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About the Institute
The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

WASHINGTON UNIVERSITY

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THE QUEST FOR A NATURAL SYSTEM
(Jussieu to Hutchinson)

A. The men who contributed:

1. ANTIONE LAURENT de JUSSIEU (1748-1836): Genera Plantarum Secundum Ordines Naturales Disposita, 1789. The "father of the natural system". Most of his families recognized today, for he stressed the weighing of characters rather than counting them.
2. AUGUSTINE PYRAMUS de CANDOLLE (1778-1841): Theorie Elementaire de la Botanique, 3rd ed., Paris, 1844. Basis of his work in Jussieu's, but far more advanced, with some ideas of phyllogeny. He sought the basic symmetry between plants, though these were often disguised by abortion, degeneration, cohesion, etc. System used in herbarium at Geneva.
3. BEORGE BENTHAM (1800-1884) and J.D. HOOKER (1817-1911): Genera Plantarum, 1862-1883. A useful, mostly natural system, based on de Candolle. System employed in most English herbaria today.
4. ADOLPH ENGLER (1844-1930): Syllabus der Pflanzenfamilien, eleven editions, the last in 1936, with many changes of family position from first to last edition. Editor of Das Pflanzenreich (monographs of genera) and Die Naturlichen Fflanzenfamilien (synopses of families). Evolutionary, considers the Amentiferae as primitive and derived these from Gymnosperms. Most big herbaria in this country follow Engler's system.
5. CHARLES E. BESSEY (1845-1915): The Phyllogenetic Taxonomy of Flowering Plants, in Ann. Mo. Bot. Gard. 2: 1915. Includes a list of "dicta" for determination of phyllogenetic position. Gives only a short diagnosis of each family, which is not generally useful for herbaria, but frequently used as a teaching guide.
6. RICHARD von WETTSTEIN: Handbuch der systematischen Botanik, 1st ed. 1901, and 3 others, the last with a Spanish translation. Reversed Engler's monocots as derived from dicots. Useful text, with many references to systematic treatments.
7. J. Hutchinson: Families of Flowering Plants, 1926. Probably the most realistic system, showing reticulate, rather than linear relations, except for basic dichotomy of woody versus herbaceous habit. Done by a salf-trained man with remarkable knowledge of plant families.
8. Carl MEZ, et al. Creators of sero-diagnosis method. Reviewed by K. S. Chester in Quart. Rev. Biol. 1937.

