب الوادي، وبناء الشراكات المجتمعية الفاعلة.

College Mission

To provide distinguished education in the fields of basic sciences and the production of applied scientific research to contribute to sustainable development by preparing distinguished graduates according to the national academic standards, developing skills and capabilities of human resources, and providing community and environmental services that meet the aspirations of the South Valley community, and building effective community partnerships.

Course cover letter

Course code No.	Course Title	No. of Units		Pre-requisites
		Th.	Pr.	
322Bot	Plant Taxonomy (ii)	2	2	202 Bot

Objectives of the course:

This course aims to introduce students the main comparative use in classification – his Knowledge of principles of modern science category, such as cellular taxonomy – taxonomy of pollen grain – chemical taxonomy – comparative morphology.

Course Description:

Introduction – comparative plant morphology – basic of palynology - anatomical character important in classification- cytology and plant taxonomy - chemical taxonomy - study families of angiosperm.

Practical about index of similarity between species – Anatomical character use in classification – chemical substance use in classification - Scientific trips to identify different plant in it is habitat and collect species.

Required text book and supplementary text book:

Stace, C. A. (1989). Plant Taxonomy and Systematics. Routl Editionge, Champan & HallInc.(USA).

Cronquist, A. (1981). An Intergrat Edition System of Classification of flowering Plants, New York.

Lawrance G. M. (1951). Taxonomy of Vascular Plants, Macrmillan Publishing Co., Inc. (NewYork).

- النباتات الزهرية نشأتها - تطورها – تصنيفها تأليف شكري إبراهيم سعد - القاهرة دار الفكر العربي .(1994)

PLANT TAXONOMY ii

(322 Bot)

Part 1

Index

1- INTRODUCTION:

Plant taxonomy is the science that finds, describes, classifies, identifies and names plants. The dominant plant lives in the geological area in which we live are the angiosperms. They are the products of a long line of evolutionary development that has culminated توجت (ended) in highly specialized organ of reproduction that we know as the flower.

Flowering plants are the most conspicuous واضح (understandable) element of the present day landscape except in those forest areas where conifers predominate. The fact that the angiosperms are dominant does not mean their evolution has come to the end. Many factors are responsible for the success of the angiosperms these are:

1. Their ability to survive and reproduce in almost all kinds of environments.
2. The production of flowers, fruits and seeds. Although the conifer and other groups of vascular plants are widely distributed none flourish لا تزدهر in so many different habitats. As do the angiosperms.
3. They live in all kinds of soils, under great extremes حدود of temperature and rainfall, in the deserts, in the arctic (freezing) regions, in, meadows المروج (fields) and marshes مستنقعات in water and in the air, in mutuality تبادلية relationships with fungi as parasites.
4. They include trees, shrubs and herbs, annuals and perennials, succulents and forms with underground storage organs.

2- BOTANICAL NOMENCLATURE

Botanical nomenclature in its modern concept is the application of certain scientific names of taxa, singular taxon, in accordance with a group of international rules.

Botanical nomenclature started as early as man began to recognize the plants around him. Every group of people, independently of each other, gave certain names to the plants known to them which we call **vernacular names**. These names could not be used for any scientific purposes for the following reasons:

1. They are not universal.
2. In any language, a few species only possess common (vernacular) names.
3. Common names are applied to genera, species or varieties.
4. Two or more unrelated plants may be known by the same name, or a single plant may have two or more names.

This led to the need of a standard scientific plant nomenclature. However, the application of scientific names is not simple, and some confusion may exist in scientific as well as popular naming. There are more scientific names than plants, i.e. for one and the same species there are usually more than one name. Only one of these names is valid and the others are to be considered **synonyms**. Confusion then started to take place between botanists and the need of a universal code governed with rules was needed. The Paris code of 1867 was made of which the following are the most important rules:

1. One plant may not have more than one name.
2. No two plants may have the same name.
3. If more than one name has been applied to a plant, the valid one is the earliest, but priority begins with the year 1753 (Linnaeus Species Plantarum in 1/5/1753).

4. Author's name should be cited with each scientific name to avoid any confusion in referring to duplicated names.

The following lines constitute a simplified exposition of the main principles and articles of the International Botanical Nomenclature.

PRINCIPLES

1. Botanical nomenclature is independent of Zoological Nomenclature.
2. The application of names of taxonomic groups is determined by means nomenclatural types.
3. The naming of taxonomic groups is based on priority of publication.
4. Each taxonomic group can bear only one correct name, the earliest that is in accordance with the rules.
5. Scientific names of plants are Latin or are treated as Latin, regardless of their derivation.

RANKS OF TAXA

A taxon is a taxonomic group or unit. Each plant belongs to a series of taxa of consecutive rank. The basic botanical taxa are: Division, Class, Family, Genus, and Species. The list may be increased by the addition of subordinate categories usually with the prefix sub-, e.g. Sub Family, Sub Genus, Sub Species……..... etc.

NAME OF TAXA

The name of the order is taken from that of its type family and has the ending (-ales), e.g. **Ranales, Geraniales**, etc.

The name of a family is taken by adding the suffix -aceae to the stem of the name of its genus, e.g. **Plumbaginaceae, Euphorbiaceae, Ranunculaceae**, etc. some exceptions are; **Palmae, Gramineae, Cruciferae, Leguminosae, Umbelliferae, Labiatae**, and **Compositae**. However, new names for these families are accordance to the rules is in the same consequence. *(***Arecaceae, Poaceae, Brassicaceae, Fabaceae, Apiaceae, Lamiaceae and Asteraceae**.)

The name of a genus may be taken from any source arbitrary manner. However, botanists who are naming genera should comply with the following suggestions:

1. To use Latin terminations.
2. To avoid names not used in Latin.
3. Not to make names by combining words from different language.
4. Not to make long names or difficult to pronounce.
5. Not to dedicate genera to persons unconnected with Botany or at least with natural sciences.

The name of a species is a binary combination consisting of the name of the genus followed by a single specific epithet (an epithet is a descriptive word used to characterize the species, e.g. *alba* or a noun in the possessive form, e.g. *smithii* or the adjectival form, e.g *libyca*). The specific epithet must be either a single word or a compound joined by a hyphen, e.g. *Adiantum capillus-veneris*. It must not consist of two or more separate words.

The names infraspecific taxa; the subspecies, variety and forma are the common categories below the rank of species.

The Author's name: the name of at least one author follows the name of a plant. This is to avoid confusion in referring to duplicated names as was previously mentioned. The author's name constitutes a brief reference to the original publication which offers a means of determining the type specimen.

3- THE TYPE METHOD

Each species or variety is based upon a type specimen (*typus*), designated by the author at the time of publication. The name of each genus is based upon a type species. Each family name is based upon a type genus and indirectly, therefore, upon the type specimen of the type species of the type genus.

THE TYPE (*typus*, nomenclatural type), "is that element to which the name of a taxon is permanently attached." A type is either a specimen or an

illustration. A specimen is a real plant (or one or more parts of a plant or a lot of small plants), dead and kept safe, in a herbarium.

Examples of where an illustration may serve as a type include:

- A detailed drawing, painting, etc., depicting the plant, from the early days of plant taxonomy. A dried plant was difficult to transport and hard to keep safe for the future; many specimens from the early days of botany have since been lost or damaged. Highly skilled botanical artists were sometimes employed by a botanist to make a faithful and detailed illustration. Some such illustrations have become the best record and have been chosen to serve as the type of a taxon.
- A detailed picture of something that can be seen only through a microscope. A tiny "plant" on a microscope slide makes for a poor type: the microscope slide may be lost or damaged, or it may be very difficult to find the "plant" in question among whatever else is on the.

Unfortunately, the type method is a recent development, and types where not be designated in the earlier botanical literature. However, in most cases a particular specimen (to be considered as the type) was cited.

The nomenclatural type is not necessarily the most typical or representative element of a taxon; it is that element with which the name is prominently associated.

A **holotype** is the one specimen or other element used by the author or designated by him as the nomenclature type. As long as a holotype is extant, it automatically fixes the application of the name concerned. If no holotype was indicated by the author who described a taxon, or when the holotype has been lost or destroyed, a **lectotype** or **neotype** as a substitute for it may be designated. An **isotype** is any duplicated (part of a single gathering made by a collector at one time) of the holotype; it is always a specimen.

Notes on circumscriping types:

1. Only a species or an infraspecific taxon can have a type of its own. For most new taxa at these ranks a type should not be an illustration.
2. A genus has the same type as that of one of its species.
3. A family has the same type as that of one of its genera.

Botanical nomenclature and Relationship to taxonomy:

Botanical nomenclature is closely linked to plant taxonomy, and botanical nomenclature serves plant taxonomy.

Plant taxonomy is an empirical تجريبي science , a science that determines what constitutes a particular taxon (taxonomic grouping, plural: taxa): e.g. "What plants belong to this species?" and "What species belong to this genus?". The definition of the limits of a taxon is called its 'circumscription'. For a particular taxon, if two taxonomists agree exactly on its circumscription, rank and position (i.e. the higher rank in which it is included) then there is only one name which can apply under the *ICN*. In summary, confusion in plant names takes different kinds; if a plant has different names or is placed in differently named taxa:

- If the confusion is purely nomenclatural, i.e. it concerns what to call a taxon which has the same circumscription, rank and position, the *ICN* provides rules to solve the differences, typically by prescribing يوصف علاج او حل that the earliest published name must be used, although names can be conserved.
- If the confusion is taxonomic, i.e. taxonomists differ in opinion on the circumscription, rank or position of taxa, then only more scientific research can settle يقضى حلاً the differences, and even then only sometimes.

4- PHYLOGENETIC CLASSIFICATION تصنيف النشوء والتطور

(Evolutionary Systems)

In the flowering plants, as well as in other organisms, the evidences الأدلة of relationships revealed in many similarities in structure have led to attempts to arrange plants groups in phylogenetic classification somewhat resembling a genealogical family (tree).

Phylogenetic Classification System definition:

Phylogenetic System of classification based on the evolutionary descent of a group of organisms. The relationship is shown through a phylogram, phylogenetic tree, or cladogram.

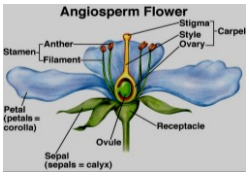
Phylogenetic Trends الاتجاهات in Angiosperms:-

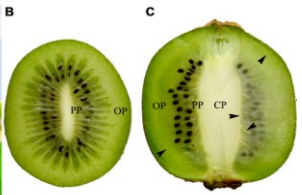
Even so it is possible to characterize families and other groups as relatively primitive or relatively advanced, mostly on the basis of the structure of the flower. Which perhaps more than any other part of the plant body exhibits evidence of great evolutionary change. The nature of such changes is best revealed by comparison with a primitive flower. This is believed to be found in the order *Ranales*, which includes a number of families. There is general agreement that the families of *Ranales*, especially the woody ones, should be placed at the base of any phylogenic system, for they have retained in one or more organs or parts, features that are considered to indicate the ancestral (family), primitive conditions in flowering plants.

It is generally recognized that evolution has proceeded from a relatively simple condition to one of relative complexity. Evolution has also proceeded by reduction leading to simplicity rather than complexity. Other evolutionary trends exhibited are fusion and change in symmetry. Some of the more outstanding directions in which floral evolution has proceeded are summarized below:

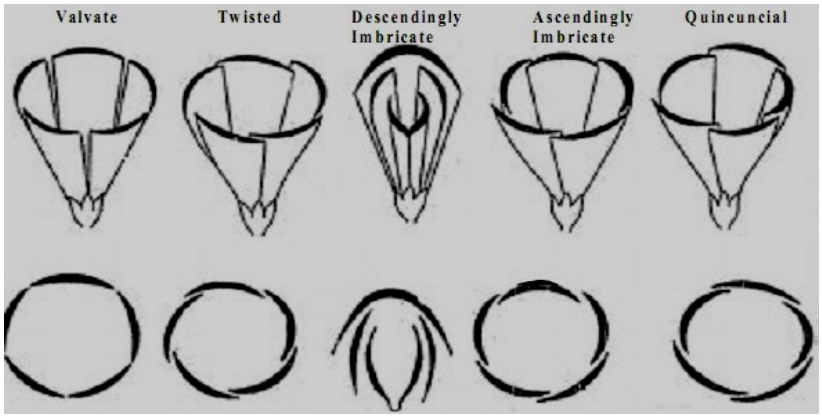
1- From a spiral to a whorled arrangement of floral parts. The whorled arrangement has arisen from the spiral by shorting (reducing) of the floral axis, ringing the parts closer together.

2- From numerous to a few floral parts. The possession of many stamens is a more primitive condition than few stamens, and a flower with two whorls of stamens is more primitive than one with a single whorl. Many carpels preceded few carpels.

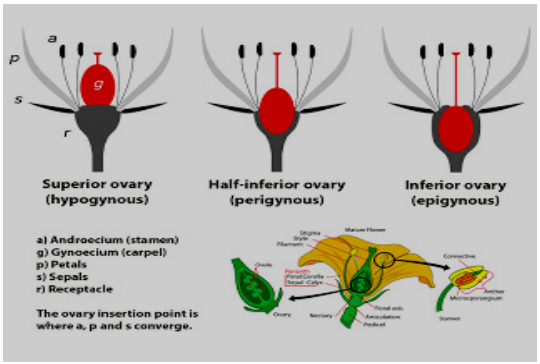




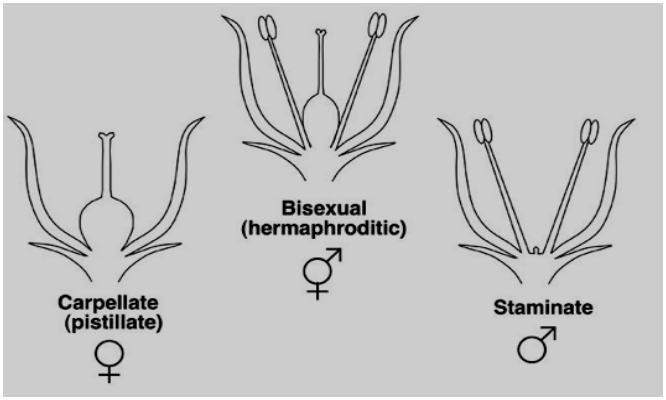
3- From distinct or separate to united parts. Separate sepals or petals are more primitive than united perianth parts, and separate carpels preceded carpels that are fused into a compound pistil.



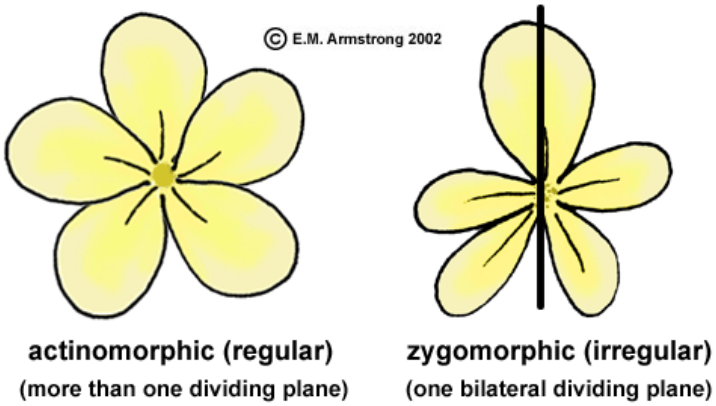
4- From the superior to the inferior ovary.



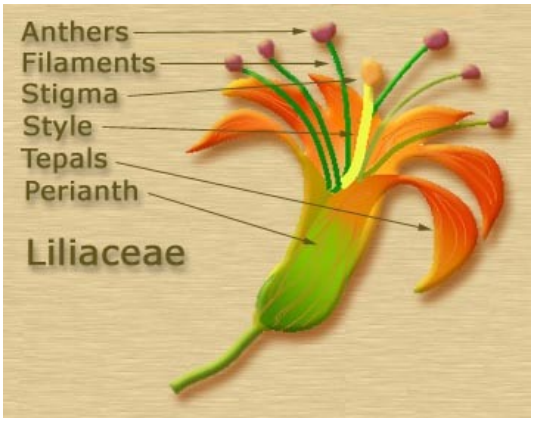
5- From bisexual to unisexual flowers.



6- From regular to irregular.



7- From both perianth whorls present to petals absent or entire perianth absent or present in highly reduced form.



Finally, the phylogenetic classification of flowering plants is based upon a relationships with different characters, and utilizes the largest possible number of them. It is now recognized that not only the floral characters assumed, but also other features contribute the phylogenetic approaches. These features such as: pollen structure, chromosome number and form, organic/chemical compounds and internal anatomy.

5- MODERN TRENDS IN PLANT TAXONOMY

a- Plant morphology in relation to taxonomy

Represents a study of the developing تطـوير , form, and structure of the plants, and by implication تضـمين (suggestion) an attempt محاولـة to interpret تفسـير (understand) these on the basis of similarity of origin and plan خطـة. There are four major areas of investigation (study or examination) in plant morphology, and each overlap with the entire field of the biological sciences.

First: of all, morphology is:

Comparative:

Meaning that the morphologist examines structures in many different plants of the same or different species, then draws comparisons and formulate يصـيغ ideas about the similarities. When structures in different species are believed to exist and develop as a result of common, inherited genetic pathways, those structures are termed homologous متماثـل. For example, the leaves of pine, oak and cabbage all look very different, but share certain basic structure and arrangement of parts. The homology of leaves is an easy conclusion اسـتنتاج to make. Morphologists of the plant goes further, and discovers that the spines of cactus صـبار also share the same basic structure and developments as leaves in other plants, cactus and therefore spines are homologous to leaves as well. This aspect جانـب of plant morphology overlaps with the of plant evolution and Paleobotany.

Secondly: plant morphology observes ادرك both:

Vegetative (somatic) and Reproductive Structures:

The vegetative structures of vascular plants include the study of the shoot system, composed of stems and leaves as well as the root system. The reproductive structures are more varied, and are usually specific to particular group of plants, such as flowers and seeds, fern sori, and moss capsule. The detailed study of reproductive structures in plant led to discover of the alternation of generations found in all plants and most algae. Reproductive

characters are therefore regarded as more useful for classification of plants than vegetative characters. This area of plant morphology overlaps with the study of biodiversity and plant systematics.

Thirdly: Plant morphology study plant structure at a range of scales. At the smallest scales are:

Ultrastructure التركيب الدقيق:

The general structural features of cells visible only with the aid of an electron microscope, and cytology, the study of cells using optical microscopy. At this scale, plant morphology overlaps with plant anatomy as field of study. At the largest scale is the study of plant growth habit, the overall architecture البنيـة الكلية of plant, the pattern of branching into a tree will vary from species to other.

Fourthly: Plant morphology examines the pattern of **"Development"**:

The process by which structures originate and mature as a plant grows. While animals produce all the body parts they will ever دائمـا have form early in their life, plants constantly باسـتمرار produce new tissues and structures throughout their life. Living plants always have embryonic tissues. The way in which new structures mature as they are produced may be affected by the point in the plant life when they begin to develop, as well as by the environment to which the structure are exposed.

Morphology A comparative science:

Plant morphologist makes comparisons between structures in many different plants of the same or different species. Making such comparison between similar structures in different plants tackles the question of why the structure is similar. It is quite likely فمـن المحتمـل جـدا that similar underlying الضـمني causes of genetic, physiological, or response to the environment have led to this similarity in appearance. The result of scientific investigation into these cases can lead to one of two into the underlying الأساسية biology:

1- Homology تنـاظر – the structure is similar between the two species because of shared common ancestry أسلاف and genetics

2- Convergence التقاء – the structure is similar between the two species because of interpreting تفسير adapt to common environmental pressures.

Understanding characteristic and structures which belong to each type is an important part of understanding plant evolution. The evolutionary biologist relies on plant morphologist to interpretلتفسير structures and in turn provides phylogenies بدوره يوفر شجرة الأنساب of plant relationships that may lead to new insights رؤى morphological.

Homology:

When structures in different species are believed to exist and develop as a result of common, inherited genetic pathways, those structures are termed homologous. For example the leaves of **pine, oak and cabbage** all look very different, but share certain basic structures and arrangement of parts. The homology of leaves is an easy conclusion to make. The plant morphologist goes further يذهب أبعد من ذلك, and discovers that the spines of **cactus** also share the same basic structure and development as leaves in plants, and therefore **cactus** spines are homologous to leaves as well.

Convergence:

When structure in different species are believed to exist and develop as a result of common adaptive responses الاستجابات التكيفية to environmental pressure, those structures are termed convergent. For example the fronds سعف of *Bryopsis plumosa* and the stem of *Asparagus setaceus* both have the same branching feathery appearance, even though one an algae and one is a flowering plant. The similarity in overall عموما structure occurs independently as a result of convergence. The growth form of many *Cacti* and species of *Euphorbia* is very similar, even though they belong to widely distant families. The similarity results from common solutions to the problem of surviving البقاء in a hot, dry environment.

Morphological character uses in identifying:-

Plant biologist uses the morphological characters of plants which can be compared, measured, counted and described to assess تقييم the differences or similarities in plant taxa and use these characters in plant identification, classification and descriptions.

When characters are used in the description or for identification they are called diagnostic or key characters which can be either qualitative and quantitative.

1- Quantitative characters are morphological features that can be counted or measured, for example a plant species has flower petals 10 – 12 mm wide.

2- Qualitative characters are morphological features such as leaf shape, flower color or pubescence.

Both kinds of characters can be very useful for the identification of plants.

Taxonomic Units:-

Taxonomic units divided into two types these are:

Major units, and Minor units

The Major units:-

This included the species, genus, family, order and class

1- Species:-

The classification. Species are a group of similar individuals which can reproduce successfully with each other while at the same time being reproductively isolated from other similar species.

2- genus:-

It is a collection of species. Generally, these members of a species have a strong relation to each other in term of characteristics

3- family:-

Is a group of genus these genus have related to each other in terms of characters. The family usually ended with aceae, but some families ended with ae thus have a new name ended with aceae as in the following table:

Old name	New name
Graminae	*Poaceae*
Palmae	*Arecaceae*
Compositae	*Asteraceae*
Cruciferrae	*Brassicaceae*
Umbellifarae	*Apiaceae*
Leguminosae	*Fabaceae*
Labiatae	*Lamiaceae*

The family name is derived from one of it is genus, family *Solanaceae* derived from genus *Solanum*.