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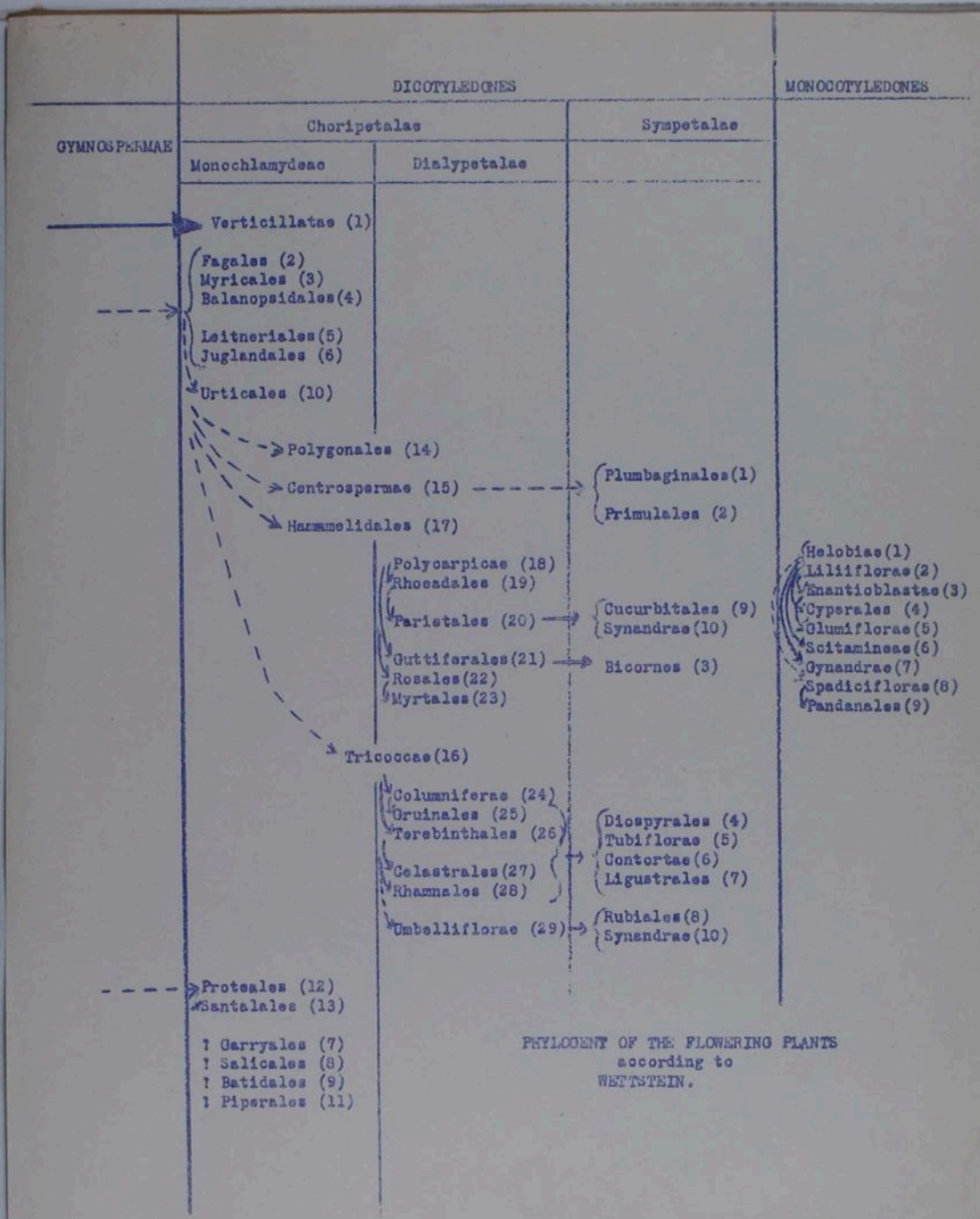
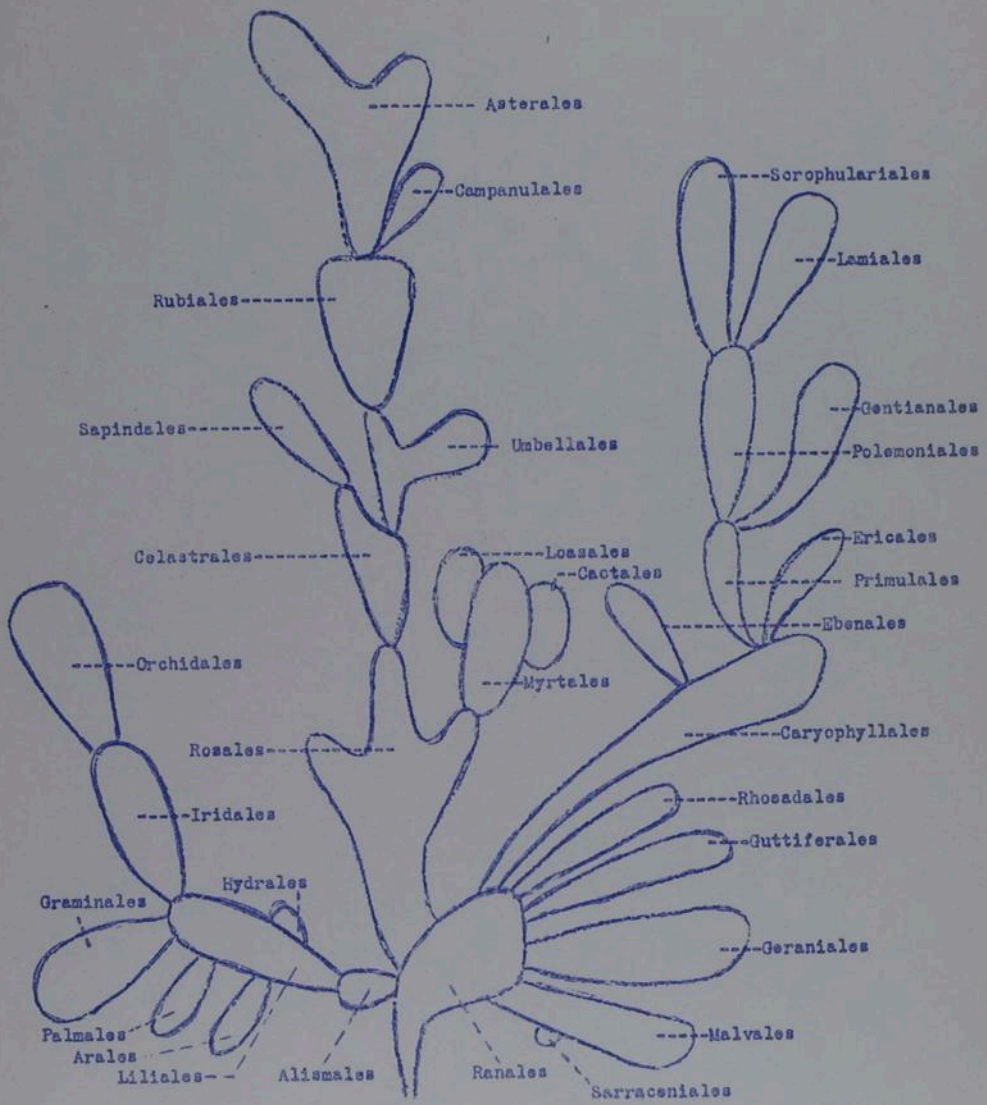
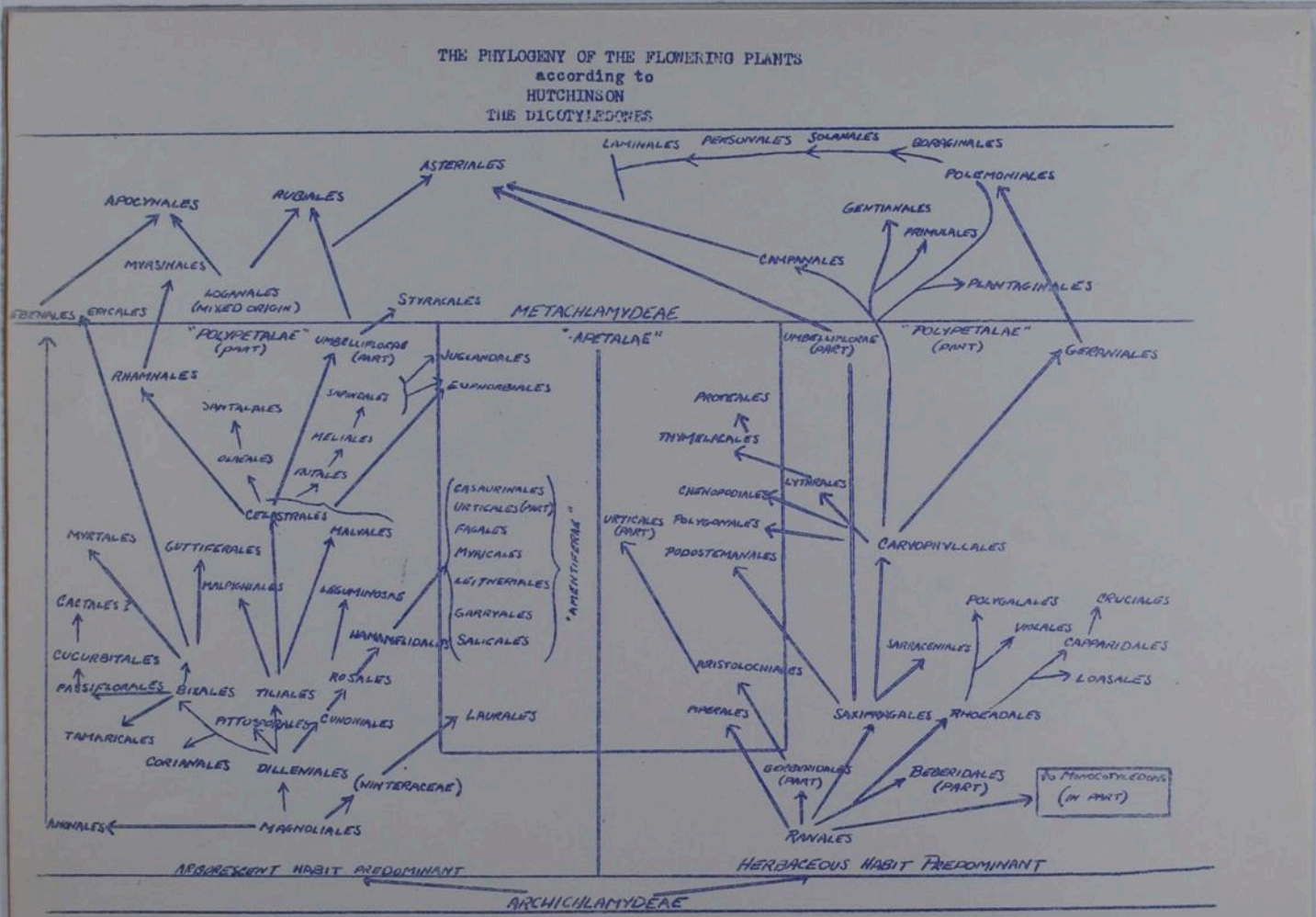