4- Order:-

Collection or group of families, these families' relation to each in term of few characters.

5- Class:-

Collection or group of orders, these orders are related to each in term of a few characters.

The minor units:-

This includes subspecies, variety and clone

1- Subspecies:-

A group of plant species has the same number of chromosome, but differ in morphological character. E.g.

Acacia nilotica subspecies *nilotica* and *Acacia nilotica* subspecies *tomentose*.

The difference between them that subspecies *tomentose* has hairy fruits while subspecies *nilotica* hasn't

2- Variety نويع or strains سلالة:-

A group of plant species has a different number of chromosome and different morphological character. E.g.

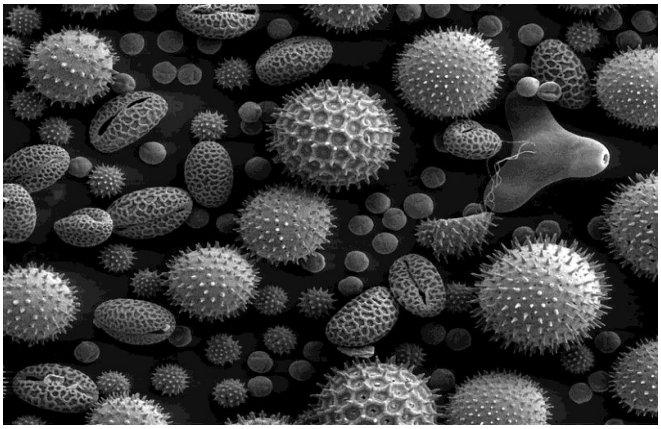
Acacia seyal var. *seyal* and *Acacia seyal* var. *fistula.*

They are differing in chromosome number, in the color of stem and shape of spines. *Acacia seyal* var. *seyal* have more chromosome (one chromosome addition), red stem and normal spines while *Acacia seyal* var. *fistula* have yellow-white stem and thick spines.

3- clone نسخة:-

Taxonomical units obtain by asexual reproduction. Use in crop production (tissue colour).

b- Palynology and Plant Classification



Palynology: is a new science search on pollen grains.

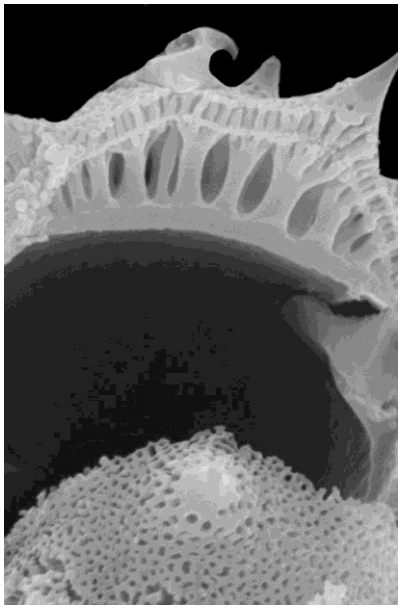
Pollen is a fine to coarse powder containing the Micro gametophytes of seed plants, which produce the male gametes. Pollen grains have a hard coat that protects the sperm cells during the process of their movement from the stamens to pistil of the flowering plant. Individual pollen grains are small enough to require magnification to see detail.

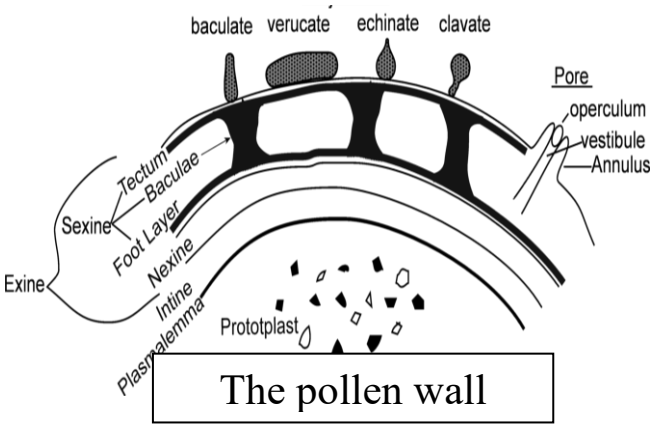
The pollen wall protect the sperm nucleus while the pollen grain is moving from anther to stigma, it protects the vital genetic material from dry out and solar radiation. The pollen walls compose of three layers:-

1- The outer layer call sexine composes of (Tectum, Baculae and foot layer) sporopollenin, which prevents the pollen grain from shrinking and crushing genetic material.

2- The middle layer call nexine compose of flexible gelatin, which prevents the pollen grain during dry and damp weather

3- The inner layer call intine compose of cellulose surrounding the protoplasm (fig. 1)





Pollen grains come in a wide variety of shapes, sizes, pollen pores and surface markings characteristic of species. (fig.2). the smallest pollen grains are around 6 micron (0.006 Mm) in diameter. Wind-borne pollen grains can be as large as about 90 to 100 micron.

Phylogenetic trends in pollen grains

The results of many studies on palynology are as follow:-

1- Big pollen grains more advance than smaller one.

2- Smooth pollen grains primitive than the ones that has a spine and trichomes.

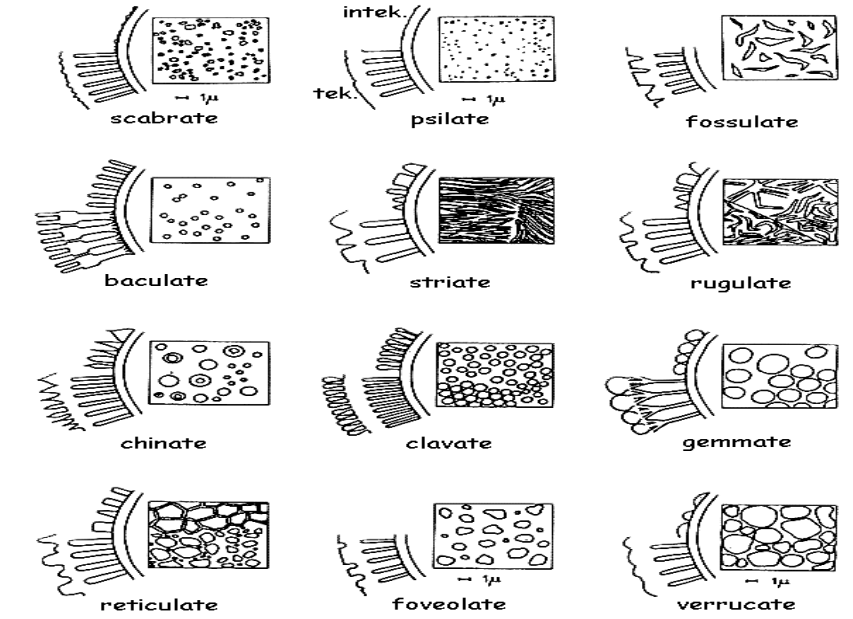
3- Pollen grains have long or ovate pores more primitive than having narrow spherical.

4- Pollen grains with one pore more primitive than one that has many pores.

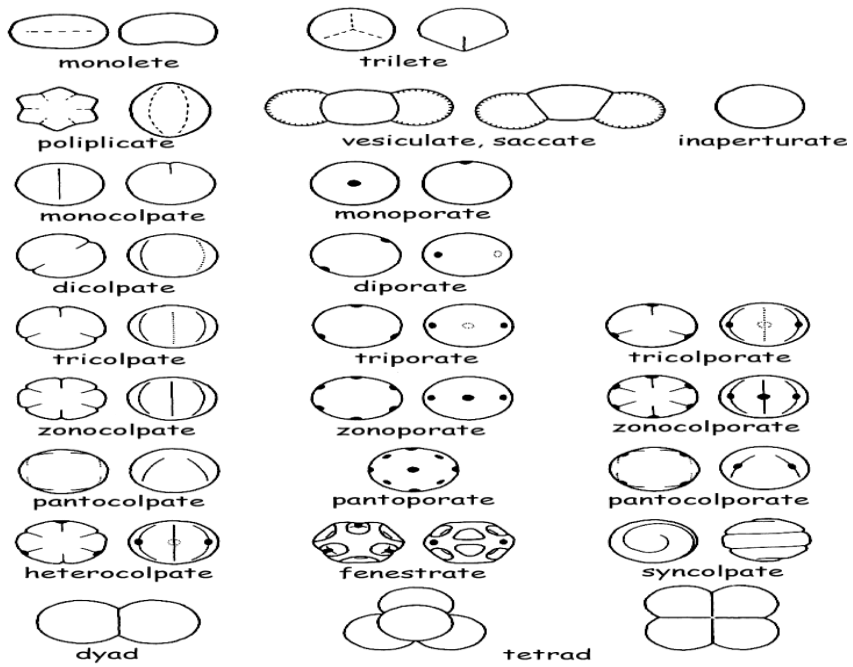
5- Pollen grains has grainy exine more primitive than one has baculate.

6- Pollen grains has thick medine more primitive than ones have thin.

Many studies on morphological structure, pores and it work help in classifying many plant families and genus and the evolutionary relationship between plant groups became clear.

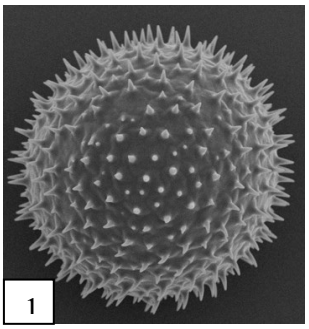


Forms of pollen surface



Pollen pores

There are many families has special pollen grains eg. Family *Malvaceae* (Fig. 1), has a pollen grain with different types of spines; *Chenopodiaceae* (Fig. 2), has smooth with many pores pollen grains; *Graminae* (Fig. 3), has smooth spherical with one pore pollen grains; *Mimosaceae* (Fig. 4), has polyads pollen grains; *Cichorease* (Fig. 5), has lophate pollen grains.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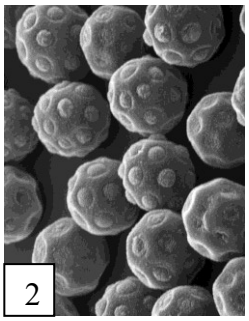
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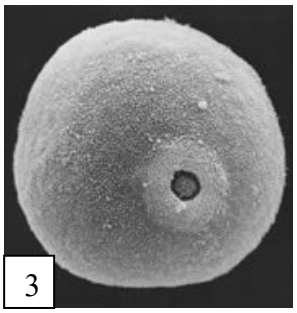
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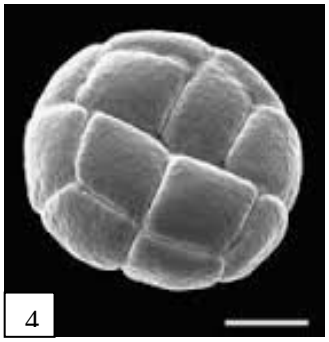
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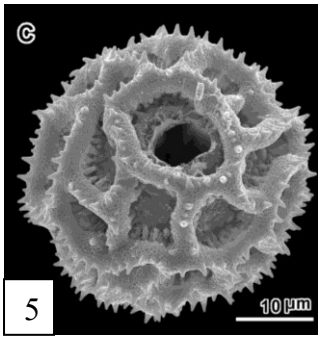


5

The relationship between palynology and taxonomy has two faces:

1- Morphology: study the structure, shape, size of pollen grains and its pore distribution.

2- Geology: pollen grains keep it wall well through geological times, this helps in determining its geographical region and the ecological change happen in it.

The results/recommendations of the palynology studies:-

1- Monocotyledon pollen grains has one pore or colpus while dicotyledonous has three or more, few dicotyledonous has one pollen pore this is the primitive one.

2- *Ranales* is an old order and primitive, it pollen grain doesn't advance found in fossil of dicotyledonous, may be *Ranales* was the original of other orders of dicotyledonous.

3- Angiosperm appears in the Cretaceous. Monocotyledon younger in age than dicotyledonous and it was not decreasing in advance than dicotyledonous may be grown from *Ranales*.

4- Classification of Engler dicotyledonous into polypetalae and gamopetalae not repose to evolutionary classification, because the research made in this subject discus that pollen grains of families *Linaceae* and *Plumbaginaceae* similar in form and structure.

5- The pollen grains of family *Calycanthaceae* discus that it doesn't belong to the order *Rosales*.

6- The pollen grain structure of the families *Nepenthaceae* and *Droseraceae* indeed their connection.

7- The family *Nyctaginaceae* can be divide into two sub-families *Mirabiloidae* it pollen grains have spines and many pores, *Pissoneae* it pollen grains smooth with three long ovate opens.

8- Through palynology studies taxonomist enable to differentiate between the families *Malvaceae* that has spiny pollen grains and *Bombaceae* has smooth pollen grains.

9- Through palynology studies found that genus *Emblingia* belong to the family *Polygonaceae* not to *Capparidaceae* also the genus *Thorelia* belong the family *Myrtaceae* not to the family *Lythraceae*

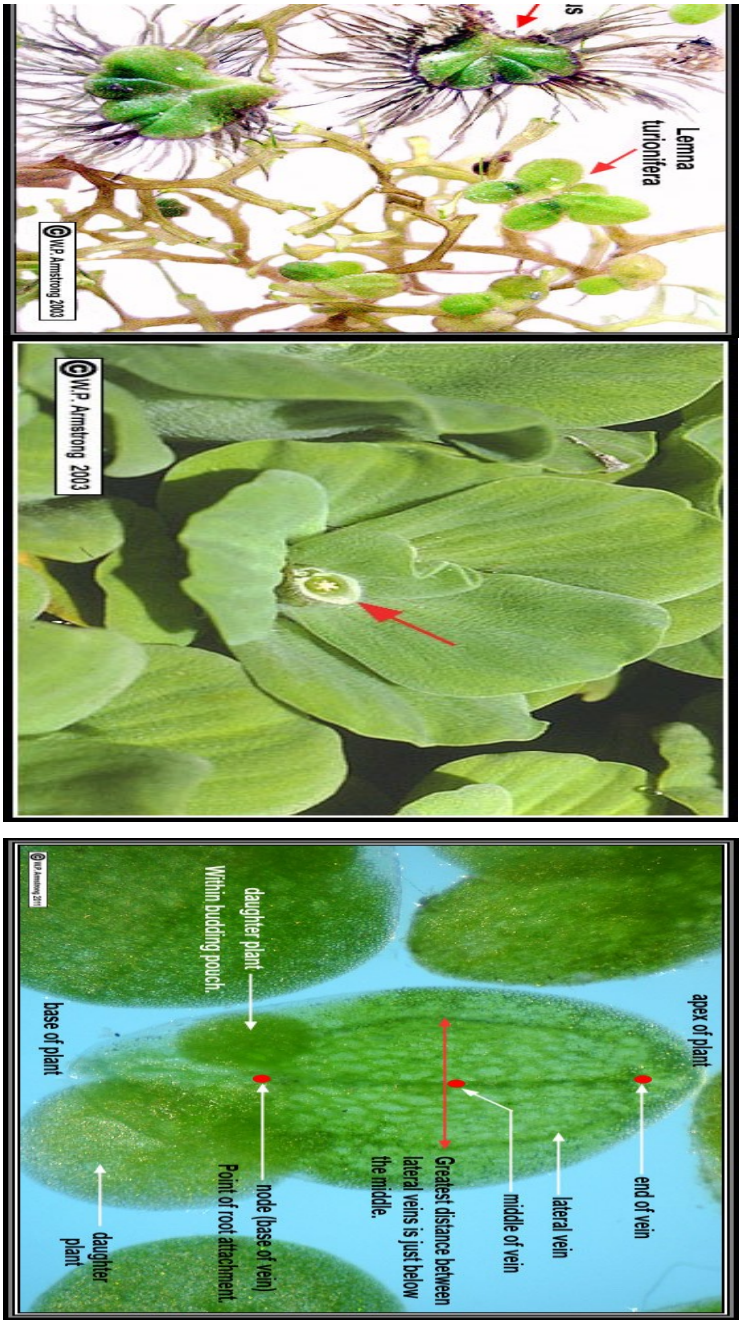
10- Through palynology studies on the many genus enable taxonomist to know the original place and steps of evaluation in its own species.

c- Anatomy and Plant Classification

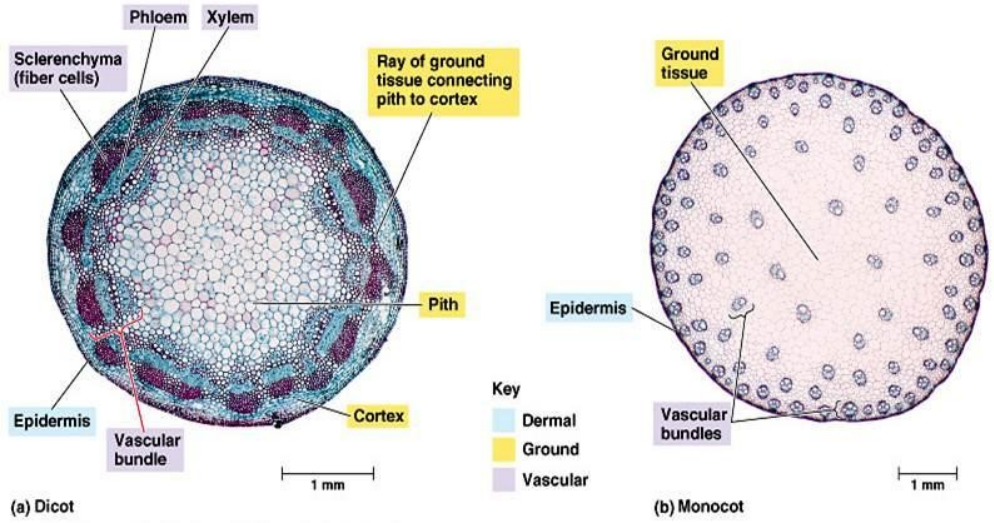
Anatomical characters are most important in studies for classification – especially when trying to determine relationships among large groups of plants, often at higher taxonomic levels – they are less often used for identification and aren't often mentioned in floras.

Plant anatomy have importance role in classification plant kingdom, through anatomical studies plant kingdom divided into Thallophyta and Tracheophyta, the last one has complex sex organs and vessel system.

Plant anatomy helped in correction taxonomic face of some plant species, for example plant Lemna in ancient classify as primitive plant because it compose of small thallus float in water, but through anatomical studies found that plant Lemna has advance vessel systems like that found in angiosperm and also has flowers, these characters help taxonomist to put Lemna in correct place with Tracheophyta.

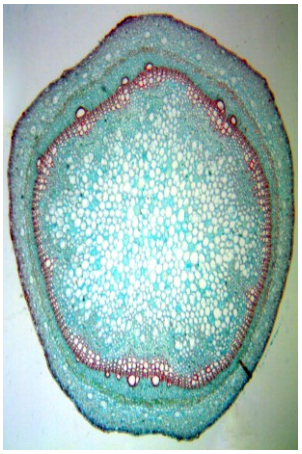


Anatomical character play important role in differentiation between dicotyledonous and monocotyledonous are vessel element arrangement.

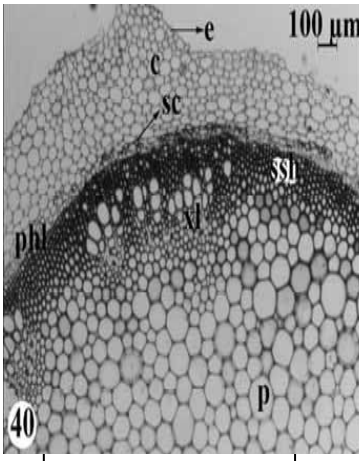


There are many families have anatomical character use to know relation between them like the inner phloem found in *Solanaceae* and *Convolvulaceae* not found in family *Scrophulariaceae* .

Solanaceae



Convolvulaceae



Scrophulariaceae

Plant anatomy also helped in correction taxonomic face of some families, for example family *Rhoipetalaceae* many morphological studies put it in order *Urticales* and other put it in order *Juglandales*, but through anatomical study found that the family belongs to the order *Juglandales*.

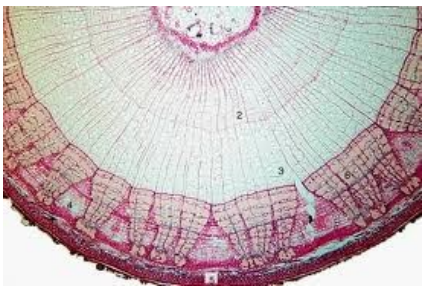
Plant anatomy also helped in correction taxonomic face of some orders for example order *Parietales* can be divide into two orders that *Parietales* and *Gutiferales*.

Anatomical studies found the orders *Geraniales* and *Sapindales* are similar in xylem structure then put them in one order *Pennatae*.

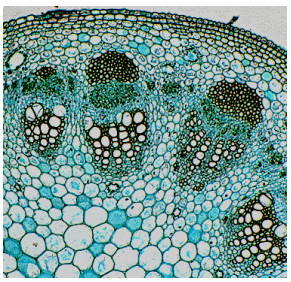
The structure and sequence of vessel bundles are important anatomical character paid dicotyledonous as of monocotyledon. There are many families has anatomical character through it found the relationship between them. Out of these characters inner phloem that found in families *Solanaceae* and *Convolvulaceae*, families *Apocynaceae* and *Asclepiadaceae* have latex vessels, this explants their connection and they belong to one order.