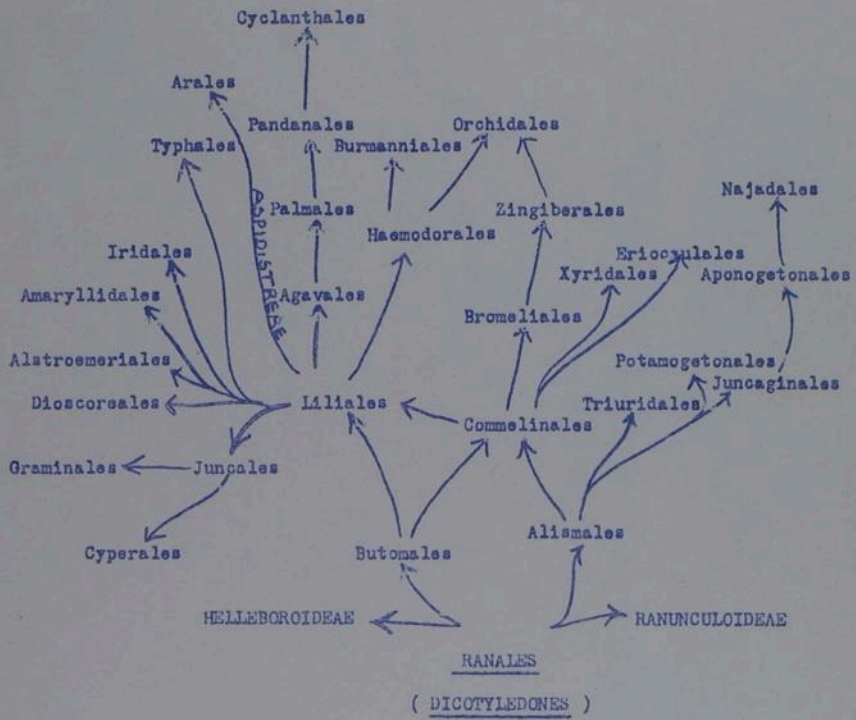
PHYLOGENY OF THE FLOWERING PLANTS
according to
WETTSTEIN.

PHYLOGENY OF THE FLOWERING PLANTS
according to
BESSEY.