The result of many anatomical studies in xylem as follow:

1. The structure of xylem in trees more primitive than in herbs.

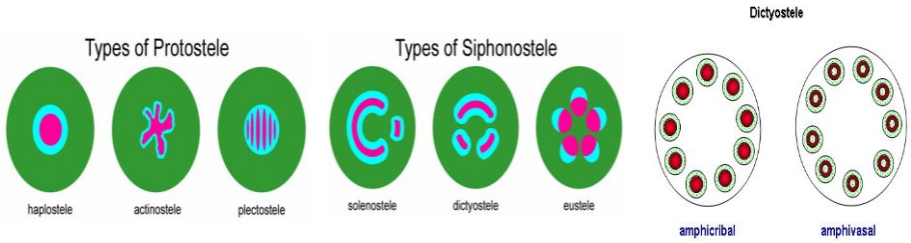


xylem in trees



xylem in herbs

2- The Protostele vessel more primitive than Siphonostele vessel and thus more primitive than Dictyostele vessel



3- Xylem vessels has septa with many scalariform pitted more primitive than xylem has septa with one pitted

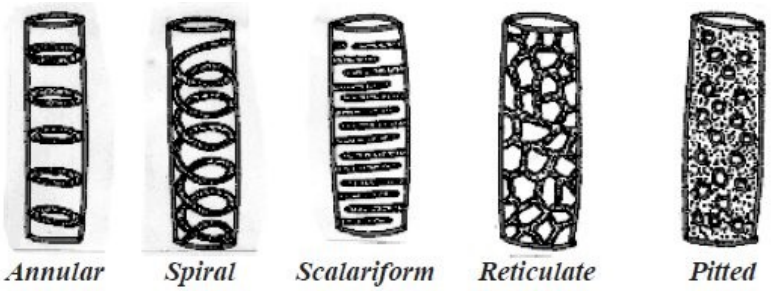


Fig. 2.5. Types of secondary wall thickenings in tracheids

4- Long narrow xylem vessels more primitive than short broad xylems vessels

5- Xylem vessels with longitudinal septa more primitive than xylem vessels with lateral septa

6- Xylem vessel with scalariform pitted more primitive than xylem vessels with opposite and this more primitive than xylem vessels with alternate pitted

7- Xylem vessels with single pitted more primitive than xylem vessels with group or cluster pitted

8- Xylem vessels in it development from group to other it develop from tracheids to fiber - tracheids to fiber

9- In angiosperm tracheids with simple scalariform pitted more primitive than tracheids with bordered pitted

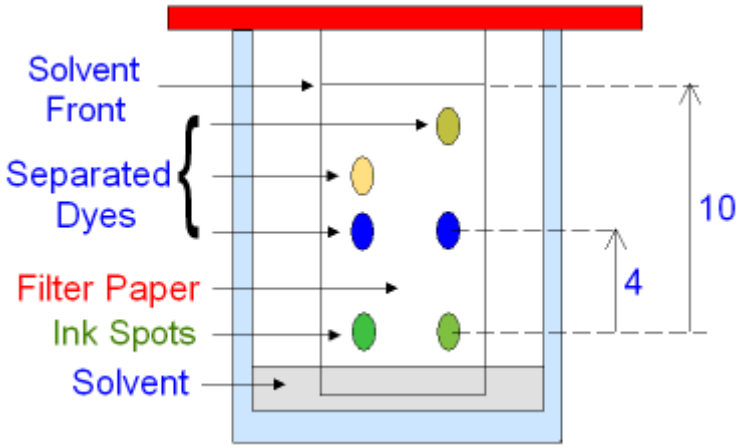
10- Xylem with diffuse parenchyma more primitive than xylem with aggregate parenchyma

11- Phloem rays with uniform cells more primitive than phloem rays with different cells.

d- Chemistry in relation to plant taxonomy

With the advent of gas and paper chromatography and other improved techniques chemical taxonomy has become fashionable and the early appearance of volume specially devoted to the subject is welcome. It incorporate the contribution made at symposium held in Paris in October 1962 the chemical

substances that have been used in plant taxonomy classification include crystals of various kinds, starch and glycosides, the application of phytochemical methods in the taxonomy of large and difficult genera is illustrated in detail by reference to *Eucalyptus* and *Pinus*. Smith discusses the usefulness of chemistry in plant taxonomy as illustrated by the flavonoid constituents, leucanthocyanins , flavonol and hydroxyl acids are shown to be characteristic of woody species and flavones and methoxy acids characteristic of herbaceous species.



Paper Chromatography

The distribution of alkanes, investigations showing that the alkane distribution pattern of hydrocarbon fraction of wax is a characteristic property of species intensive studies of the genera and species of the family *Semervivoideae* in this respect suggested certain rearrangements of species but on the whole there was only a rough parallelism of hydrocarbon pattern and botanical classification.

A higher degree of conformity was observed in some other group. N. A, Sorensen, deals chemical taxonomy of acetylenic compounds giving instances of the occurrence of fats peculiar to single genus or group of related genera and others where the a cetylenic pattern conforms broadly to the classification by orthodox methods, this is so in the tribes of the *compsitae*.

In the distribution of fatty acid, lipid in plant, F. B, shotland gives and outline of what is known of the lipids of bacteria, yeasts, fungi and other cryptogams and in the varions groups of the phanerogams, the families being grouped according to the types of fats they contain. Certain features distinguish the bacteria from another group and distinguish the bacteria from another group and distinction can be made even between different bacteria groups, the fungi too have certain distinguishing features but the phanerogams little of significance emerges beyond the occurrence of cyclic acids in the seeds fats of the orders *Bixales, Tiliales Malvales* which are presumed to have phylogenetic affinities.

V. Plouvier deals with distribution of aliphatic polyols and cyclitol, the consistent presence of pinitol and seqoitols in gymnosperms is taken as evidence يؤخذ كدليل of a monophyletic أحادي النمط الخلوي origin of families in which these compound occur, certain homogenous groups are recognizable التعرف also in the angiosperms but they seem to have rather rapidly lost the chemical character of their more primitive ancestors الأسلاف البدائية. In fact this flexibility in metabolism is one probable cause of their development reviewing the distribution of plant glycosides.

R. Paris points out that the full range of glycosides is found only in the Angiosperms and cites cases where specific differences and also chemical races have been detected.

J. B, Harbrone review the distribution of anthocyanin in higher plants since all families of *Caryophyllaceae* contain beta cyanine in place of anthocyanin, it is suggested that this family should be removed from the order *Centrospermae*, the analysis of the cliploid potato species it possible to revise تنقيح the nomenclature of the group. Other generation جيل can be made.

R. Hegnauer write on the taxonomic significance of alkaloid, many alkaloid and other substances regarded as characteristic of certain plants have been found extensively in others in small quantities and hence the ability to accumulate تراكم a given compound is more important than the ability just to synthesize it more

over the same end product may be formed in different plants by different synthetic pathways and is not there always an indication إشارة of the relationship. Evidence دليل based on the alkaloid points against Huchinsons classification of *Liliaceae*. The *Alliodeae* and *Amarylliodideae* suggestions are made for a rearrangement of the families, their affinities الانتماءات with the *Rutaceae* and the *Papaveraceae*.

J. R. Price contributes a separate chapter on the distribution of alkaloid in the *Rutaceae*, after emphasizing التأكيد some of limitations of chemical approach اقتراب, it is pointed out that four class of alkaloids apparently occur exclusively in this family, which is hence regarded as distinct متميز and على وجه الحصر homogeneous group a view supported by evidence from essential oil and other compounds evidence دليل from Coumarone and other compounds also suggests that the flindersioideae, Aurantioideae, Toddalioideae and Rutoideae represent a homogeneous group distinct from the *Meliaceae* and other associated families.

A. Kjaer deals with the distribution of sulphur compounds showing that the families *Capparidaceae*, *Cruiciferae*, *Moringaceae* and *Resedaceae* represent a natural group characterized by the presence of thioglucoside whereas the *Papaveraceae* should be removed from the order *Rhoeadales*.

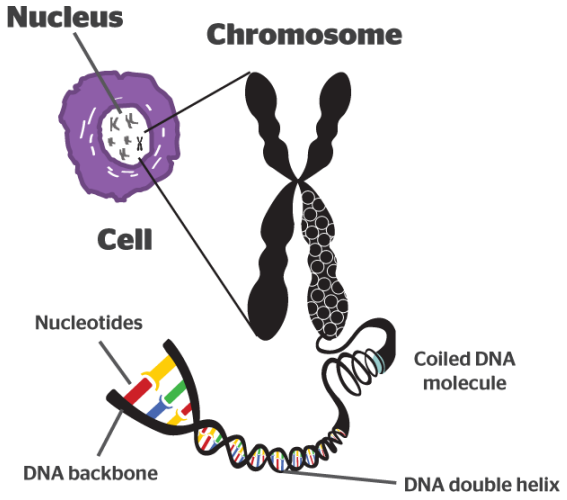
e- Cytology and plant taxonomy

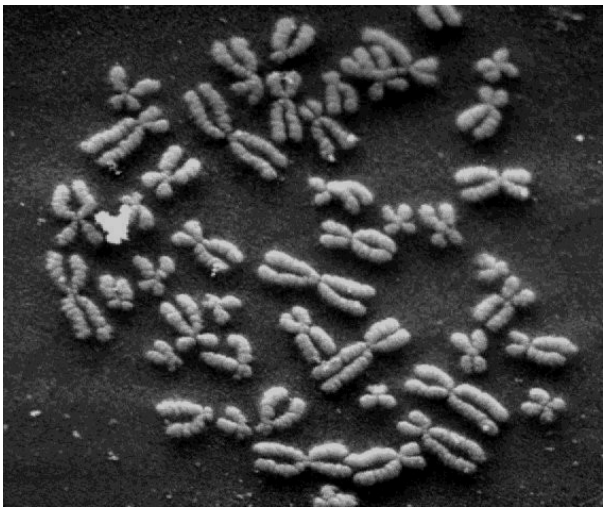
Cytology played important role in plant taxonomy. It served plant taxonomy in genus and species classification.

Plant cytology gives information about chromosome number, structure and behaviour during meiosis and mitosis division.

About chromosomes there are many species belong to different genera have the same number of chromosomes. In some cases plant with mono-chromosomes similar to plant with di-chromosomes and poly-chromosomes in structure and another characters, these plants are photo to one species. In other cases, these plants differ in morphological and anatomical character in this case, these plants are different species belong to one genus or different genus.

Structure of chromosome such as length, diameter and centromere position is most important in plant taxonomy.

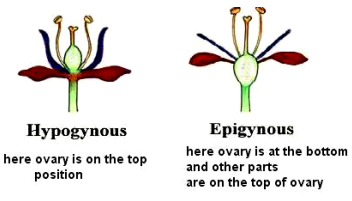




There are many studies in cytology cleared the evaluation relation between plants that helped in classification genus and species as follow:

1- Species *Sedum pulcheium* found three types these are:

- With di- chromosome (2n =22)
- With four- chromosome (2n =44)
- With sex- chromosome (2n =66)



The types of plant growth in different area and environment and has four groups of

chromosome resulted from the crossing the plant have 2n =22 with the plant have 2n = 66

2- genus *yucca* has hypogenous flowers belong to the family *Liliaceae* while genus *Agave* has epigenous flowers and belong *Amaryllidaceae*, but the study of cytology found two genera has the same number of chromosomes and the genera have similar morphological and anatomical characters.

3- Engler used fruit types to divide family *Ranunculaceae* to groups, any group have many genera the result of this many genera differ in structure and behaviour found in one group, this surprise the taxonomist. The study on cytology enable taxonomist to divide this family into uniform group, the species of each group connected with similar morphological, anatomical and cytological character.

Engler used fruits types and placentation to divided family *Oleaceae* into two subfamily *Oleideae* and *Jasminoideae*, taxonomist found this classification uncompleted, then taxonomist used chromosome structure in addition to placentation and fruit types and divided the family into group and each group has genus with similar chromosome structure, fruit types and placentation. From this classification the number of chromosomes in subfamily *Oleaceae* 23.

The family *Rosaceae* has three subfamily, these are:

Subfamily *Pomoideae* has 17 chromosomes

Subfamily *Spiroideae* has 9 chromosomes

Subfamily *Prunoideae* has 8 chromosomes.

The research in morphology and cytology cleared that the subfamily *Pomoideae* poly-chromosome, growth result of crossing of *Spiroideae* and *Prunoideae*.

The species *Sanicula crassioalis* belong to the family *Umbelliferae* and has many copies with 4, 6, 8 chromosome, 4 resulted from crossing of 6 and 8.

The result of many research found that the percentage of poly-chromosome in most angiosperm 30-35% and in *graminae* about 75%. There correlation between poly-chromosome and plant form.

Part 2

Angiosperms Plant families

index

1- Selected Families of Dicots

Anacardiaceae

Class: Dicotyledoneae

Sub-class: Dialypetalae

Order: Sapindales

Family: Anacardiaceae

General characters

Leaf form: Leaves evergreen, or deciduous; nearly always alternate (opposite in Bouea); aromatic (resinous), simple, or compound; when compound, pinnate. Lamina pinnately veined. Leaves exstipulate. Lamina margins entire.

Inflorescence: Flowers aggregated in 'inflorescences'; in panicles. The ultimate inflorescence unit racemose.

Floral morphology: Flowers regular; typically 5 merous; Hypogynous disk present.

Perianth with distinct calyx and corolla

- Calyx 3–5; 1 whorled; basally gamosepalous. Calyx is imbricate.
- Corolla when present, 3–5; 1 whorled; polypetalous, or gamopetalous (rarely, basally). Corolla imbricate.

Androecium: 5–10(–12). Androecial members free of the perianth; free of one another, or coherent; (when coherent 1 adelphous); 1 whorled, or 2 whorled. Pollen grains aperturate; (2–)3 aperturate; colporate.

Gynoecium: 1–3–5(–6) carpelled. The pistil 1–5 celled. Gynoecium syncarpous; superior (usually), or partly inferior. Ovary 1–5 locular. Styles 1 (usually), or 3–6, Stigmas 1–5; Ovules in the single cavity when unilocular, 1; 1 per locule.

Placentation when unilocular parietal, or basal.

Fruit: fleshy (usually), or non-fleshy (occasionally); when dry indehiscent; a drupe. The drupes with one stone. Seeds non-endospermic.

Some examples of important plants names:

Mangifera sp.

Schinus sp.

Economic uses: Including commercially important fruits — cashew-nut (Anacardium, and the fleshy peduncle, 'cashew-apple'), mango (Mangifera), Resins, oils and lacquers from Toxicodendron.

Sumach. (*Rhus Cotinus.*)

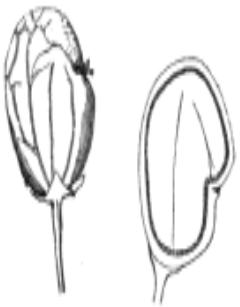
Sumach.
Fertile flower accompanied by abortive flowers.

Sumach.
Vertical section of flower (mag.).

Sumach.
Stamen (mag.).

Sumach.
Diagram.

Sumach.
Fruiting and sterile pedicels.



Sumach.
Fruit, entire and cut vertically.

Meliaceae

Class: Dicotyledoneae

Sub class: Dialypetalae

Order: Meliales

Family: Meliaceae

General characters

Leaf form: Leaves alternate or opposite, petiolate; compound (usually), pinnate (mostly), Leaves exstipulate. Lamina margins entire (usually), serrate, or dentate.

Inflorescence: Flowers solitary, or aggregated in 'inflorescences'; in cymes, in racemes, in panicles, and in spikes.

Floral morphology: Flowers minute to large; regular; cyclic. Hypogynous disk present, or absent.

Perianth with distinct calyx and corolla; (5–) 6–12(–21); 2 whorled, or 3 whorled.

- Calyx (2–) 3–5(–7) 1 whorled; gamosepalous (usually), or polysepalous, imbricate.
- Corolla 3–7(–14); 1 whorled, or 2 whorled; polypetalous, or gamopetalous, imbricate, or contorted, or valvate.

Androecium: (3–) 5–10(–23), or 10–100 (to 'many', unbranched and free of the perianth, or adnate; when joined, 1 adelphous. Pollen grains aperturate; 2–5 aperturate; colporate.

Gynoecium: (1–) 2–6(–20) carpelled, syncarpous**,** superior**.** Styles when demarcated, 1; Stigmas 1. Ovules when unilocular 1, or 2, or 3–100 (i.e. one to 'many'); 1–2 per locule. Placentation when unilocular; parietal; usually axile.

Fruit: fleshy, or non-fleshy; dehiscent, or indehiscent; a capsule, or a berry, or a drupe, or a nut (rarely); Capsules septicidal, or loculicidal. Seeds endospermic or non-endospermic.

Some examples of important plants names:

[See Appendix Page 119]

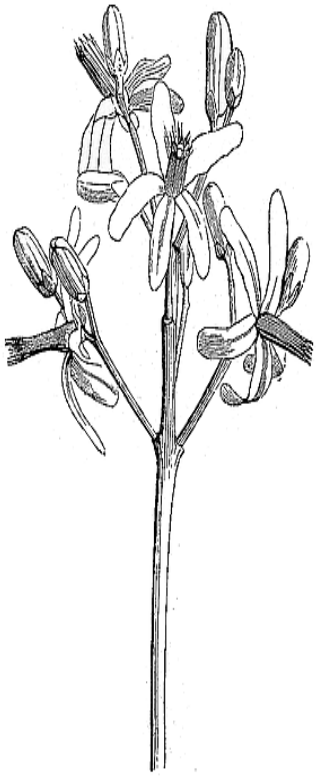
Azadirachta indica

Khaya ivorensis

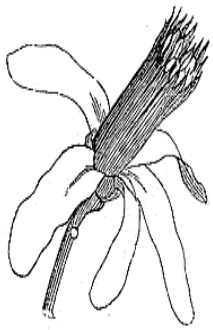
Khaya senegallensis

Melia sp.

Economic uses: Edible fruit from *Lansium domesticum,* timber from *Swietenia* (mahogany), *Kaha* (African mahogany).

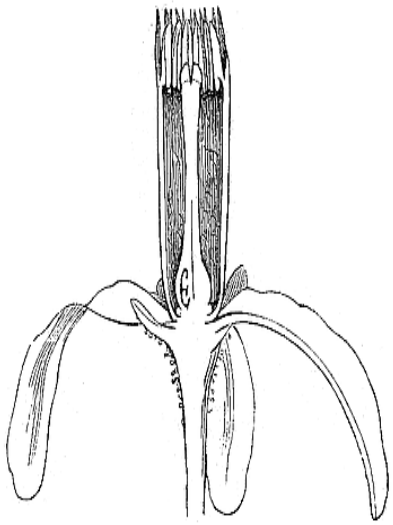


Melia Azedarach.



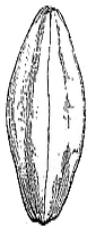
Melia.
Flower (mag.).

Melia.
Stamen (mag.).

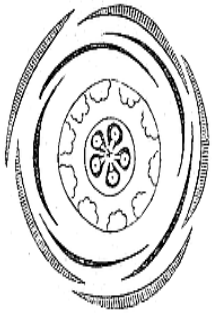


Melia.
Vertical section of flower (mag.).

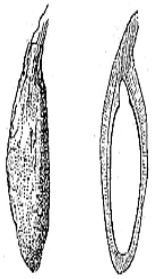
Melia.
Fruit (mag.).



Melia.
Stone (mag.).

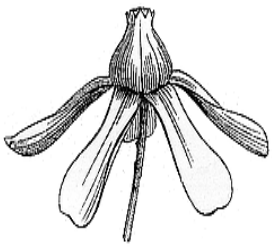


Melia.
Diagram.

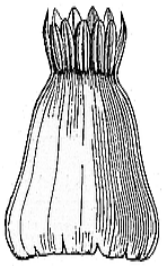


Melia.
Seed, entire and cut longitudinally.

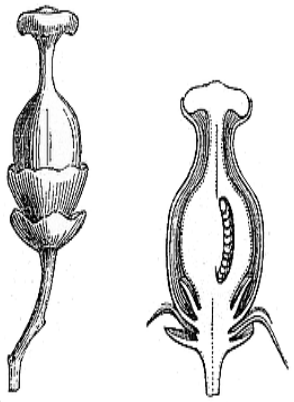
Melia.
Pistil (mag.).



Swietenia.
Flower.



Swietenia.
Part of androecium (mag.).



Swietenia.
Pistil, entire and cut vertically (mag.).

Rosaceae

Class: Dicotyledoneae

Sub class: Dialypetalae

Order: Rosales

Family: Rosaceae

Subfamily: Rosoideae

General characters

Leaf form: deciduous (usually), or evergreen; alternate (except some species); simple, or compound, pinnate, or palmate. Lamina when simple dissected, or entire; Lamina margins crenate, or serrate, or dentate, or entire (rather infrequently). Pinnately veined (usually), or palmately veined (e.g. *Alchemilla*). Leaves stipulate.

Inflorescence: Flowers solitary, or aggregated in 'inflorescences'; in cymes, in panicles, in racemes, in corymbs and in umbels.

Floral morphology: Flowers small to large; often fragrant and usually regular.

Perianth with distinct calyx and corolla; (5–) 10(–20); 2 whorled (usually), or 1 whorled.

- Calyx (3–)5(–10) 1 whorled; polysepalous, or gamosepalous; regular; usually imbricate.
- Corolla when present, (3–) 5(–10); 1 whorled; polypetalous; usually imbricate; regular; white, or yellow, or red, or pink (but not blue)..

Androecium: (1–) 10–100 (usually 'many'). Free of the perianth (but usually attached to a hypanthium); free of one another, or coherent. 1–5 whorled. Androecium exclusively of fertile stamens (normally), or including staminodes (in cultivars). Staminodes when present, 5–50 (several to 'many'); external to the fertile stamens.

Gynoecium: 1–50 carpelled. Gynoecium monomerous, or apocarpous, or syncarpous (*Maloideae*); superior, or partly inferior, or inferior. Placentation when apocarpous or one-carpelled marginal, or apical.

Fruit: fleshy, or non-fleshy; an aggregate (when carpels free). Fruit when syncarpous dehiscent (rarely), or indehiscent; a capsule (*Lindleyella*), or a berry (sometimes in the guise of a pome), or a drupe; enclosed in the fleshy receptacle. Seeds endospermic or non-endospermic.

Some examples of important plants names:

[See Appendix Page 120]

Fragaria sp.