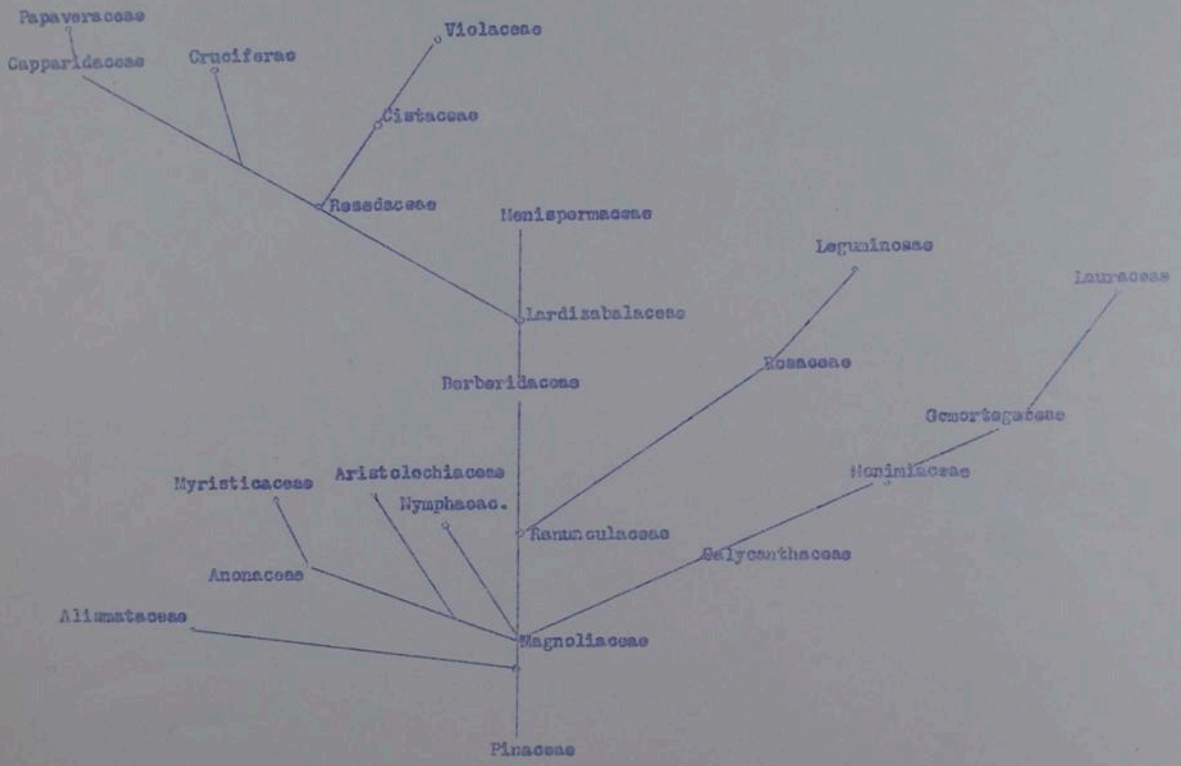


THE MONOCOTYLEDONES

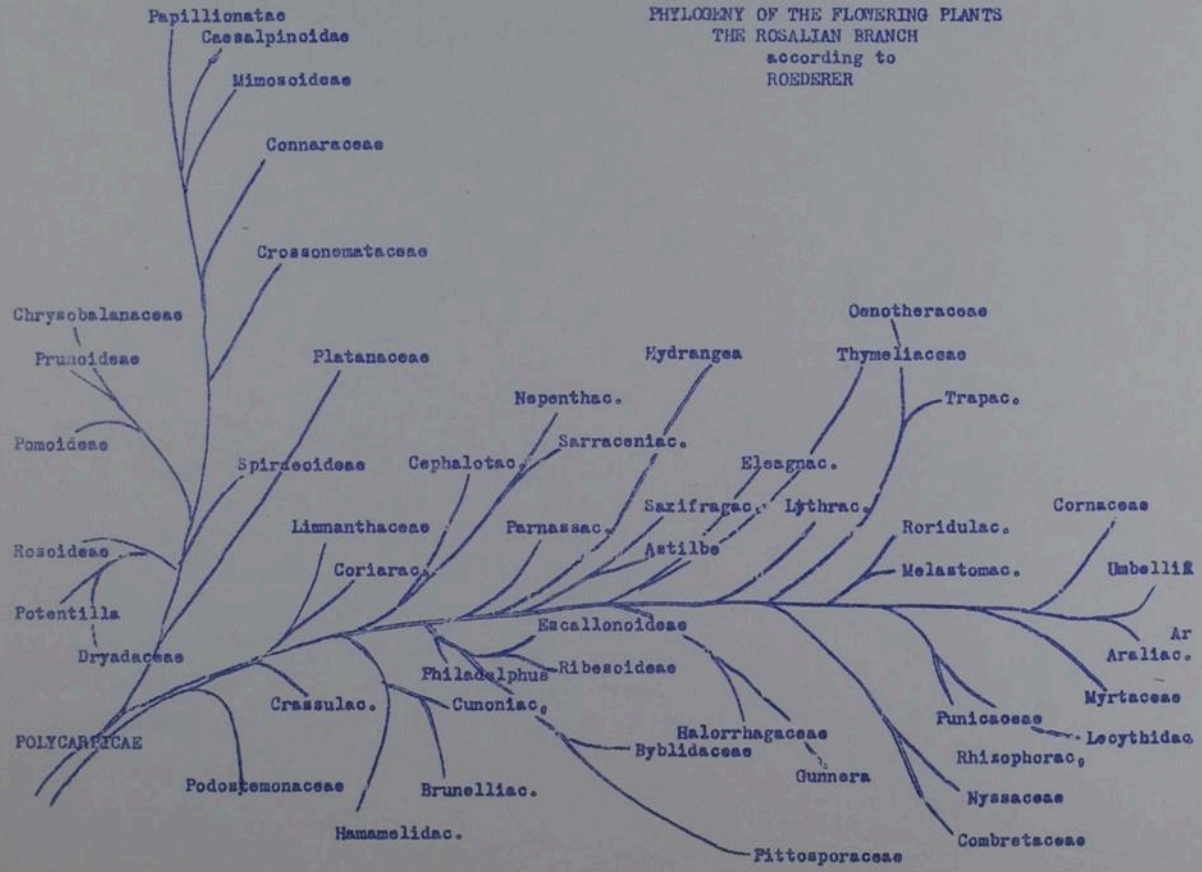


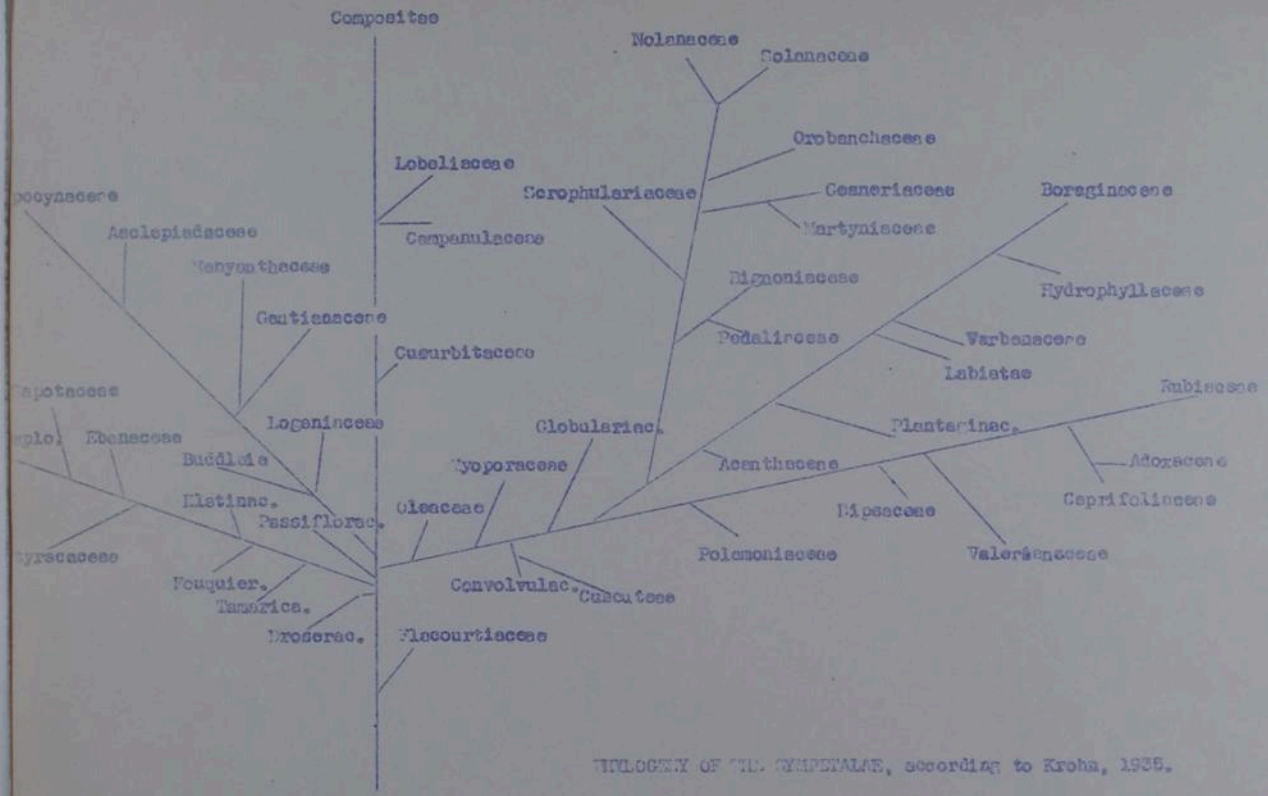
THE PHYLOGENY OF THE FLOWERING PLANTS
according to
HUTCHINSON

PHYLOGENY OF THE RANALES BRANCH, according to Lange, 1924.