Rosa sp.

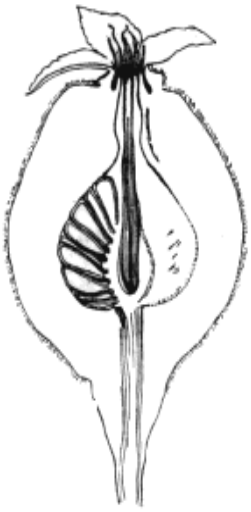
Economic uses: Edible fruit from *Malus* spp. (apples), *Prunus* spp. (Peach), many ornamental trees and shrubs or hedge-plants, e.g. *Rosa sp.* and some widely naturalized pests (e.g. from *Cotoneaster*).

Quince. (*Cydonia vulgaris.*)

Quince.
Vertical section of flower.

Quince.
Diagram.

Pear. (*Pyrus communis.*)



Quince. Vertical section of fruit.

Pear.
Vertical section of
flower.

Pear.
Transverse section
of ovary.

Pear. Seed, entire and cut vertically (mag.).

Pear. Vertical section of fruit.

Caesalpiniaceae and Mimosaceae

Class: Dicotyledonae

Sub-class: Dialypetalae

Order: Leguminosae

Family: Caesalpiniaceae

Family: Mimosaceae

General characters

Leaf form: Leaves evergreen, or deciduous; minute to very large; alternate (usually), or opposite to whorled; petiolate to sessile; compound (commonly), or simple. Stipules intrapetiolar; scaly, or leafy, or spiny.

Inflorescence: Flowers aggregated in 'inflorescences' (usually), or solitary; in panicles, in racemes, in spikes, and in heads.

Floral morphology: Flowers minute to large; regular (Mimosoideae), or somewhat irregular to very irregular (Papilionoideae, most Caesalpinioideae); commonly zygomorphic.

Perianth with distinct calyx and corolla (nearly always), or sepaline (corolla at least sometimes absent in 26 genera of Caesalpinioideae); (3–)5, or (6–)10(–11); 1 whorled (rarely), or 2 whorled.

- Calyx 5, or (3–) 5(–6); 1 whorled; polysepalous, or partially gamosepalous, or gamosepalous (characteristic of most Mimosoideae and Papilionoideae). In Caesalpinioideae, sometimes 2 of the members joined.
- Corolla (1–)3–5 (commonly reduced below five or missing.); 1 whorled; polypetalous (commonly in Caesalpinioideae), or partially gamopetalous (usually, in Papilionoideae), or gamopetalous (in some Mimosoideae)

Androecium: (1–) 9–10, or 10–50 (often 9–10, but commonly fewer, especially in Caesalpinioideae, and sometimes 'many' in Mimosoideae. Androecial members free of the perianth (mostly), or adnate. ; free of one another (sometimes), or coherent (in a variety of configurations); when cohering 1 adelphous, or 2 adelphous.

Gynoecium: 1 carpelled (nearly always), or 2–16 carpelled (in a few Mimosoideae); The pistil 1 celled (nearly always), or 2 celled by a false septum. Placentation marginal.

Fruit: non-fleshy, or fleshy. The fruiting carpel dehiscent, or indehiscent; a legume (usually), or a follicle, or an achene. Seeds endospermic, or non-endospermic.

Economic uses: Numerous cultivated ornamentals, e.g. *Bauhinia*, *Wisteria*, *Acacia*, *Cassia*, *Cytissus*, *Genista*, *Albizia*, *Lathyrus*. Important tropical timbers from *Acacia*, *Albizzia*, *Dalbergia*.

Some examples of important plants names:

Caesalpiniaceae	**Mimosaceae**
Bouhinia variegate	*Acacia farensiana*
Poinciana regia	*Acacia nilotica*
Tamarindus indicus	*Albizzia lebbek*
Ceratonia siliqua	
Cassia nodosa	

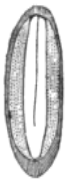
Example:Caesalpiniaceae

Cercis Siliquastrum.

Cercis.
Diagram.

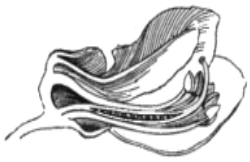
Cercis.
Androecium and pistil (mag.).

Cercis.
Section of seed parallel to plane of cotyledons.



Cercis.
Section of seed perpendicular to plane of cotyledons.

Cercis. Calyx.



Cercis.
Flower cut vertically.

Cercis. Pod.

Cercis.
Seed (mag.).

Cercis.
Pistil.

Cercis.
Wings.

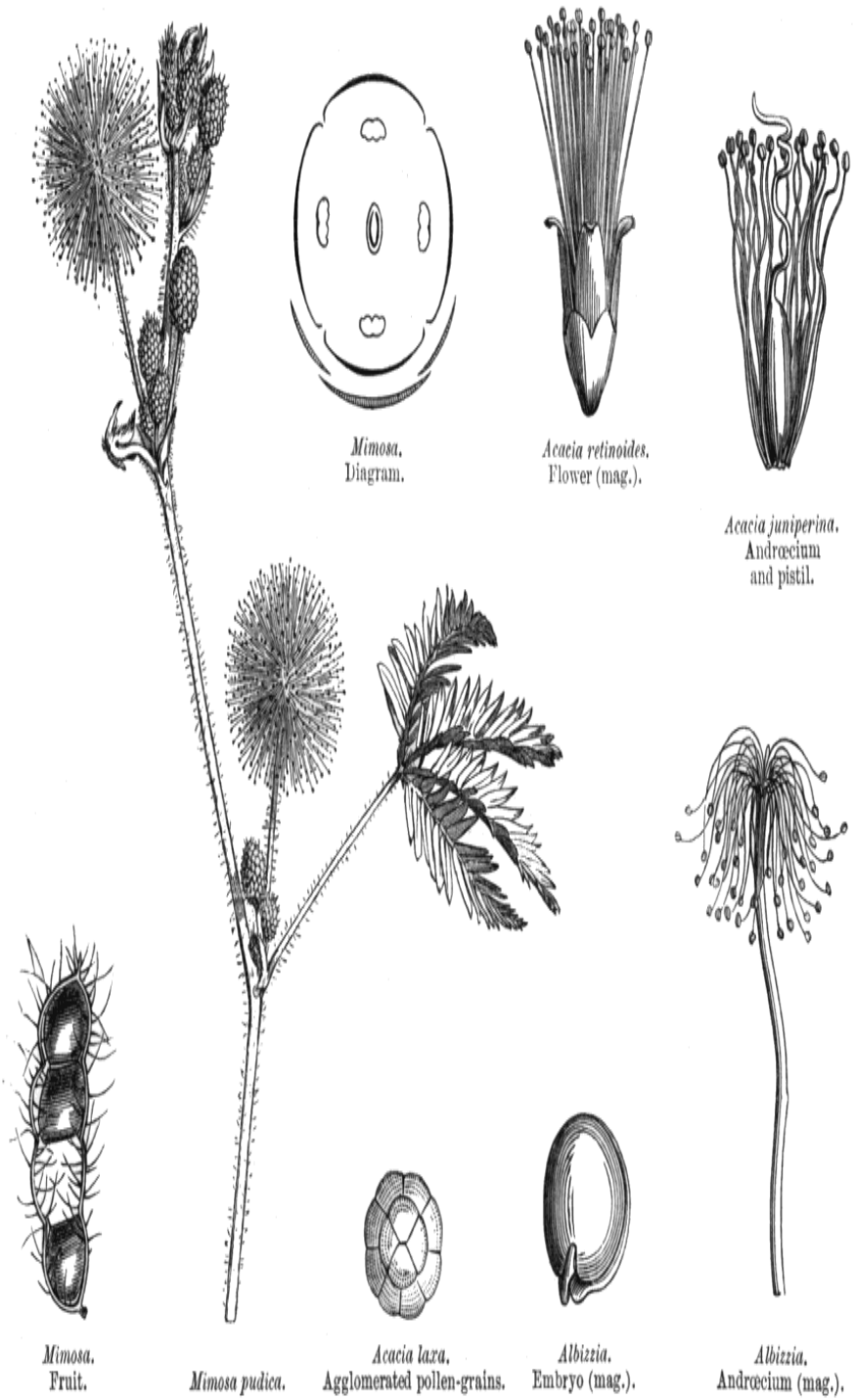
Cercis.
Keel.

Cassia.
Diagram.

Cassia tora.
Transverse section of seed (mag.).

Copaifera Langsdorfii.
Arillate seed (mag.).

Example: Mimosaceae



Tiliaceae

Class: Dicotyledoneae

Subclass: Dialypetalae

Order: Malvales

Family: Tiliaceae

General characters

Leaf form: Leaves alternate or spiral, petiolate; non-sheathing; simple. Lamina dissected, or entire; Leaves stipulate.

Inflorescence: Flowers solitary, or aggregated in 'inflorescences'; in cymes.

Floral morphology: Flowers regular; (3–)5 merous. Hypogynous disk absent.

Perianth with distinct calyx and corolla; with distinct calyx and corolla, or sepaline (corolla rarely lacking); (4–) 5–10; 2 whorled (usually), or 1 whorled.

- Calyx (3–)5; 1 whorled; polysepalous, or gamosepalous (sometimes basally connate); regular; imbricate. Epicalyx present, or absent.
- Corolla normally (4–) 5; 1 whorled; polypetalous; imbricate, or contorted; regular. Petals deeply bifid, or entire.

Androecium: (10–) 15–100 (usually 'many'). Androecial members branched, free of the perianth and free of one another, or coherent; when coherent 1 adelphous, or 5 adelphous, or 10 adelphous; 1–10 whorled.

Gynoecium: 2–100 carpelled (to 'many'), the pistil 1 celled, or 2–100 celled (to 'many'). Gynoecium syncarpous; superior, or inferior (*Neotessmannia*). Ovary 1 locular (the septa incomplete), or 2–100 locular (to 'many' with many ovules. Gynoecium stylate. Styles 1; Stigmas 1; capitate. Placentation when unilocular (i.e. rarely), free central; usually axile.

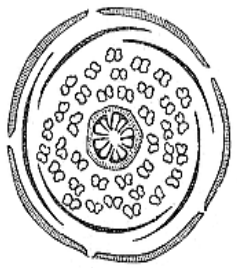
Fruit: fleshy, or non-fleshy; dehiscent, or indehiscent, or a schizocarp.

Some examples of important plants names:

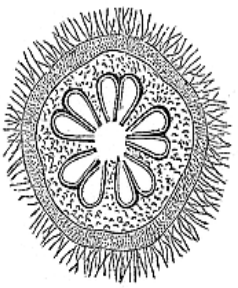
Corchorus olitorius

Tilia sp.

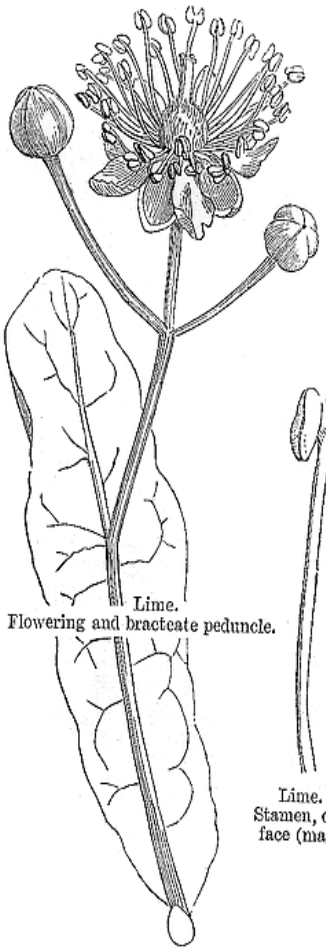
Economic uses: *Tilia* supplies lumber (basswood, whitewood), also ornamental and shade trees popular for street plantings.



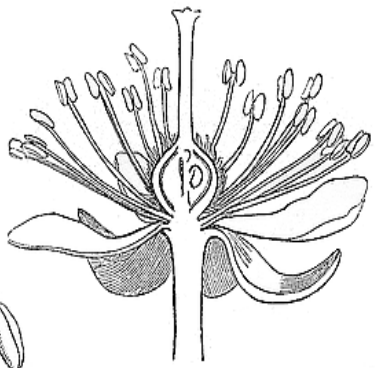
Lime. Diagram.



Lime.
Transverse section of ovary (mag.).

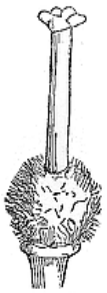


Lime.
Flowering and bracteate peduncle.



Lime.
Vertical section of flower (mag.).

Vertical section of flower



Lime.
Pistil (mag.).

Lime,
Embryo laid open (mag.).

Lime.
Fruit (mag.).

Lime.
Stamen, outer face (mag.).

Lime.
Seed, entire and cut vertically (mag.).

Umbelliferae

Alternatively ***Apiaceae*** Lindl.

Class: Dicotyledoneae

Subclass: Dialypetalyae

Order: Umbelliflorae

Family: Umbelliferae

General characters

Leaf form: Leaves small to large; alternate, or alternate and opposite,simple, or compound; when compound, pinnate, or bipinnate, or multiply compound, or palmate Lamina when simple, entire, when simple/dissected, pinnatifid (usually), or palmatifid. Leaves stipulate or exstipulate.

Inflorescence: umbels (nearly always), or in heads, with involucral bracts.

Floral morphology: Flowers bracteate; mostly small; regular to somewhat irregular. Flowers 5 merous (except for the gynoecium).

Perianth with distinct calyx and corolla, sepaline or petaline; 4–10; 2 whorled, or 1 whorled (rarely).

- Calyx when detectable, 5; 1 whorled; polysepalous, or gamosepalous.
- Corolla 5; 1 whorled; polypetalous; valvate

Androecium: 5. Androecial members free of the perianth, free of one another; 1 whorled. Pollen grains aperturate; (2–) 3 aperturate; mostly (tri-) colporate.

Gynoecium: 2 carpelled. The pistil 1 celled, or 2 celled. Gynoecium syncarpous, inferior.

Ovary (1–) 2 locular, Ovules 1 per locule, or 2 per locule. Placentation axile, or apical.

Fruit: non-fleshy; a schizocarp. Mericarps 2; 1-seeded**,** seeds endospermic and oily.

Some examples of important plants names:

Ammi majus

Apium graveolens (celery)

Carum carvi (caraway)

Chamaele sp.

Coriandrum

Cuminum

Daucus carota (carrot)

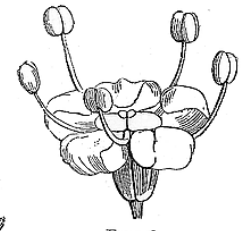
Petroselinum (parsley)

Foeniculum vulgare (fennel)

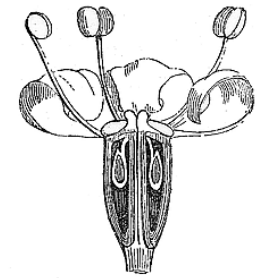
Pimpinella (anise)

Economic uses: Important sources of many foodstuffs and condiments.

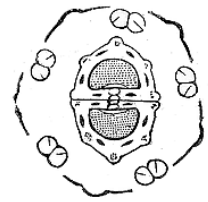
Fœniculum officinale.
Umbel and umbellules without involucre or involucels.



Fennel.
Flower (mag.).

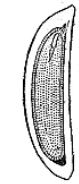


Fennel. Flower cut vertically (mag.).



Fennel.
Diagram.
Calyx suppressed.

Fennel.
Fruit (mag.).
2-partite carpophore.

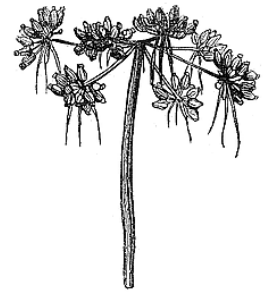


Fennel.
Transverse section of carpel (mag.).

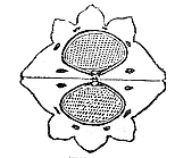
Fennel.
Transverse section of fruit (mag.).
Carpels with five primary sides, furrows 1-vittate; commissural face 2-vittate.

Æthusa.
Vertical section of a semi-globose carpel, with thick wall, showing the minute embryo at the top of the albumen (mag.).

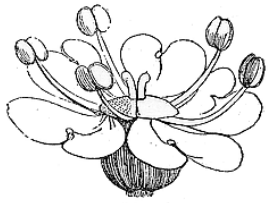
Carrot. (*Daucus Carota.*)
Umbel and umbellules with involucre and involucels.



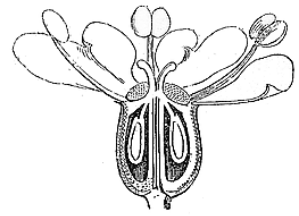
Æthusa Cynapium.
Naked umbel; umbellules with involucels.



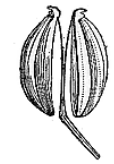
Æthusa.
Transverse section of fruit (mag.). Carpels with five raised and thickened sides: the lateral largest; furrows 1-vittate; commissural face 2-vittate.



Æthusa.
Flower (mag.).



Æthusa.
Flower cut vertically (mag.).



Æthusa.
Fruit.
Bifid carpophore (mag.).

Æthusa.
Umbellule with 3-phyllous involucel.

Euphorbiaceae

Class: Dicotyledonae
Sub-class: Dialypetalae
Order: Geraniales
Family: Euphorbiaceae

General characters

Leaf form: Leaves minute to large; alternate (usually), or opposite to whorled (rarely); leathery, or fleshy, or membranous, or modified into spines; petiolate to sessile; simple (usually), or compound . Lamina entire; pinnately veined, or palmately veined. Leaves stipulate (nearly always, but the stipules sometimes reduced to branched hair like structures, or to glands). Stipules scaly, or leafy, or spiny, or represented by glands.

Inflorescence: The ultimate inflorescence unit nearly always cymose (commonly the first branching racemose, with all the subsequent branching cymose). Inflorescences terminal, or axillary; with involucral bracts, or without involucral bracts.

Floral morphology: Flowers bracteate, or ebracteate, minute, or small, or medium-sized; regular. Hypogynous disk present (commonly).

Perianth sepaline, absent, or petaline (occasionally); when present, (3–) 5or 6(–12); free, or joined; 1 whorled (usually), or 2 whorled. When 2 whorled:

- Calyx 5; polysepalous, or gamosepalous; regular.
- Corolla when present, 5; polypetalous; regular.

Androecium: 1–1000 (i.e. to 'many'). Androecial members branched (e.g. *Ricinus*), or unbranched; free of the perianth; Pollen grains aperturate, or nonaperturate (rarely); 3 aperturate (commonly); colpate, or colporate.

Gynoecium: (2–) 3 carpelled, or 4–30 carpelled (rarely). Gynoecium syncarpous;; superior. Ovary (2–) 3 locular, or 4–30 locular (rarely). Styles 3 (usually), or 6(–12) (or more); free, or partially joined, Stigmas 3 (usually), or 6(–12) (or more); Ovules 1 per locule, or 2 per locule. Placentation axile, or apical.

Fruit: non-fleshy (usually), or fleshy; dehiscent, or indehiscent, or a schizocarp (usually). Mericarps when schizocarpic, (2–)3 (usually, usually dehiscent), Fruit when non-schizocarpic, a capsule, or a drupe. Seeds endospermic (nearly always). Endosperm oily; flat, or folded.

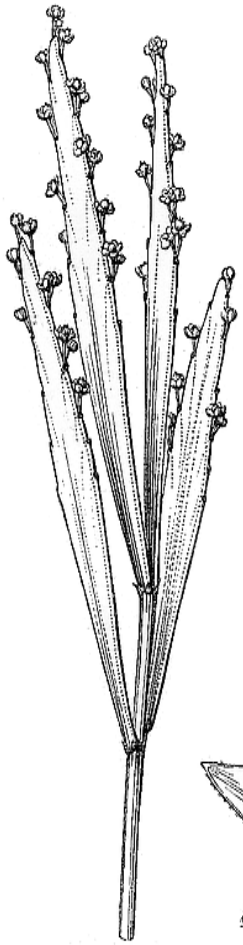
Some examples of important plants names:

Euphorbia sp.

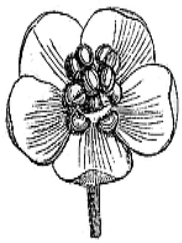
Euphorbia pepulus

Ricinus communis

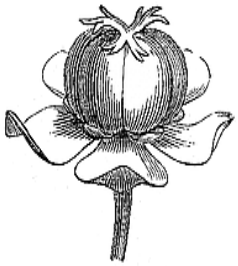
Economic uses: Commercial products include rubber, tung oil, castor oil (*Ricinus*). Many ornamentals, especially from *Euphorbia*.



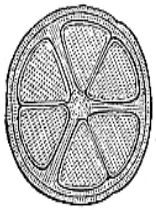
Xylophylla montana.



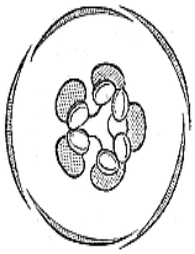
Xylophylla.
♂ flower (mag.).



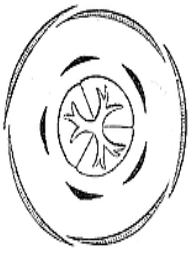
Xylophylla.
♀ flower (mag.).



Xylophylla.
Transverse section of ovary (mag.).



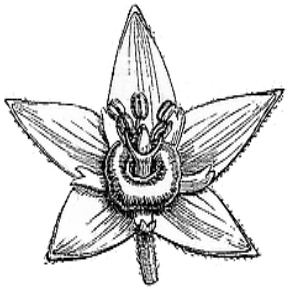
Xylophylla.
Diagram ♂.



Xylophylla.
Diagram ♀.

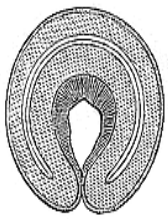
Bridelia.
Seed, septum (*cl.*) and abortive ovules.

Bridelia.
Seed (mag.).



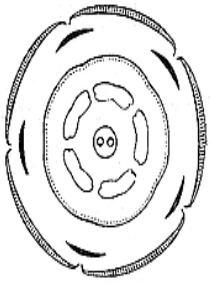
Bridelia glauca.
♂ flower expanded.