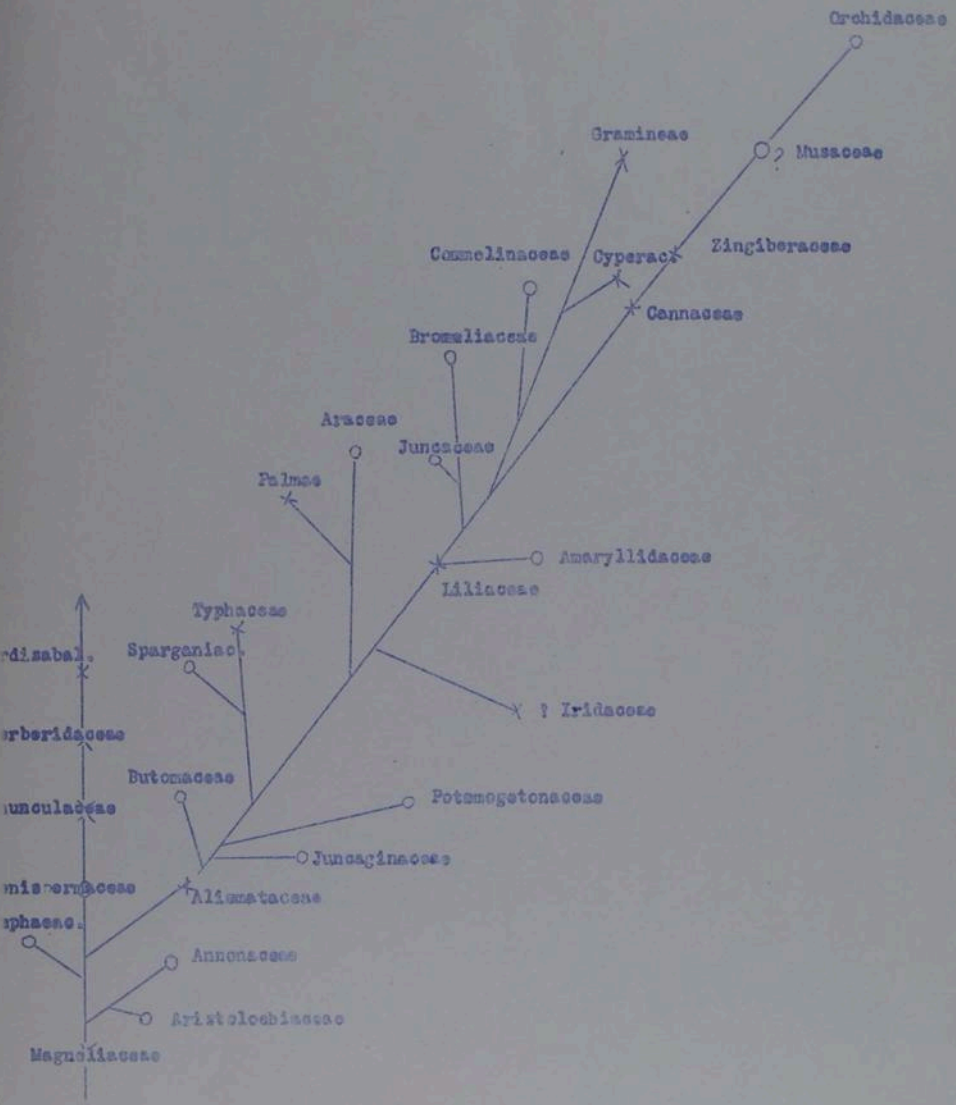
PHYLOGENY OF THE FLOWERING PLANTS
THE ROSALIAN BRANCH
according to
ROEDERER





PHYLOGENY OF THE GAMOPETALAE, according to Krohn, 1935.

PHYLOGENY OF THE MONOCOTYLEDONES, according to Worsdell, 1922.



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DG Rogers Dick Holm 10/24/49

TAXONOMY OF PHANEROGAMS

Taxonomy is the systematic arrangement of organisms designed to give expression to their evolutionary relationships. This expression usually is implicit rather than explicit. Taxonomy involves detailed analyses from as many points of view aspossible, description, and arrangement into a system expressed as a'natural' key and sequence which imply the presumed relationships. Some sort of phylogenetic diagram may be used to describe the relationships, but these are to be considered as quite hypothetical and of a very general nature. After the system of relationis worked out--the taxonomic system--it must be fitted into the arbitrary structure agreed upon in the International Rules of Botanical Nomenclature designed to give stability. This stability is only nomenclatural: cf. species of bacteria, apomictic dandelions, or aneuploid sedges. In working out relationships, transmission genetics and descriptive morphology commonly are employed or assumed; actually all fields of botany have something to contribute. The newer dynamic, as opposed to static or descriptive, fields of botany: developmental morphology and population genetics (esp. in relation to ecology) are becoming of the greatest importance. For while we may be able to make a classification of organs, species, etc. on a static basis with apparent ease, when we consider their development we may find convergences or similar origins which were not suspected. Because of the tremendous number of plants which must be named, described and keyed in order to be used with precision by any workers (cf. standardization of chemicals) it is necessary to: be as brief as possible, have a universally agreed system of doing things, make artificial keys, study local flora. The work of taxonomists should not be judged by these aspects of taxonomy. Similarly, a taxonomist must be, and usually is, a morphologist, anatomist, geneticist, etc. (ore better still, a biologist), capable of understanding basic research in all fields of botany--he cannot do significant research in taxonomy, as defined above, in nomenclature, e.g. These remarks are to be interpreted as relatively impractical and more or less naive, but nevertheless useful, goals.

History of taxonomy. The renascent period of uncritical attitude and unquestioned adherence to dogma, revival of encyclopedias, the compilation of knowledge, in botany, especially of the medicinal properties of plants.

OTTO BRUNFELSIUS(Brunfels, 1464-1534)-early Lutheran herbalist who published in 1530 his Herbarium vivae icones, a conpilation with excellent, original illustration

HIERONYMOUS TRAGUS(Hieronymous Bock)- prepared an original herbal the New Kreuterbuch (1539).

VALERIUS CORDUS(1515-1544)- made detailed systematic descriptions in Historia plantarum, published posthumously by Gesner in 1561.

CONRAD GESNER(1516-1565)-physician and zoologist, emphasized importance of flower and fruit in classification.

LEONHARD FUCHS(1501-1566)-physician and medical botanist, compiler who believed in the supreme authority of Dioscorides, excellent illustrations in his De historia stirpium.