Castor-oil plant.
♂ flower.

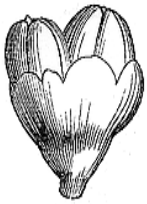


Bridelia.
Seed cut transversely (mag.).

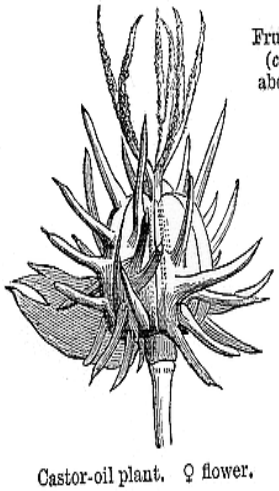
Bridelia.
Fruit cut. Septum (*cl.*) bearing the abortive ovules at the top.



Bridelia. Diagram ♂.



Stillingia.
♂ diandrous flower (mag.).



Castor-oil plant. ♀ flower.

Rutaceae

Class: Dicotyledonae

Sub-class: Dialypetalae

Order: Geraniales

Family: Rutaceae

General characters

Leaf form: Leaves evergreen, or deciduous; alternate, or opposite; petiolate; simple, or compound (usually); Lamina when simple dissected, or entire; sometimes linear.Leaves exstipulate (usually), or stipulate (rarely). Stipules when present, intrapetiolar; represented by glands.

Inflorescence: Flowers solitary (rarely), or aggregated in 'inflorescences'; in cymes, in panicles, in racemes, and in corymbs.

Floral morphology: Flowers bracteate; small to medium-sized; Flowers mostly (3–) 5 merous; Hypogynous disk present.

Perianth with distinct calyx and corolla; (3–) 6, or (6–) 10; 2 whorled.

- Calyx (3–) 4, or 5; 1 whorled; polysepalous, or gamosepalous (basally); regular; imbricate, or valvate.
- Corolla (3–) 4, or 5; 1 whorled; polypetalous, or gamopetalous; imbricate, or valvate.

Androecium: 2, or 3, or 5, or 8, or 10, or 20–60. Androecial members unbranched, or branched; free of the perianth; free or coherent (the filaments usually more or less basally connate); 1 adelphous, or 3–12 adelphous ('polyadelphous' in *Citrus*); 1 whorled, or 2 whorled. Pollen grains aperturate; (2–) 3–6(–8) aperturate; colporate.

Gynoecium: (1–) 3 carpelled (rarely), or 4–5(–100) carpelled, The pistil when syncarpous, (1–) 4–5(–100) celled (to 'many'). Gynoecium apocarpous to syncarpous; Carpel is (1–) 2–100 ovuled (i.e. to many). Styles 1, or 3–5; free or

partially joined; apical. Stigmas wet type, or dry type, Ovules 1–5(–50) per locule (i.e. to many). Placentation of the free carpels marginal; Placentation when syncarpous, axile.

Fruit: fleshy, or non-fleshy; a berry (often in the form of a hesperidium), or a schizocarp, a drupe , a follicle or a samara.

Seeds endospermic or non endospermic.

Some examples of important plants names:

Citrus aurantifolia

Citrus aurantium

Citrus limonia

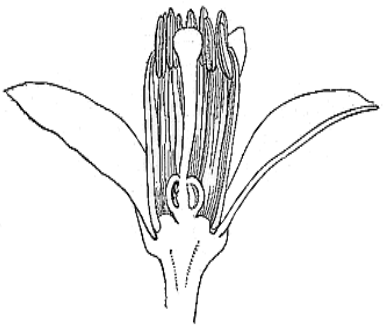
Citrus nobilis

Citrus sinensis

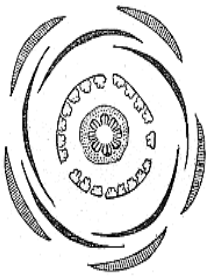
Ruta graveolens

Economic uses: Many edible fruits from *Citrus* spp.,(orange, lemon, lime, grapefruit etc.) several are or have been officinal (*Ruta*, chiefly on account of their oils).

Orange (*Citrus Aurantium*).

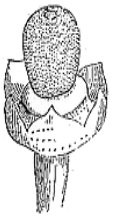


Orange. Vertical section of flower (mag.).

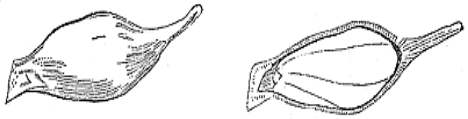


Orange. Diagram.

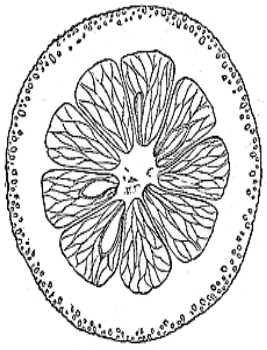
Orange.
Part of andrœcium (mag.).



Orange,
Calyx and ovary (mag.).

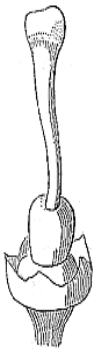


Orange. Seed, entire and cut (mag.).

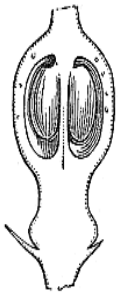


Orange.
Transverse section of
fruit.

Orange.
Calyx and
andrœcium (mag.).



Orange.
Calyx and
pistil (mag.).



Bergera.
Vertical section of
ovary (mag.).

Bergera.
Pistil
(mag.).

Zygophyllaceae

Class: Dicotyledoneae

Sub class: Dialypetaleae

Order: Geraniales

Family: Zygophyllaceae

General characters

Leaf form: Leaves opposite (usually), or alternate, 'herbaceous', or fleshy, or modified into spines; petiolate or sessile. Compound or simple (e.g. *Zygophyllum* and *Fagonia*)

Leaves stipulate, Stipules free and spiny (often) or scaly or leafy.

Inflorescence: cymose(the ultimate unit). Inflorescences terminal, or axillary.

Floral morphology: Flowers ebracteate,regular, cyclic, (4–)5(–6) merous. Hypogynous disk present (usually), or absent.

Perianth: with distinct calyx and corolla (usually), or sepaline**.** (4–) 5, or (8–) 10(–12); (1–) 2 whorled.

- Calyx (4–) 5(–6); 1 whorled; polysepalous, or gamosepalous; regular; imbricate (usually), or valvate.
- Corolla when present, (4–)5(–6); 1 whorled; polypetalous; imbricate, or contorted, or valvate (rarely); regular; white, or yellow, or red, or blue (rarely).

Androecium: (4–)5, or 10, or 15. Androecial members unbranched; free of the perianth; free of one another; 1–3 whorled. Pollen grains aperturate; 3 aperturate, or 4–20 aperturate (to 'polyforate'); colpate, or porate, or colporate.

Gynoecium: (2–)5(–6) carpelled. The pistil (2–)4–12 celled. Gynoecium syncarpous; superior. Styles 1; Stigmas 1; lobed or capitates, Ovary (2–) 5(–6) locular, Ovules 1–50 per locule (to 'several'). Placentation axile.

Fruit: non-fleshy (usually), or fleshy; dehiscent (usually), or indehiscent, or a schizocarp. Mericarps when schizocarpic, 2–5; indehiscent, when non-schizocarpic, a capsule (usually), Capsules septicidal, or loculicidal. Seeds endospermic, or non-endospermic. Endosperm oily.

Some examples of important plants:

Fagonia arabica

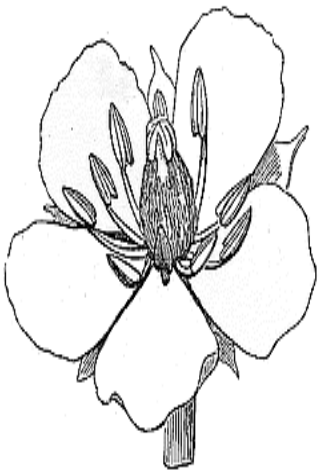
Tribulus sp.

Zygophyllum coccinium

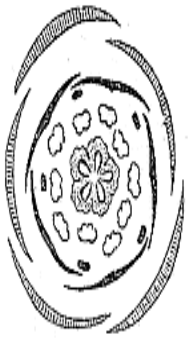
Zygophyllum simplex

Economic uses: *Zygophyllum*, *Tribulus* are cultivated in warm regions as ornamentals.

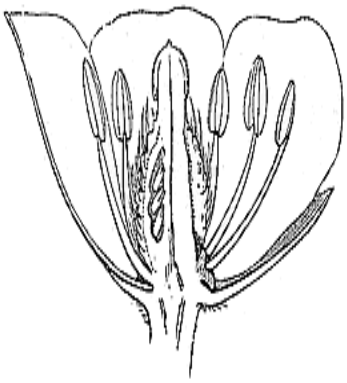
Tribulus terrestris.



Tribulus.
Flower (mag.).

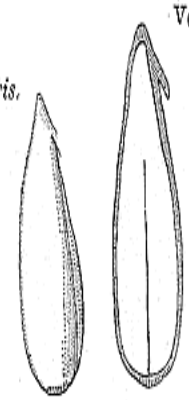


Tribulus.
Diagram.

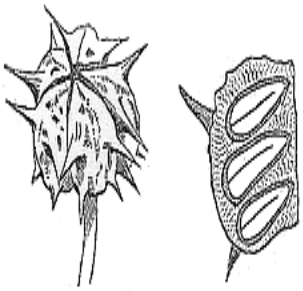


Tribulus.
Vertical section of flower (mag.).

Tribulus.
Pistil (mag.).



Tribulus.
Seed, entire and cut vertically (mag.).



Tribulus.
Fruit, entire and cut vertically.

Portulacaceae

Class: Dicotyledoneae

Sub-class: Symypetalae

Order: Charyophyllales

Family: Portulaceae

General characters

Leaf form: Leaves alternate, or opposite; fleshy (often), petiolate to sessile; non-sheathing; simple. Leaves stipulate, or exstipulate (*Claytonia*). Stipules intrapetiolar; scaly (or sometimes, as in *Portulaca*, represented by axillary hairs).

Inflorescence: Flowers solitary, or aggregated in 'inflorescences'; in cymes.

Floral morphology: *Perianth* with distinct calyx and corolla.

- **Calyx** 2; 1–2 whorled; polysepalous, or gamosepalous (the members sometimes united basally).
- **Corolla** (2–)5(–18); 1 whorled; polypetalous, or gamopetalous (sometimes basally connate). Corolla lobes markedly longer than the tube. Corolla imbricate; regular; white, or yellow, or pink, or purple (often satiny).

Androecium: 5, or 10, or 4–100 (i.e. to 'many'). Androecial members branched (bundled, when 'many'), or unbranched; free of the perianth.

Gynoecium: (2–) 3(–9) carpelled. Carpels reduced in number relative to the perianth. The pistil 1 celled. Gynoecium syncarpous; synovarious, or synstylovarious; superior, or partly inferior (*Portulaca*). Ovary 1 locular. Styles 1, or 3(–9). Placentation basal, or free central. Ovules in the single cavity 2–100 (to 'many').

Fruit: non-fleshy; dehiscent (usually), or indehiscent; a capsule.

Seeds non-endospermic.

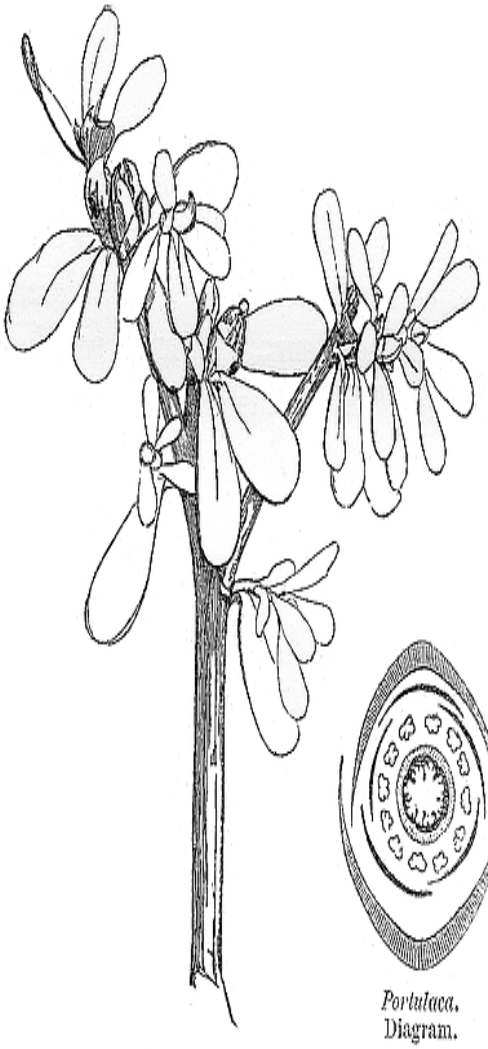
Some examples of important plants names:

Calyptrotheca sp.

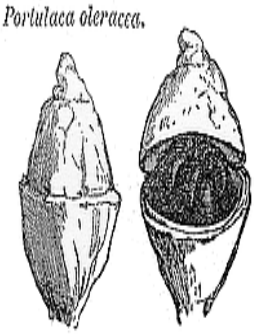
Portulaca oleracea

Talinum sp.

Economic uses: A few cultivated ornamentals (*Portulaca grandiflora*, *Talinum*, *Lewisia* and *Calandrina* spp.), and *Portulaca oleracea* constitutes a potherb and salad green.



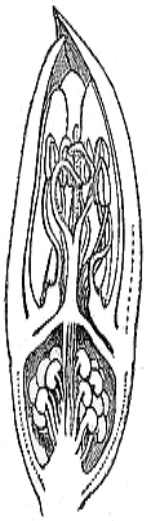
Portulaca oleracea.



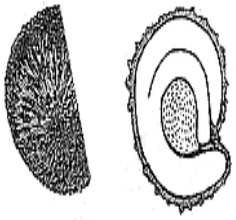
Portulaca.
Fruit, entire and dehiscent.

Portulaca.
Diagram.

Portulaca.
Flower (mag.).

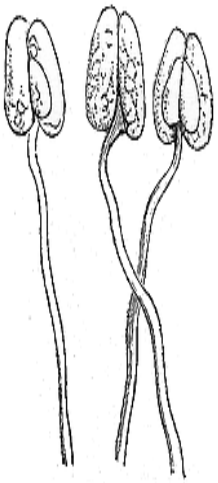


Portulaca.
Flower cut vertically (mag.).



Portulaca.
Seed, entire and cut vertically (mag.).

Portulaca.
Style and stigmas (mag.).



Portulaca.
Stamens (mag.).

Portulaca.
Flower-bud (mag.).

Punicaceae (*Lythraceae)*

Class: Dicotyledoneae

Sub-class: Dialypetalae

Order: Myrtales

Family: Punicaceae

General characters

Leaf form: alternate to opposite; petiolate; non-sheathing; simple. Lamina entire; pinnately veined; leaves exstipulate.

Inflorescence: Flowers solitary, or aggregated in 'inflorescences'.

Floral morphology: *Perianth* with distinct calyx and corolla. 10–16; 2 whorled

- **Calyx** 5–8; 1 whorled; polysepalous (in the form of lobes on the hypanthium); regular; becoming leathery; persistent; valvate.
- **Corolla** 5–8; 1 whorled; polypetalous; imbricate and crumpled in bud; regular. Petals clawed to sessile.

Androecium: 30–100 ('many'). Androecial free of the perianth (but inserted inside the hypanthium); free of one another; about 5–7 whorled.

Gynoecium: 7–9(–15) carpelled. The pistil 7–9(–15) celled. Gynoecium syncarpous; eu-syncarpous; inferior. Styles 1; (slender,simple). Stigmas 1; capitate; wet type; papillate; Placentation axile; in *Punica granatum* placentation is axile and parietal, where the carpels become superposed in two or three layers by differential growth, the lower with axile placentation, the upper parietal). Ovules 20–50 per locule.

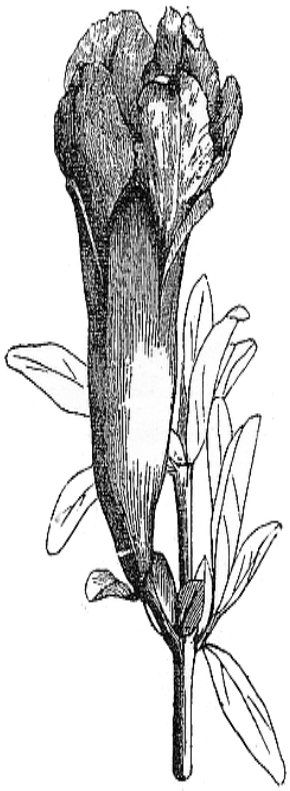
Fruit: fleshy; indehiscent; a berry representing the hypanthium, crowned by the persistent calyx. Seeds non-endospermic.

Some examples of important plants names:

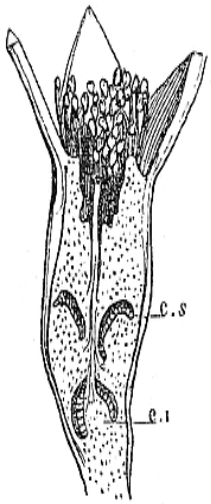
Punica granatum

P. protopunica

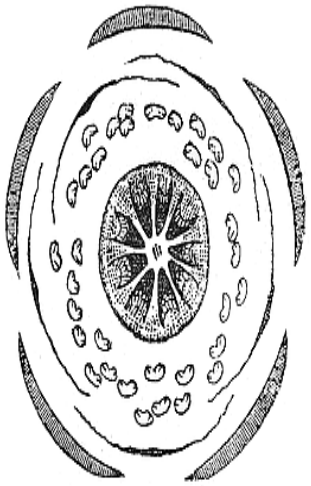
Economic uses: 'Pomegranate' is the berry of *Punica granatum*.



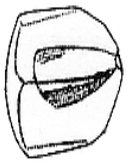
Pomegranate (*Punica Granatum*).

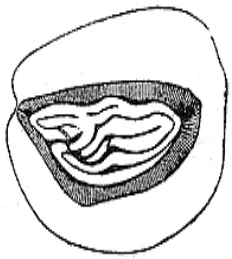


Pomegranate. Vertical section of flower.

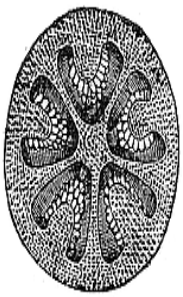


Pomegranate. Diagram.





Pomegranate. Seed entire and cut vertically (mag.).



Pomegranate.
Transverse section of upper chamber of fruit.

Pomegranate.
Transverse section of lower chamber of fruit.

Pomegranate.
Stamens.

Pomegranate.
Seed cut transversely (mag.).

Acanthaceae

Class: Dicotyledoneae

Subclass: Sympetalae

Order: Tubiflorae

Family: Acanthaceae

General characters

Leaf form: opposite (decussate); Lamina dissected, or entire; pinnately veined; cross-venulate. Leaves exstipulate. Lamina margins entire, or crenate, or serrate, or dentate

Inflorescence: Flowers solitary, or aggregated in 'inflorescences'; in cymes, in racemes, and in verticils.

Floral morphology: 4 merous, or 5 merous; Hypogynous disk present.

Perianth with distinct calyx and corolla:

- Calyx (3–) 4, or 5; 1 whorled; gamosepalous; variously entire, or lobulate. Calyx imbricate, or valvate, or contorted.
- Corolla 4, or 5, or 3 (when the upper lip is suppressed); 1 whorled; gamopetalous (at least basally). Corolla imbricate or contorted.

Androecium: 2, or 4(–5). Androecial members adnate (usually exserted, the filaments inserted on the corolla tube); all equal; free of one another, 1 whorled. Androecium of fertile stamens. Anthers separate from one another.

Pollen grains aperturate, or nonaperturate (rarely); 2–8 aperturate; colpate, or porate, or colporate.

Gynoecium: 2 carpelled, syncarpous, superior. Ovary 2 locular. Ovary sessile. Ovules 2–50 per locule (i.e., 2 : many). Styles 1, Stigmas 2. Placentation axile.

Fruit: non-fleshy; dehiscent; a capsule. Capsules loculicidal.

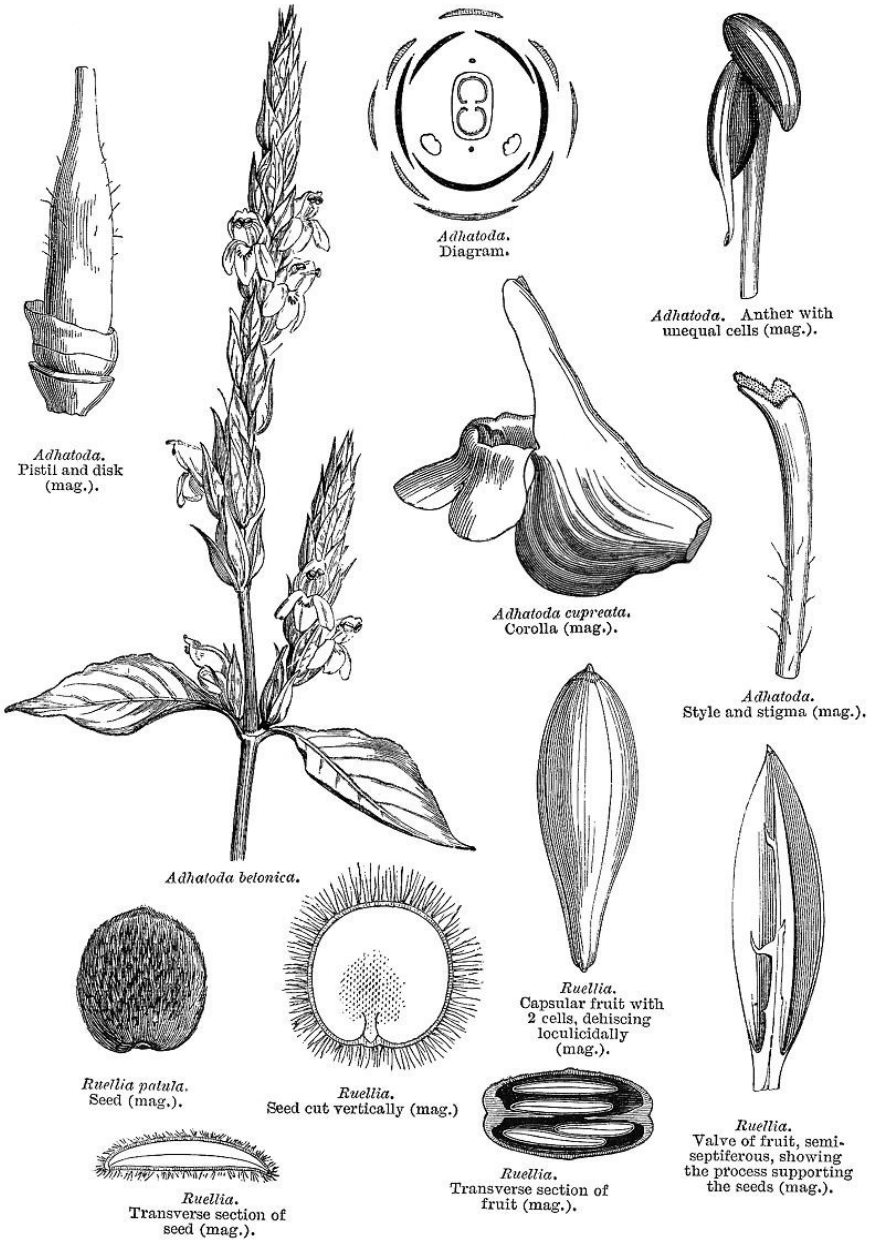
Seeds non-endospermic, hook-like outgrowths and conspicuously or not conspicuously hairy.

Some examples of important plants names:

Acanthus sp.

Adhatoda vasica or (*Justicia angustifolia*)

Economic uses: A few cultivated ornamentals: *Acanthus*, *Fittonia*, *Justicia*, etc.



Verbenaceae

Class: Dicotyledonae

Sub-class: Sympetalae

Order: Tubiflorae

Family: Verbenaceae

General characters

Leaf form: Leaves well developed, or much reduced (occasionally). Leaves opposite (usually), or whorled, or alternate (rarely); petiolate to sessile; simple, or compound; when compound; pinnate (e.g.*Vitex*), or palmate. Lamina dissected, or entire; when dissected, pinnatifid; pinnately veined; Leaves exstipulate.

Inflorescence: Inflorescences terminal, or axillary; in cymes, racemes, spikes, heads, and in verticils.

Floral morphology: Flowers bracteate; small to medium-sized; Flowers (4–)5(–8) merous Hypogynous disk present, or absent.

Perianth with distinct calyx and corolla; (7–) 10(–16); 2 whorled.

- Calyx (2–) 5(–8); 1 whorled; gamosepalous.
- Corolla (4–) 5(–8); 1 whorled; gamopetalous**;** imbricate; tubular (usually), or campanulate (rarely).

Androecium: (2–) 4(–5). Androecial members to the corolla tube (epipetalous), 1 whorled. Pollen grains aperturate; (2–) 3(–5) aperturate, or 6 aperturate; colpate, or colporate, or rugate.

Gynoecium: 2 carpelled (usually), 4 or 5 carpelled, syncarpous and superior. Styles 1; Stigmas 1; 1 lobed, or 2 lobed, Ovules 2 per locule. Placentation basal to axile, or axile.

Fruit: fleshy, non fleshy, dehiscent, non dehiscent or a schizocarp. Seeds non-endospermic.

Some examples of important plants names:

Avicennia officinales

Duranta repens

Duranta repens var. variegate

Lantana camara

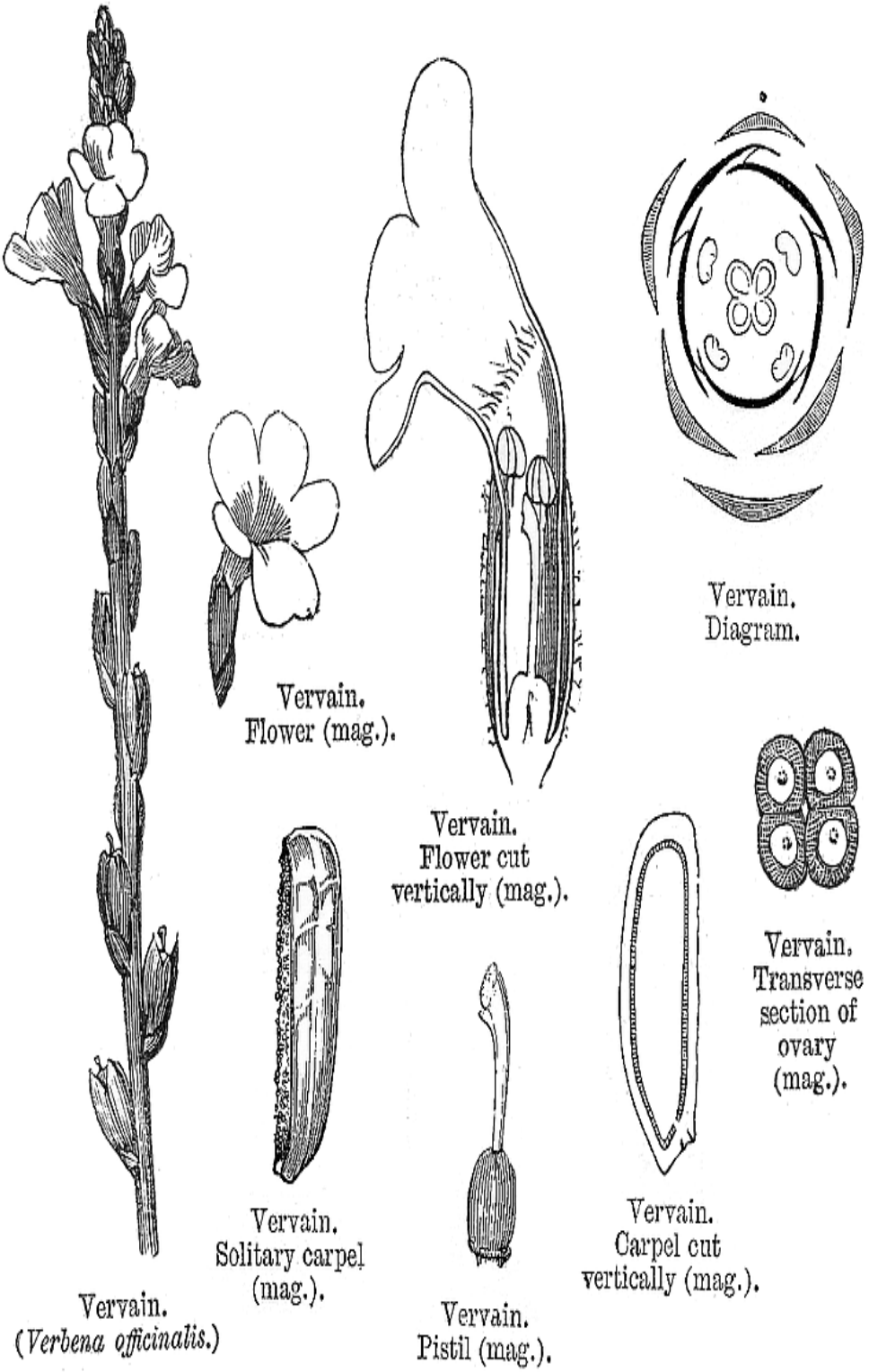
Lippie nodiflora

Tectona grandis (Teak)

Verbena hybrid

Vitex agatus-castus

Economic uses: Timber from Tectona grandis (teak); some notable ornamentals, e.g. *Duranta, Vitex, Verbena, Lantana*


Vervain.
(*Verbena officinalis.*)
Vervain.
Flower (mag.).
Vervain.
Flower cut
vertically (mag.).
Vervain.
Diagram.
Vervain.
Transverse
section of
ovary
(mag.).
Vervain.
Solitary carpel
(mag.).
Vervain.
Pistil (mag.).
Vervain.
Carpel cut
vertically (mag.).

Apocynaceae

Class: Dicotyledonae

Sub-class: Sympetalae

Order: Contortae

Family: Apocynaceae

General characters

Leaf form: Leaves evergreen; alternate, or opposite, or whorled, simple. Lamina entire; pinnately veined. Leaves stipulate (rarely), or exstipulate.

Inflorescence: The ultimate inflorescence unit usually a panicle.

Floral morphology: Flowers bracteate; bracteolate; regular; usually 4–5 merous; Hypogynous disk usually present.

Perianth with distinct calyx and corolla; 10; 2 whorled.

- Calyx 5; 1 whorled; gamosepalous; regular; imbricate (quincuncial).
- Corolla 5; 1 whorled; gamopetalous; Corolla contorted (usually), or valvate (rarely); funnel-shaped, white, or yellow, or red, or pink, or purple, or blue.

Androecium: 5. Androecial members, 1 whorled. Epipetalous; Pollen grains aperturate; (2–)3–4 aperturate; porate, or colporate.

Gynoecium: 2 carpelled or 2–5(–8) carpelled. The pistil 1–2 celled. Gynoecium syncarpous, Styles 1. Stigmas 1, Ovules in the single cavity when unilocular (2:100); when bilocular, 2, 4, 6 or many by locule. Placentation when unilocular, with the two placentas parietal; when bilocular, axile, or apical.

Fruit: fleshy, or non-fleshy; dehiscent, or indehiscent, or a schizocarp. Mericarps when schizocarpic, 2; comprising follicles, Fruit when non-schizocarpic, a capsule, or a berry, or a drupe.

Seeds endospermic, or non-endospermic. Endosperm oily. Seeds usually flat; conspicuously hairy.

Some examples of important plants names:

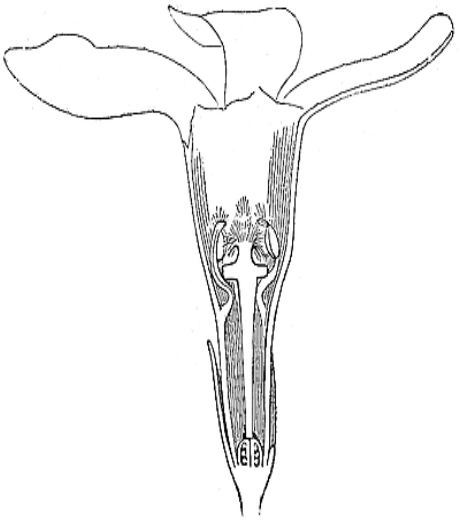
Nerium oleander

Vinca rosa

Thevetia sp.

Economic uses: Many are commercial sources of rubber, numerous showy ornamentals, several sources of drugs and alkaloids, edible fruit ('Natal plum') from *Carissa carandas*.

Small-flowered Periwinkle.

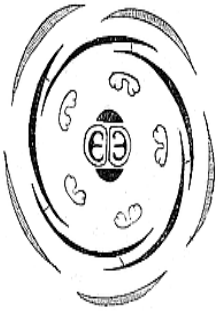


Periwinkle.
Vertical section of flower (mag.).

Periwinkle.
Open follicle.

Periwinkle.
Pistil
(mag.).

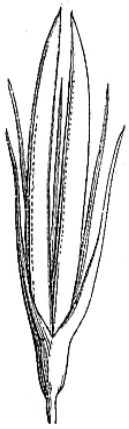
Periwinkle.
Seed cut transversely (mag.).



Periwinkle.
Diagram.

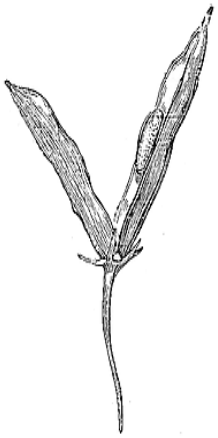
Periwinkle
Stamen
(mag.).

Oleander.
Stamen
(mag.).



Periwinkle.
Ovaries and calyx
(mag.).

Periwinkle.
Young
fruit.



Periwinkle.
Ripe fruit separated into
2 follicles.

Periwinkle.
Seed, ventral face
(mag.).

Periwinkle.
Seed cut vertically
(mag.).

Asclepiadaceae

Class: Dicotyledonae

Sub-class: Sympetalae

Order: Contortae

Family: Asclepiadaceae

General characters

Leaf form: Leaves opposite, decussate or alternate, simple, entire and exstipulate. In xerophytic species leaves reduced to spines.

Inflorescence: usually a dichasial cyme or sometimes racemose or umbellate.

Floral morphology: Flowers regular; 5 merous. Hypogynous disk absent.

Perianth with distinct calyx and corolla; 10; 2 whorled.

- Calyx 5; 1 whorled; usually gamosepalous (at the base). Calyx lobes markedly longer than the tube. Calyx regular; imbricate, or valvate.
- Corolla 5; 1 whorled; appendiculate (with a corona, simple or of separate scales, in only *Gymnema*, *Leptadenia*, *Oxystelma*), or not appendiculate (mostly); gamopetalous (the tube short). Corolla lobes about the same length as the tube, or markedly longer than the tube. Corolla contorted.

Androecium: Androecial members adnate; united with the gynoecium (forming a gynostegium with it).1 adelphous; 1 whorled. Androecium exclusively of fertile 5 stamens.

Gynoecium: 2 carpelled, the pistil 2 celled, syncarpous gynoecium (but the carpels united only by their styleheads i.e. stigmas), superior. Placentation marginal or axile.

Fruit: non-fleshy; an aggregate (of two carpels), dehiscent; comprising a pair of 'follicles'. Seeds endospermic. Endosperm oily. Seeds conspicuously hairy, winged or wingless.

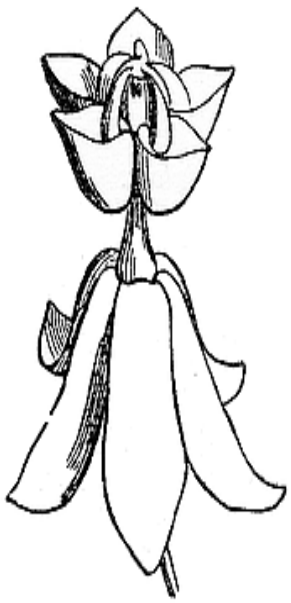
Some examples of important plants names:

Asclepias sp.

Calotropis procera

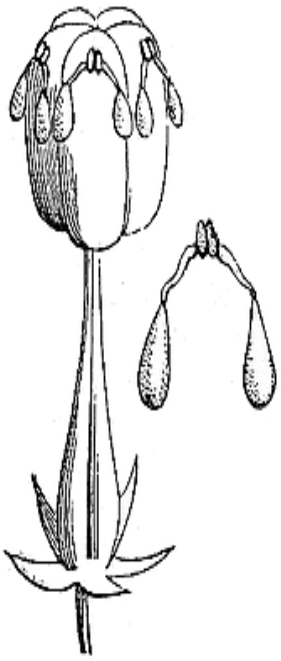
Tylophora indica

Economic uses: the members of the family are important for ornamental and drugs and for floss of seeds.

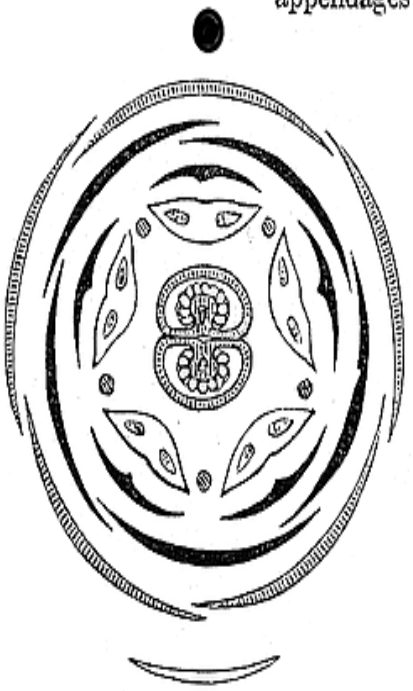


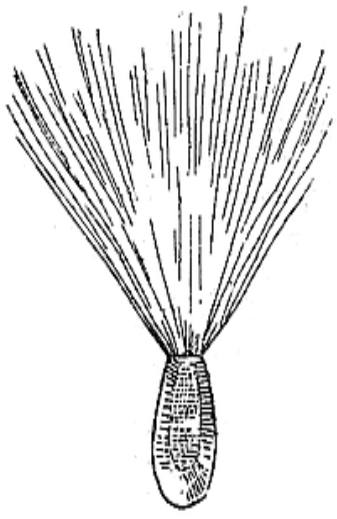
Asclepias.
Flower (mag.).

Asclepias.
Stamen furnished with its appendages (mag.).



Asclepias.
Pistil bearing pollen-masses (mag.).





Asclepias.
Seed (mag.).

Solanaceae

Class: Dicotyledoneae

Sub-class: Sympetalae

Order: Tubiflorae

Family: Solanaceae

General characters

Leaf form: Leaves alternate, or alternate to opposite simple, or compound; Lamina dissected, or entire and exstipulate.

Inflorescence: cymose. Inflorescences terminal, or axillary.

Floral morphology: Flowers small to medium-sized, regular or somewhat irregular, Flowers mostly (4–) 5 merous; cyclic, Hypogynous disk usually present.

Perianth with distinct calyx and corolla; 10 (nearly always); 2 whorled.

- Calyx (4–) 5(–7); 1 whorled; gamosepalous. Calyx regular and persistent.
- Corolla (4–) 5(–7); 1 whorled; gamopetalous. Imbricate, valvate, or contorted; rotate, or campanulate, or funnel-shaped, or tubular.

Androecium: 5 (usually), Androecial members adnate (epipetalous, on the tube); all equal (often),in 1 whorled. Pollen grains aperturate (usually), or nonaperturate; (2–)3–5(–6) aperturate; colpate, or colporate.

Gynoecium: 2 carpelled, Gynoecium syncarpous, superior and oblique (the posterior carpel to the right). Styles 1, Stigmas 1–2 Ovary 2 locular**.**

Ovules 1–50 per locule (i.e. to 'many'). Placentation axile (the placentae usually more or less swollen).

Fruit: fleshy, or non-fleshy; dehiscent, or indehiscent; a capsule, or a berry, or a drupe. Capsules septicidal (commonly), or loculicidal. Seeds endospermic (usually). Endosperm oily (usually), or not oily.

Some examples of important plants:

Capsicum sp.

Datura inoxia

Datura stramonium

Hyoscyamus muticus

Lycium sp.

Nicotiana tobacco

Solanum lycopersicum

Solanum nigrum

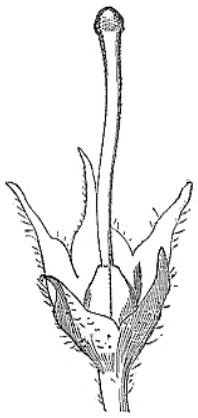
Solanum melongena

Solanum tubersum

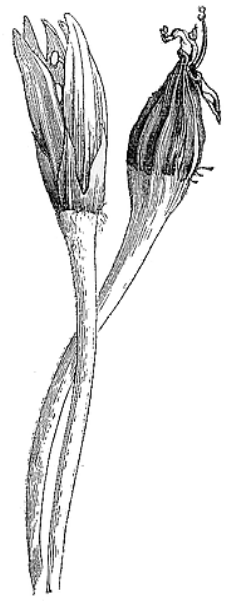
Withania somnifera

Economic uses: Products include potato and eggplant (*Solanum* spp.), and tomato (*Lycopersicon*). Other edible fruits, *Capsicum* (sweet and chilli peppers), Most produce poisonous alkaloids, and some are commercially important in this connection (*Nicotiana*, *Hyoscyamus*, *Datura*). Many cultivated ornamentals, e.g. *Lycium*, *Solanum.*

Solanum tuberosum.

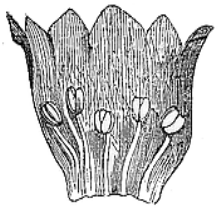


Solanum.
Calyx and pistil (mag.).



Mandragora.
Flowers.

Mandragora.
Corolla and androecium laid open.

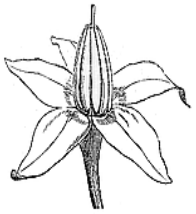


Belladonna.
Corolla and androecium laid open.

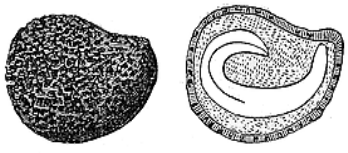
Mandragora.
Pistil.

Mandragora.
Flower cut vertically.

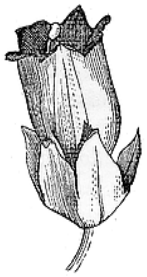
Solanum.
Diagram.



Bitter-sweet.
Flower (mag.).

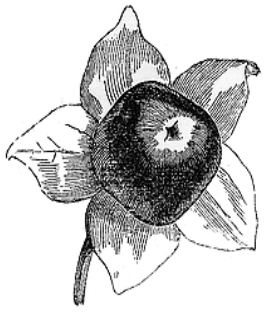


Belladonna.
Seed, entire and cut longitudinally (mag.).



Belladonna.
Flower.

Belladonna.
Pistil.



Belladonna.
Berry.

Cucurbitaceae

Class: Dicotyledonae

Sub-class: Sympetalae

Order: Cucurbitales

Family: Cucurbitaceae

General characters

Leaf form: Leaves alternate; spiral; petiolate; simple, or compound. Lamina dissected, or entire; when simple/dissected, palmatifid; usually palmately veined.

Inflorescence: Flowers solitary, or aggregated in 'inflorescences'.

Floral morphology: Flowers small to large; regular and imperfect.

Perianth with distinct calyx and corolla; (6–) 10 (–12); 2 whorled.

- Calyx (3–) 5(–6); 1 whorled; gamosepalous; regular; imbricate.
- Corolla (3–) 5(–6); 1 whorled; polypetalous, or gamopetalous; more or less valvate or imbricate; regular; green, or white, or yellow, or orange.