CAROLUS CLUSIUS(Charles de l'Ecluse, 1526-1609)- physician, traveled much through Europe, introduced many new plants including white potato. Rariorum aliquot stirpium per Hispanias observatorum (1576).

WILLIAM TURNER(?1515-1568)-English herbalist who threw out many superstitions; used alphabetical arrangement; original. A New Herball(1551,1562, 1568).

JOHN GERARD (1545-1612)-British gardener who produced the unoriginal, plagiaristic, superstitious Herball or general historie of plants (1597).

ANDREA CESALPINO (1519-1603)-physician and botanist at Bologna, director of botanical garden, physician to Pope. De plantis(1583). Philosopher of aristotelian school who sought theoretical rather than practical (medicinal) classification, on basis of flower and fruit which he regarded as being more 'perfect'. Believed flowers had arisen from leaves.

BAUHIN brothers: JOHANN, Historia plantarum universalis, woodcuts largely from Fuchs); KASPAR, traveled throughout Europe studying botany, studied at Basel receiving degree to teach botany. Phytopinax(1596), Prodromus theatri botanici (1620), illustrated, good descriptions, synonymies, mostly binomial names, natural classification attempted.

NICOLAS MONARDES(1493-1588)-"unhampered by too many facts" wrote in Spanish of medicinal properties of New World plants, transl.: Ioyful Newes out of the Newe Found Worlde, written in Spanish by Nicolas Monardes, physician of Seville, and Englished by John Frampton, Anno 1577.

FRANCISCO HERNANDEZ-commissioned by Philip II of Spain to explore New World, ran out of money and suffered many hardships, his collected writins, published after his death are of ethnobotanical importance(J. Sauer says most recent are most accurate.)

The seventeenth century a period of great progress inall fields(Descartes, Hobbes, Spinoza, Leibntz, Newton), of organizationa dn synthesis, of invention of microscope, of societies and academies (Royal Society of London (1662), Academie des Sciences (1666), Akademie der Wissenschaften (1700)-.

JOACHIM JUNG (1587-1657)-significant for his philosophical concepts of libing organisms, studied morphology apart from taxonomy, developed precise descriptions and conceptions or organs, e.g. in Isagoge phytoscopia (1678).

JOSEPH PITTON DE TOURNEFORT(1656-1708)-used morphology of flower and fruit in classification, revised concept of Kaspar Bauhin, but placed chief emphasis on the genus; worked out an artificial system of groups higher than genus.

ROBERT MORISON(1620-1683)- Scotsman who joined Royalists against Cromwell, in France gained favor of court and studied botany. Recalled to England by Charles II was made Royal Physician, Royal Professor of Botany, and Director of the Royal Botanic Gardens, later, Professor of Botany at Oxford. Disagreeable person who gave no credit to Cesalpino, Gesner, et al, from whom he drew freely. Plantarum historiae universalis Oxoniensis, pars secunda...(1680), 1st part unpublished, employs a system of classification based on flower and fruit.

JOHN RAY (1628-1705)-marks end of period of herbalists and beginning of observational period; considered species as constant; made important classification based on habit (tree, shrubs, and herbs) and number of cotyledons in Historia Plantarum (1686-1704). Admitted probability of sexuality in plants.

ZACHARIAS JANSSEN-spectacle maker in Holland presented in 1590 to Charles Albert, Archduke of Austria, first microscope, 6 feet long with two lenses.

ROBERT HOOKE (1635-1703)- hobbyist who in Micrographia (1665) described his 'adventures through the microscope' portraying "cells" and "interstitia" of cork.

Figures in plant anatomy:Marcello Malpighi (1628-1694), animal physiologist and plant anatomist, describes stomata, seed coat, galls, etc.; Nehemiah Grew(1628-1711) physician and Secretary of Royal Society, made exact drawings and descriptions, founder of histology:parenchyma, fibers, vessels, etc.

Figures in physiology:Harvey's discovery of circulation of blood in mammals led to study of absorption and translocation in plants by Jung, Malpighi, Grew, etc. with mostly unsatisfactory results; Van Helmont (1577-1644), chemist who studied gases, finding fermentation produced same kind of air as when charcoal is burned, performed famous experiment of growing weighed tree in weighed soil to determine source of 'food'; Edme Mariotte (c 1620-1684),studied ascent of sap in plants in relation to grafts between wild and cultivated pears.

Figures in botanical exploration: Hans Sloane (1660-1753), brought to England and described a collection of plants from Jamaica (worked by Ray); James Cunningham investigated flora of China and described tea plant; Rumphius (Georg Eberhard Rumpf, 1628-1702), worked on flora of Moluccas (Amboina) in Herbarium Amboinse (1741-1755), the famous Dutch East India Co. manuscript, unpublished for 30 years.

The eighteenth century was a less inventive period of criticism and agnosticism, the church and state largely indifferent to progress of science.

RUDOLPH CAMERARIUS (1665-1721)- professor of botany and director of botanical garden at Tübingen, later professor of physics; proved existence of sexuality in dioecious plants in his garden, e.g. mulberry, mercury:stamens produce male powder which

must be applied to stigma if fruit is to be formed.

JAMES LOGAN (1674-1751)-governor of Pennsylvania, noted wind pollination in corn.

J.G. GLEDITSCH (1714-1786)-director of botanical garden in Berlin, imported branch of staminate palm to produce seed on pistillate plant in Berlin, repeating what Assyrian had done in 5th century B.C.