Androecium: 5 ('essentially'), or 3 by reduction. Androecial members branched and unbranched; variously coherent by connate filaments, or in *Cucurbita* by cohesion of the anthers into a column, or free of one another. When coherent, commonly 1 adelphous or 2 adelphous; 1 whorled. Androecium exclusively of fertile stamens.

Gynoecium: 1 carpelled, or (2–) 3(–5) carpelled. Carpels reduced in number relative to the perianth. The pistil 1 celled. Inferior ovary and Placentation usually parietal; or axile.

Fruit: fleshy (usually) berry, or non-fleshy (sometimes) dehiscent or non-dehiscent.

Seeds non-endospermic; medium sized to large; often flattened, winged, or wingless. **Some examples of important plants names:**

Citrullus colocynesis

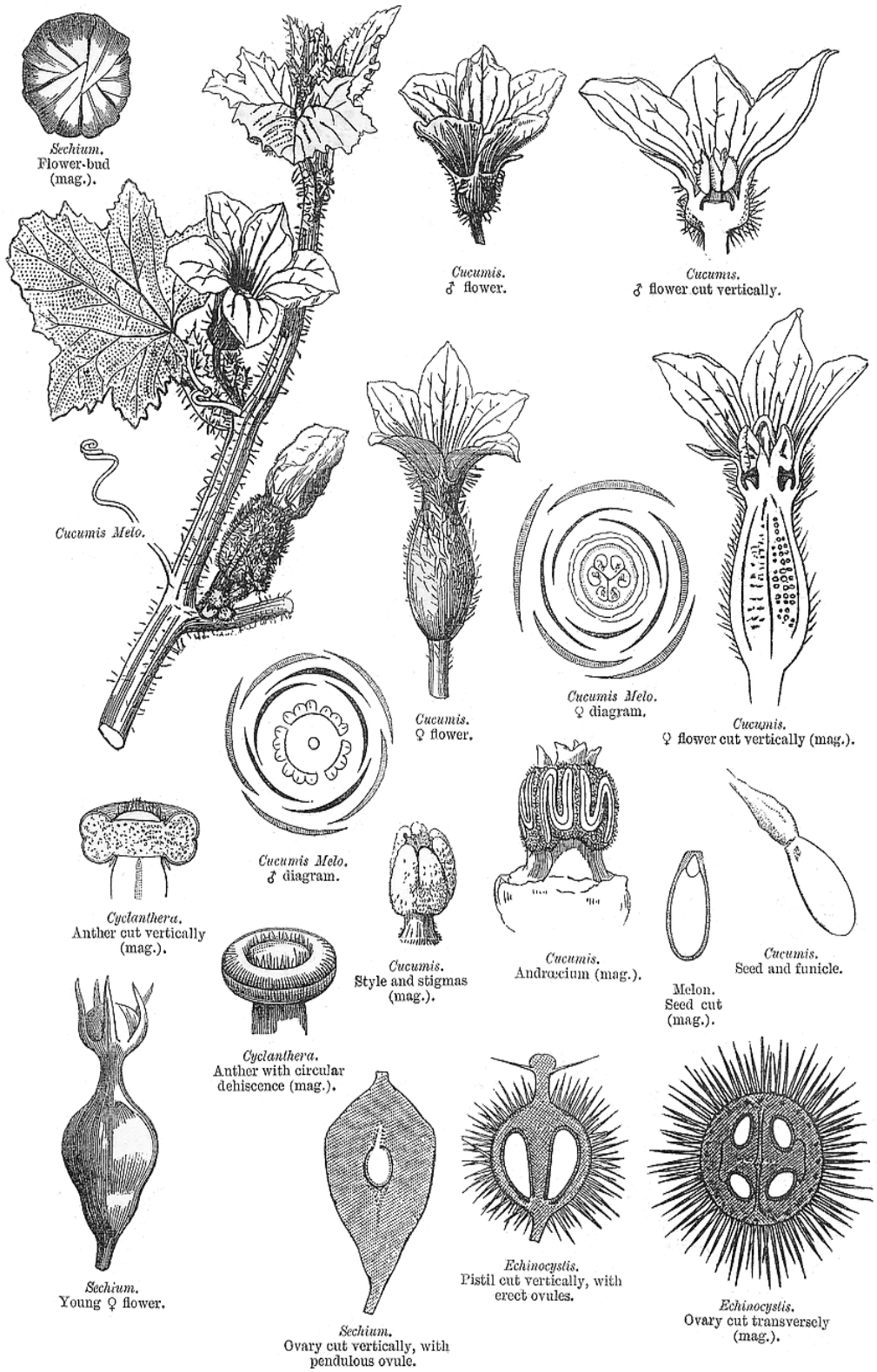
Cucumis

Cucurbita

Cucurbita

Luffa cyliderica

Economic uses: Many sources of important edible fruits, e.g. *Cucurbita*, *Cucumis*, *Lagenaria*, *Sechium* (melons, cucumbers, etc.), and some are poisonous.


Sechium.
Flower-bud
(mag.).
Cucumis Melo.
Cucumis.
♂ flower.
Cucumis.
♂ flower cut vertically.
Cucumis.
♀ flower.
Cucumis Melo.
♀ diagram.
Cucumis.
♀ flower cut vertically (mag.).
Cucumis Melo.
♂ diagram.
Cyclanthera.
Anther cut vertically
(mag.).
Cucumis.
Style and stigmas
(mag.).
Cucumis.
Androecium (mag.).
Melon.
Seed cut
(mag.).
Cucumis.
Seed and funicle.
Cyclanthera.
Anther with circular
dehiscence (mag.).
Sechium.
Young ♀ flower.
Sechium.
Ovary cut vertically, with
pendulous ovule.
Echinocystis.
Pistil cut vertically, with
erect ovules.
Echinocystis.
Ovary cut transversely
(mag.).

Compositae (alternatively named ***Asteraceae***)

Class: Dicotyledoneae

Subclass: Sympetalae

Order: Synanderae

Family: Compositae

General characters

Leaf form: Leaves well developed, or much reduced (sometimes). Leaves alternate (usually), or opposite (less often), or whorled (rarely); Lamina dissected, or entire; pinnatifid, or palmatifid, Leaves exstipulate (nearly always), or stipulate (rarely). Lamina margins entire, or crenate, or serrate, or dentate.

Inflorescence: Flowers aggregated in 'inflorescences'; in heads.

Floral morphology: Flowers bracteate (the bracts forming an involucre in one to several series); minute to small; regular and somewhat irregular.

Perianth with distinct calyx and corolla or petaline (calyx sometimes absent), (1–) 3–35; 1 whorled, or 2 whorled.

- Calyx when present, (1–)2–30 (of scales, awns or bristles constituting the 'pappus'); represented by bristles (commonly). 1 whorled.
- Corolla 1–3 (ligulate florets), or (4–)5 (disk florets); 1 whorled; gamopetalous; valvate

Androecium: 3–5. Androecial members adnate; coherent; 1 whorled. Anthers cohering (nearly always, forming a tube around the style — with a few exceptions.

Gynoecium: 2 carpelled. The pistil 1 celled. Gynoecium syncarpous; inferior. Ovary 1 locular. Placentation basal. Ovules in the single cavity 1.

Fruit: non-fleshy; indehiscent; a cypsella (almost invariably), or a drupe (occasionally). Seeds non-endospermic or with thin endosperm.

Some examples of important plants names:

Hlianthus annus

Lactuca sativa

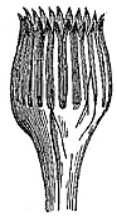
Carthamus tinctorius

Cynura scolymus

Sonchus oleraceus

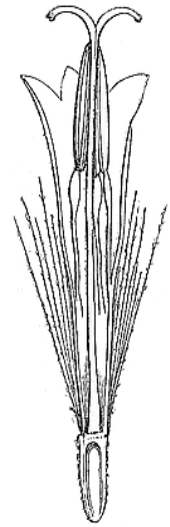
Economic uses: Sources of foodstuffs include *Lactuca* (lettuce), Insecticides from safflower dye from *Carthamus*. At least 200 genera are widely planted as ornamentals.

Senecio Jacobœa.
(Tubulifloral.)

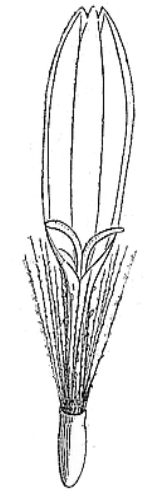


Groundsel.
Closed head (mag.).

Groundsel.
☿ Floret (mag.).

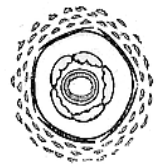


Groundsel.
☿ floret cut vertically (mag.).

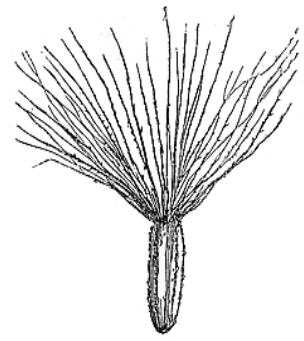


Groundsel.
♀ floret (mag.).

Chrysanthemum.
Pistil (mag.).



Groundsel.
Diagram (mag.).



Groundsel. Fruit (mag.).

Groundsel,
☿ floret. Pistil (mag.).

Milfoil.
(Tubulifloral.)

Achillea.
Head (mag.).

Chrysanthemum.
♀ floret.

Chrysanthemum.
☿ floret (mag.).

Milfoil.
☿ floret (mag.).

Milfoil.
♀ demi-floret (mag.).

Division: Emberyophta

Sub-division: Angiospermae

Selected Families of Monocots

Taxonomic position of ***Gramineae*** Alternatively ***Poaceae***

Class: Monocotyledoneae

Order: Glumiflorae

Family: Graminae

General characters

Leaf form: Leaves evergreen, or deciduous; minute to large; alternate,sessile or petiolate. Lamina entire; linear to obovate and parallel-veined (usually).

Inflorescence: Flowers aggregated in 'spikelets', Inflorescences terminal, or axillary; with 1–50 florets.

Floral morphology: Flowers bracteates in association with specialised bracts termed 'glumes', 'lemmas' and 'paleas',the flowers are minute to small, hypogynous disk absent.

Perianth 0, or (1–) 2–3(–6); (lodicules) free to joined; 1 whorled.

Androecium: (1–)2–3, or 4 (rarely), Androecial members free of the perianth, or adnate; usually free of one another, or coherent. Pollen grains aperturate; 1 aperturate, porate.

Gynoecium: theoretically 2(–3) carpelled. The pistil 1 celled. Gynoecium syncarpous; Ovary 1 locular, ovules in the single cavity 1; sessile Styles 1, or 2(–3); Stigmas (1–) 2–3.

Fruit: non-fleshy (usually), or fleshy (occasionally); indehiscent; a caryopsis (usually). Seeds nearly always endospermic.

Some examples of important plants:

Avena sp.

Cymbopogon sp

Cynodon dactylon

Dichanthelium annulatum

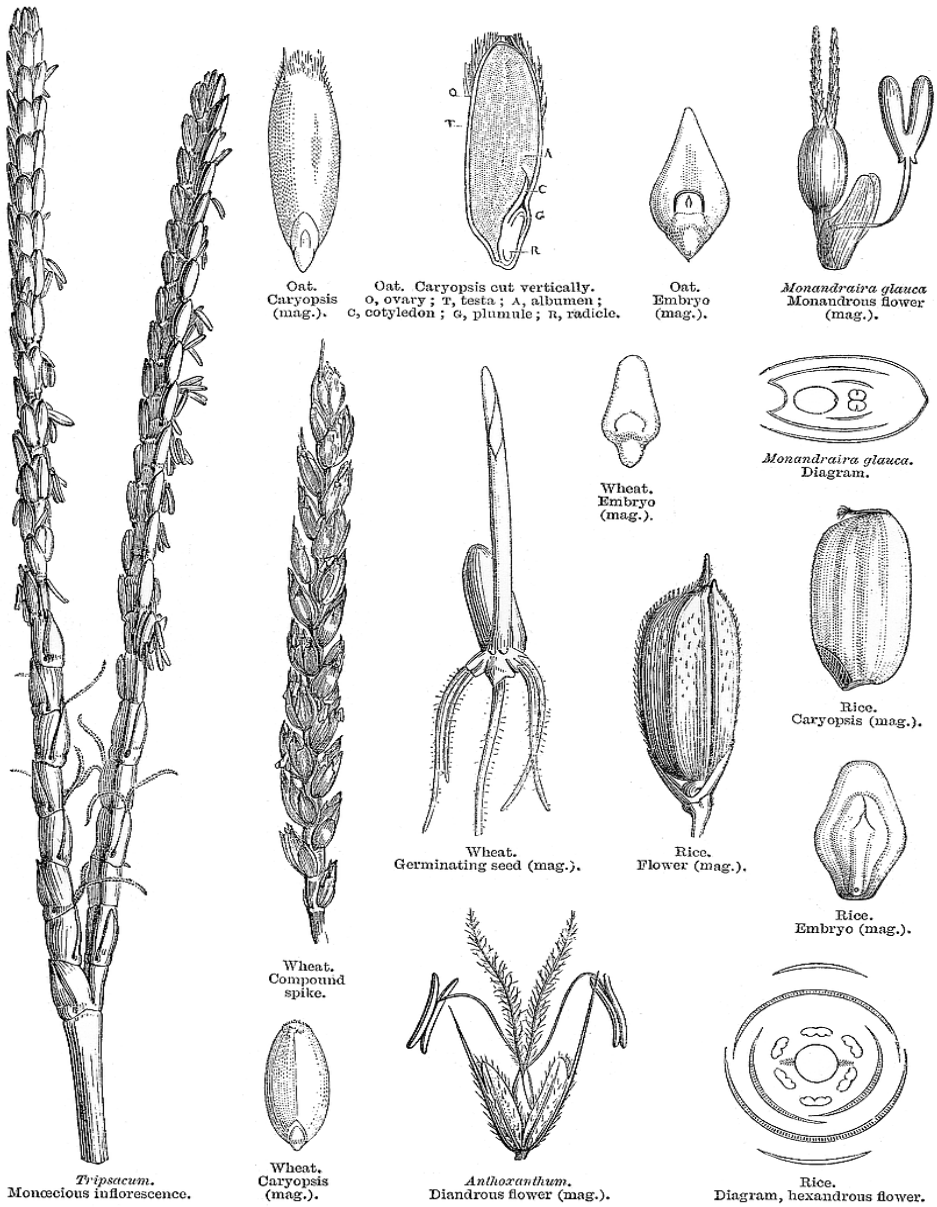
Oryza sativa

Sorghum varigatum

Triticum vulgare

Zea mays

Economic uses: Economically the most important of families — cereals,



sugarcane, fodder and pasture alcohol, thatching, matting, bamboo construction work, etc.

Palmae

Alternatively ***Arecaceae*** Schultz-Schultzenst. (nom. altern.)

Class: Monocotyledonae

Order: Principes

Family: Palmae

General characters

Leaf form: Leaves evergreen; small to very large; alternate; petiolate, leaves nearly always compound; pinnate, or palmate.

Inflorescence: Flowers aggregated in panicles (usually, and usually complex), when complex; usually spatheate. Inflorescences axillary (usually), or terminal.

Floral morphology: Flowers small; more or less regular; 3 merous; cyclic (usually).

Perianth: with distinct calyx and corolla, or of 'tepals',or absent.

Androecium: 3, or 6, or 9, or 10–900 (i.e. occasionally very numerous). Androecial members free of the perianth, or adnate, 1 adelphous; 2 whorled, or 3 whorled. Pollen grains aperturate; 1 aperturate (usually), or 2 aperturate; sulcate.

Gynoecium: 3(–10) carpelled; Gynoecium apocarpous, or syncarpous, ovary when syncarpous 1 locular or 3(–10) locular, ovules 1 per locule. Styles 1, or 3(–10). Placentation sub apical, or basal

Fruit: fleshy, or non-fleshy; an aggregate (occasionally), Fruit indehiscent (usually), or dehiscent (rarely); nearly always a berry, or a drupe. Fruit 1 seeded. Seeds endospermic.

Some examples of important plants:

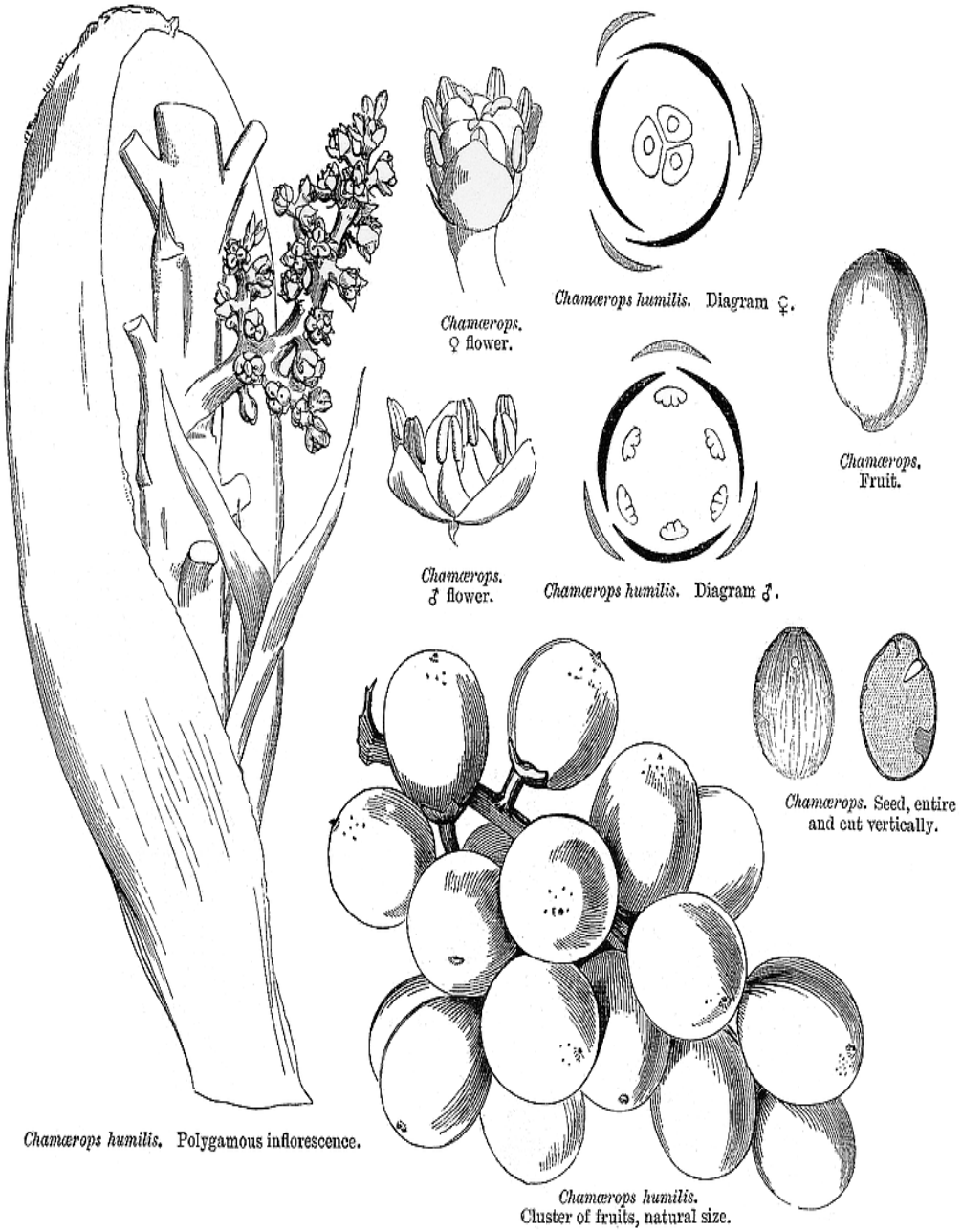
Cocos sp.

Hyphaene thebiaca

Latania sp.

Washingtonia sp.

Economic uses, etc. Pantropically of great economic importance: coconut products, oils, dates, ivory nuts, carnauba wax, rattan cane, raffia, etc.



Asparagaceae Juss.

Class: Monocotyledonae

Order: Aspraragales

Family: Asparagaceae

General characters

Leaf form. Leaves much reduced (to small bractlike structures). The herbs perennial; without conspicuous aggregations of leaves; rhizomatous. Leaves alternate; membranous (scales); more or less sheathing; simple. Lamina entire; parallel-veined. Leaves exstipulate.

Inflorescence: Flowers solitary, or aggregated in 'inflorescences'; when aggregated, in cymes, or in racemes, or in umbels. The ultimate inflorescence units probably cymose. Inflorescences umbel-like or racemelike, but probably always determinate?.

Floral morphology: Flowers small; regular; 3 merous; cyclic. *Perianth* of 'tepals'; 6; free, or joined; 2 whorled; isomerous; sepaloid, or petaloid; similar in the two whorls; green, or white, or yellow. Tepal apex trichomes (TAT) absent (*Asparagus*).

Androecium: 6. Androecial members adnate (at the base of the perianth); free of one another; 2 whorled. Androecium exclusively of fertile stamens (in male and hermaphrodite flowers). Stamens 6; diplostemonous. Anthers dorsifixed, or basifixed; dehiscing via longitudinal slits; introrse. Pollen grains aperturate; 1 aperturate.

Gynoecium: 3 carpelled. Carpels isomerous with the perianth. The pistil 3 celled. Gynoecium syncarpous; synstylovarious to eu-syncarpous; superior. Ovary 3 locular. Gynoecium stylate. Styles 1; apical; shorter than the ovary to about as long as the ovary (usually rather short). Stylar canal present. Stigmas wet type, or dry type. Placentation axile. Ovules 2–12 per locule.

Fruit: fleshy; indehiscent; a berry. Seeds endospermic. Endosperm oily. Embryo well differentiated. Cotyledons 1. Embryo straight, or curved. Testa 'often' black.

Examples of species:

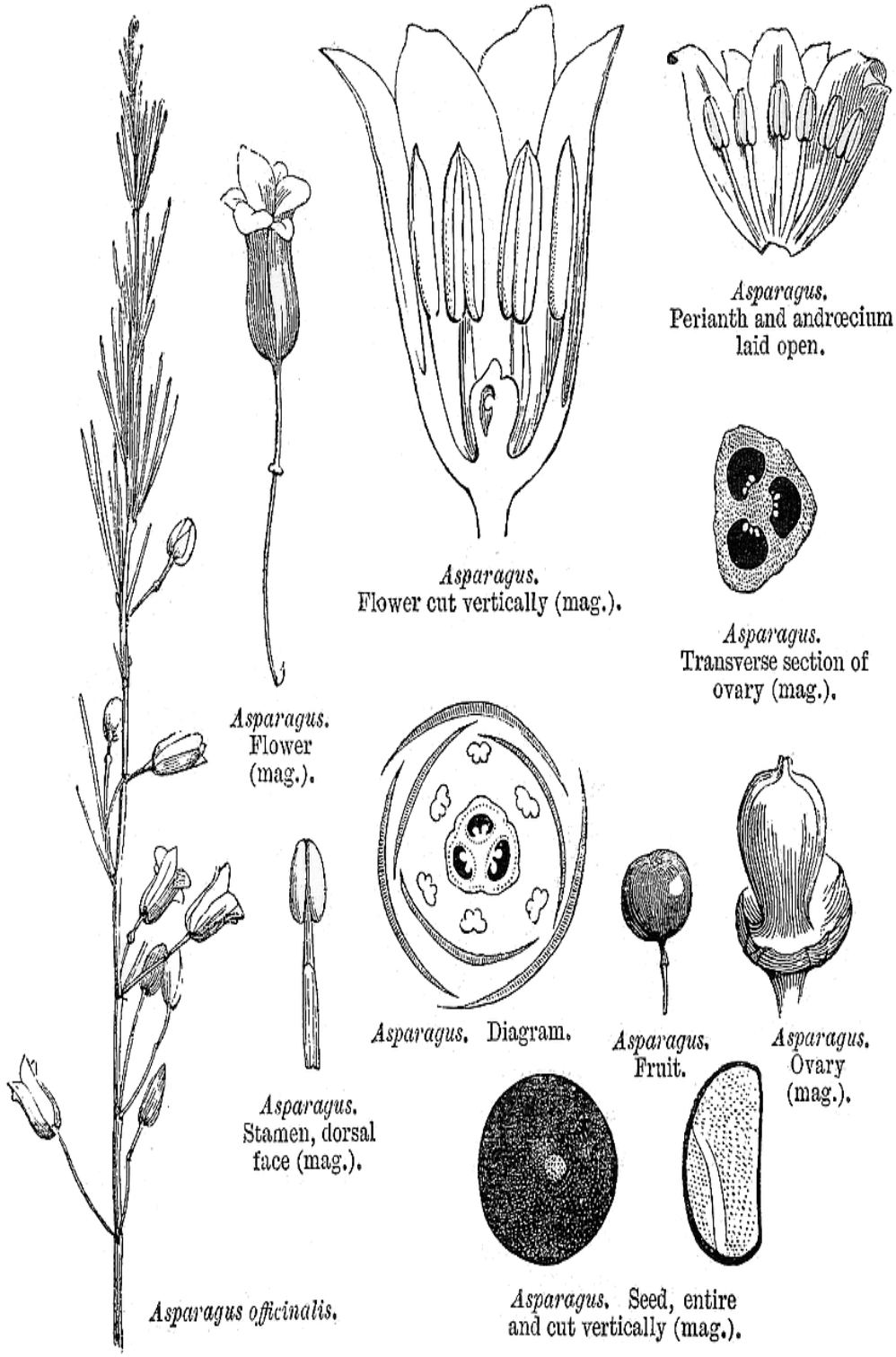
Asparagus,

Hemiphylacus(?),

Myrsiphyllum,

Protasparagu.

Economic uses: Cultivated ornamentals, and culinary asparagus (*A. officinalis*).


Asparagus officinalis.
Asparagus. Flower (mag.).
Asparagus. Stamen, dorsal face (mag.).
Asparagus. Flower cut vertically (mag.).
Asparagus. Perianth and androecium laid open.
Asparagus. Transverse section of ovary (mag.).
Asparagus. Diagram.
Asparagus. Fruit.
Asparagus. Ovary (mag.).
Asparagus. Seed, entire and cut vertically (mag.).

Typhaceae Juss.

Class: Monocotyledonae

Order: Typhales

Family: Typhaceae

General characters

Habit and leaf form: Aquatic herbs. Perennial; with a basal aggregation of leaves, or without conspicuous aggregations of leaves; rhizomatous. Leaves emergent. Leaves alternate; distichous; triangular in section or flat; leathery; sessile; sheathing; simple. Lamina entire; linear; parallel-veined; without cross-venules. Leaf development 'graminaceous'.

Inflorescences scapiflorous; terminal; a dense compound spike, with condensed secondary/tertiary branches formed from closely approximated annular meristems, the female flowers in the lower part, the males above.

Floral morphology: Flowers small. Floral receptacle developing a gynophore, or with neither androphore nor gynophore.

Perianth vestigial (in the form of simple, lobed or forked hairs); 1–10(–20) (? — commonly 3 in the males, 1–4 in the females); free, or joined (somewhat adnate to the slender, elongated axis); 1–5 whorled (irregular).

Androecium: (1–)3(–5). Androecial members free of the perianth; coherent (by the filaments); 1 adelphous (the filaments joined basally for variable distances). Androecium exclusively of fertile stamens. Stamens (1–)3(–5). Anthers basifixed; non-versatile; dehiscing via longitudinal slits. Pollen grains aperturate; 1 aperturate.

Gynoecium: 1 carpelled. The pistil 1-celled. Gynoecium monomerous; of one carpel; superior. Carpel stylate; apically stigmatic; 1 ovuled. Placentation apical. Stigmas dry type; non-papillate.

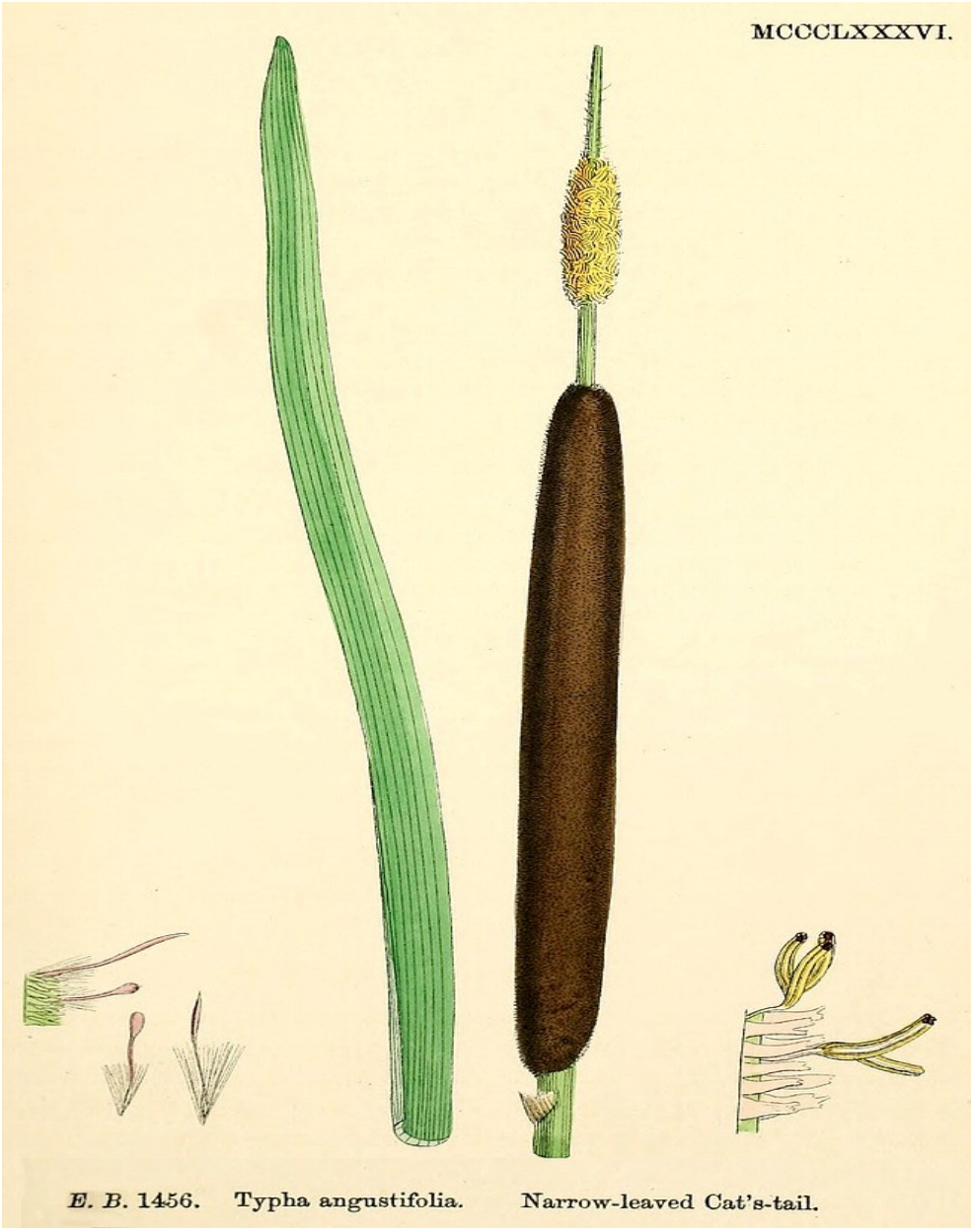
Fruit: non-fleshy. The fruiting carpel dehiscent; a follicle (but this tiny and achene-like before dehiscence). Dispersal unit with the perianth-hairs forming a

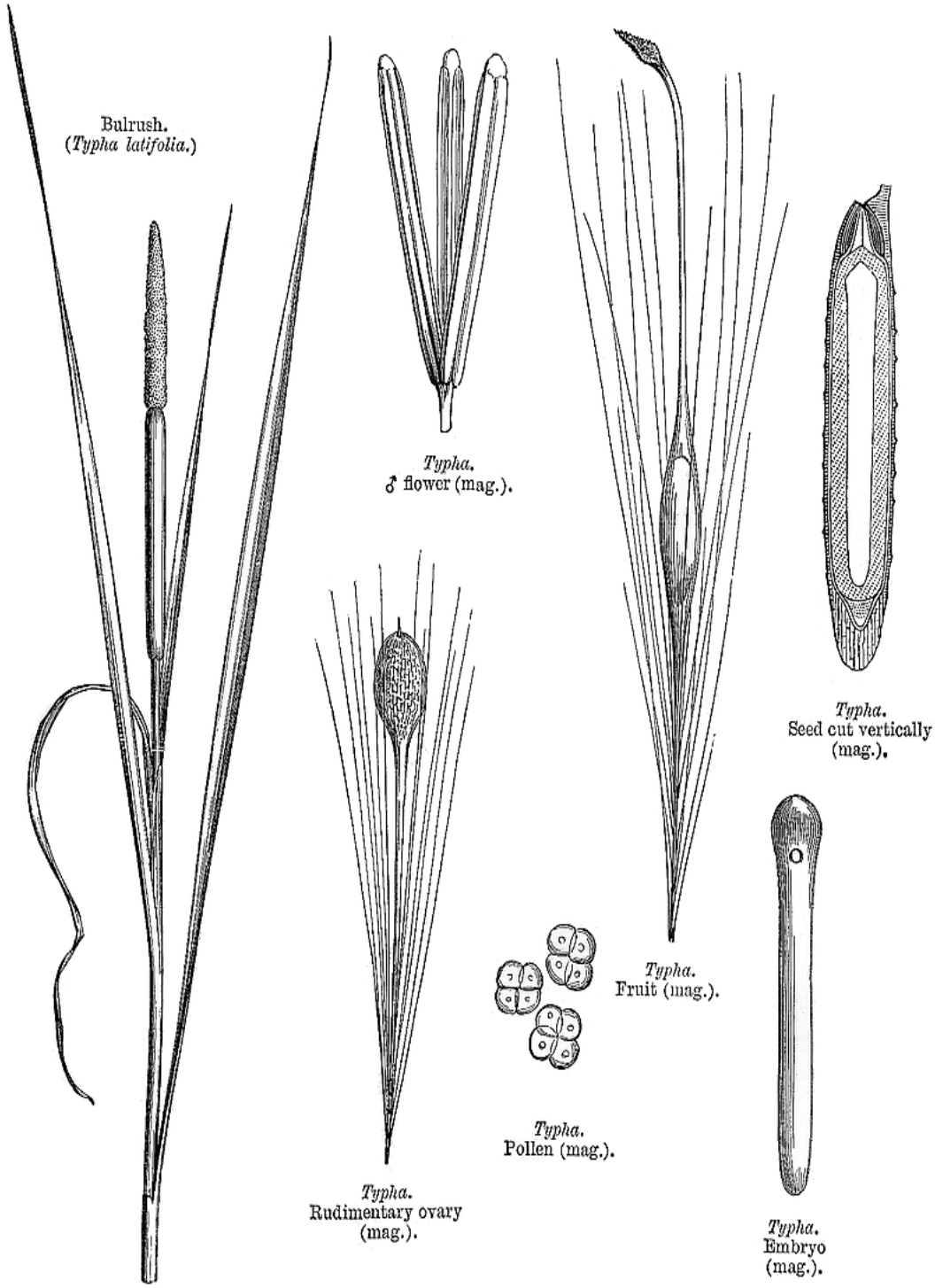
parachute. Dispersal by wind. Fruit 1 seeded. Seeds endospermic. Endosperm oily. Seeds with starch. Cotyledons 1.

Species: 10. Genera 1;

Typha.

Economic uses: The leaves used in weaving chair bottoms and mats.




Bulrush.
(*Typha latifolia.*)
Typha.
♂ flower (mag.).
Typha.
Fruit (mag.).
Typha.
Seed cut vertically
(mag.).
Typha.
Rudimentary ovary
(mag.).
Typha.
Pollen (mag.).
Typha.
Embryo
(mag.).

Zingiberaceae Lindl.

Class: Monocotyledomae

Order: Zingiberales

Family: Zingerberaceae

General characters

Leaf form: herbs; bearing essential oils, or perennial; without conspicuous aggregations of leaves; rhizomatous. Leaves persistent; alternate; distichous; 'herbaceous', or leathery; petiolate, or subsessile, or sessile; sheathing (the appressed sheaths often constituting pseudostems, cf. *Musa*). Leaf sheaths tubular, or not tubular; with free margins. Leaves usually without marked odour (often by contrast with the aromatic roots and/or fruits); simple. Lamina entire; linear, or lanceolate, or oblanceolate, or oblong, or ovate; pinnately veined.

Inflorescence: Flowers aggregated in 'inflorescences'; in cymes, or in spikes. The ultimate inflorescence units cymose, or racemose. Inflorescences terminal; spikes or thyrses.

Floral morphology: bracteate; bracteolate, or ebracteolate; medium-sized; very irregular; zygomorphic. The floral irregularity involving the perianth and involving the androecium. Flowers 3 merous; cyclic.

Perianth **with distinct calyx and corolla**; 6; joined; 2 whorled; isomerous; different in the two whorls. Calyx 3; 1 whorled; gamosepalous; entire, or lobulate, or blunt-lobed; unequal but not bilabiate, or regular; valvate (or splitting on one side); with the median member anterior. Corolla 3; 1 whorled; gamopetalous; unequal but not bilabiate (the median petal usually bigger).

Androecium: 5. Androecial members free of the perianth; coherent. Androecium including staminodes. Staminodes 4, or 2; external to the fertile stamens and in the same series as the fertile stamens; petaloid (the members of the outer whorl usually much smaller). Stamens 1. Anthers dehiscing via longitudinal slits. Pollen grains aperturate, or nonaperturate (usually); when aperturate, 1 aperturate.

Gynoecium: 3 carpelled. Carpels isomerous with the perianth. The pistil 1 celled, or 3 celled. Gynoecium syncarpous; eu-syncarpous; inferior. Ovary 1 locular, or 3 locular. The 'odd' carpel anterior. Gynoecium stylate. Styles 1; apical; much longer than the ovary (slender, passing between the thecae of the anther). Stigmas 1; wet type; papillate. Placentation when unilocular parietal to basal, or free central (rarely); when trilocular, axile.

Fruit: fleshy, or non-fleshy; dehiscent, or indehiscent; a capsule, or capsular-indehiscent, or a berry. Seeds thinly endospermic. Seeds with starch. Cotyledons 1. Testa black.

Examples of Species about 700. Genera about 45;

Aframomum

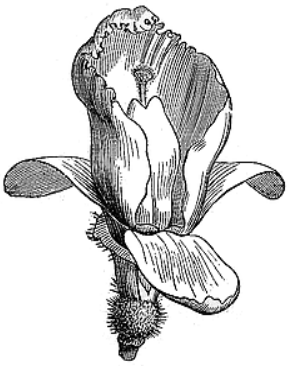
Alpinia

Zingiber.

Economic uses: The sources of ginger root, numerous fragrant oils for perfumery, cardamom seed, and horticultural ornamentals.

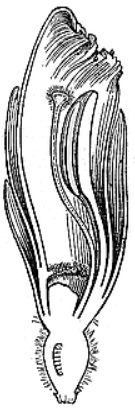

Zingiber officinale. Rosc.
1
2
3
7
5
A
B
9
6
4
8

Alpinia nutans. Entire plant and flower, reduced.

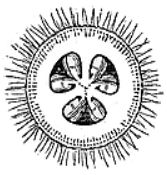


Alpinia.
Flower.

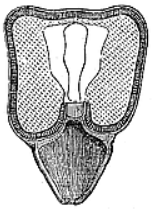
Renealmia sanguinolenta.
Dehiscent fruit.



Alpinia.
Flower cut vertically.



Alpinia.
Transverse section of fruit.

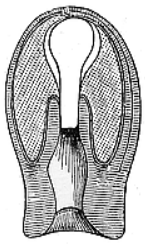


Amomum Granum-paradisi. Vertical section of seed.

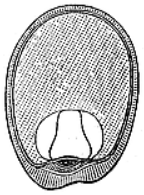
Amomum.
Embryo (mag.).

Renealmia.
Embryo (mag.).

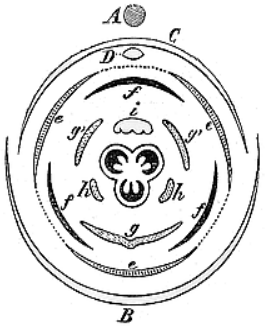
Renealmia.
Arillate seed.



Renealmia.
Vertical section of seed.



Renealmia.
Transverse section of seed, on a level with the embryo.



Hedychium Gardnerianum.
Diagram.

A. Axis; *B.* Outer bract; *C.* Inner bract; *D.* Shoot; *e.* Sepals; *f.* Petals; *g*, *g'*, *g'*, Outer staminodes; *h*, *h*, Inner staminodes; *i.* Fertile stamen.

Identification of The Plant Families (The key-method)

- Definition:
- It is the comparing of unknown plant to another plant already known. The identification process begins by studying the characteristics of the unknown plant, and then identifying it with one or more of the identification methods.
- Methods:

1. By comparing unknown plants with others known in botanical gardens or herbaria.
2. By using the identifying keys.

The identification scheme

- It is necessary to identify the plant, examine the samples to be defined carefully and determine some important characteristics such as:

1. The habit of the plant, herbaceous or woody.
2. Examining the flower and identifying its parts.
3. Observe if the sepals and petals are separated or conjunctivae and limit their number.
4. Limit the number of stamens and their contact points.
5. Examination of ovarian structure and determination of the number of locules and the position of ovaries.
6. Determine the shape of leaves, their arrangement and the venation system.
7. Examining the trichomes types and distribution.

The Keys

- They are modern arranged systems that are useful for identifying the unknown plant.
- They represent one of the patterns of divisional references.
- The key is an artificial analytical arrangement of a group of similar or different plant characteristics in a successive system that offers a choice

between two opposing proposals that result in accepting one and rejecting the other.

- In 1672, the first to use the botanical keys was Morrsion to distinguish between the inflorescences of Umbelliferae, but the use of the keys in their current concept is due to Lamarck (1778).

Example:

1.a.	Flowers trimerous; leaves exstipulate, parallel-veined; perianth of tepal, in 2-wholrs; androecium of 6 stamens, usually in 2-whorled.	**Monocotyledoneae (Asparagaceae)**
b.	Flowers 4-5 (-8) merous; leaves exstipulate or stipulate, reticulate-veined; perianth of distinct sepals and petals, in 1- or 2-wholrs; androecium of 10-many stamens, in 1-or 2-whorled.	**2 . Dicotyledoneae**
2.a.	Ovary of three to many locules; placentation axile.	**3. order: Malvales**
b.	Gynoecium of one or more carpels; placentation marginal or apical.	**4. order: Rosales**
3.a.	Stamens many, monoadephlus, stamen tube adnate to the corolla base; anthers 1-celled; fruit schizocarpic or capsule.	**Malvaceae**
b.	Stamens usually many, more or less distinct; anrthers 2-celled; fruit capsule or drupe.	**Tiliaceae**
4.a.	Leaves usually compound; flowers regular or zygomorphic; gynoecium monocarpellate; placentation marginal.	**Leguminosae**
b.	Leaves simple or compound; flowers usually regular; gynoecium mono- or polycarpellate, carples free or connate; placentation apical.	**Rosaceae**

Appendix

Comparison of Monocots and Dicots	
Monocotyledons	Dicotyledons
Embryo with 1 cotyledon, usually developing under ground	Embryo with 2 cotyledons, usually developing above ground
Roots usually fibrous	A primary root usually present
Growth is mostly herbaceous	Growth either herbaceous or woody
Vascular bundles scattered	Vascular bundles usually forming a ring
Leaves usually parallel-veined	Leaves usually net-veined
Flower parts usually in multiples of 3's	Flower parts usually 4's or 5's

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