J.G.KOLREUTER (1733-1806)-discovered function of nectar and role of insects and wind in pollination and made many artificial hybrids:Vorlaufige Nachricht von einigen das Geschlecht der Pflanzen betreffenden Versuchen (1761-1766). Made hybrids of Nicotiana, Dianthus, and Mat thiola, noted they were sterile and discussed what would happen in nature.

CHRISTIAN KONRAD SPRENGEL (1750-1816)- Das entdeckte Geheimniss der Natur im Bau undin der Befruchtung der Blumen (1793). Reminescent of Darwin in study of structure, colors, and odors of flowers; discussed occurrence of cross-pollination which he thought normally was universal.

CAROLUS LINNAEUS (1707-1788)-Swedish botanist who trained many students and collectors; Systema naturae (1735), Genera Plantarum (1737), Philosophia botanica (1751), Species plantarum (1753). Developed so,called sexual system based on counting number of stamens and pistils. Gave Latin description of each plant as was customary, but in addition, a shorthand binomial; Species plantarum thus the starting point of nomenclature for most plant groups. Artificial system was very popular, leading to such works as Mrs. Lincoln's Botany for Young Ladies, etc. ridiculed e.g. by Heine in Die Harzreise. Linnaeus had an experimental garden where he became convinced of the occurrence of hybridization and the occasional change of species; developed a series of natural orders, his Fragmenta, in Philosophia. Here, as previously, "natural system" does not imply evolution, for relationships were held to be similar to family relationships in animals.

Seeking to perfect the artificial system of L. were: C. L. Willdenow(1765-1812) J,A. Murray (1740-1791), Ch. Persoon (1755-1837), and J. Roemer (1763-1819) and J.A. Schultes (1773-1831) who continued Species plantarum.

Other classifications opposed to that of L. and seeking 'natural system' were those of:Pivinus, based on the corolla, Haller, Adanson who emphasixed importance of using a natural classification.

BERNARD DE JUSSIEU (16991777-)-arranged plants in the Trianon gardens according to Linnaen system and then remodeled it, ending up with his own system.

ANTOINE-LAURENT DE JUSSIEU (1748-1836)-(his nephew)incorporated his uncle's system in his Genera plantarum secundum ordines naturales disposita (1789), most of his families are recognixed today, for he stressed the weighing of characters rather than the counting of them. Puts gymnosperms in class with Euphorbiaceae Amentaceae, etc.

Figures in experimental plant physiology:Stephen Hales (1677-1761), Vegetable Staticks(patterned after work of Harvey); Charled Bonnet (1720-1793), known for his "preposterous conclusion"; Duhammel (Henri Louis Duhammel de Monceau, 1700-1781), physiologist who collaborated with Buffon; Joseph Priestly (1733-1804), discovered production of O_2 by plants, etc.; Scheele found his plants produced CO_2 ; Jan Ingenhousz, worked out outlines of C-cycle; Jean Senebier (1742-1809), discovered relation between light, O_2 and CO_2.

Figures on botanical exploration:Michel Adanson (1727-1806), studied plants of Senegal deriving a natural system and idea of mutability of species, Familles des Plantes (1763); Joseph Banke (1743-1820), most extensive botanical explorations, travelled with Capt. Cook together with Dr. Solander, collection and library in British Museum.

Figures in Plant Geography:Carl Ludwig Willdenow (1765-1812), studied seed dissemination and plant distribution, plant associations, floristic areas, and sought concept of centers of dispersal; Alexander von Humboldt (1769-1859), world traveler who contributed to all fields of knowledge, travelled with Bonpland (1773-1858) to South America and Mexico publishing 30 volume work on their results; Robert Brown (1773-1858), "versatile genius" known for discovery of nucleus, brownian movement,etc. naturalist of Flinder's expedition to Australia comparing the plants with those of other regions, librarian of Linnaen Society of London; J.F. Schouw (1789-1852) studied effects of external factors, looked for characteristic floras; Meyen(1804-

1840), noted outlines of life zones, developed theory of spontaneous generation to explain similarities of alpine plants throughout the world; with contemporaries worried about species constancy deciding that species were constant, but the characters used to define them were not; Alphonse de Candolle (1806-1893), clarified subject and formulated methods of study; Augustin Pyrame de Candolle (1778-1841), Geographie botanique raisonnee (1855), tried to discover laws of distribution, distemperature and area of species, decided creation of species was probably successive Figures in floristic studies: Joseph D. Hooker (1817-1911), studied geographical distribution, endemism, and affinities of floras. Second son of Sir W. J. Hooker, like his father Director of Kew, botanist on voyages of Erebus, widely traveled friend of Darwin and Gray, and exponent of organic evolution; August Grisebach (1814-1879), Die Vegetation der Erde (1872). One of the first to define types of physiognomy of vegetation with relation to climate; Asa Gray (1810-1888), great American botanist, studied affinities of floras of Japan and America, friend of Darwin and Hooker, author of interesting essays on botany and botanists; Adolph Engler (1844 1930); Oscar Drude (1852-1933); Vesque; Bonnier and Flahault (1879); Volkens; Schenk; Eugene Warming (1841-1924); A, F, W, Schimper (1856-1901) important phytogeographers who cannot be discussed briefly.

Important natural systems of classification and their authors.

A. P. DE CANDOLLE (1778-1841)-as Goethe and Jung sought to find a morphological 'type' in the parts of the same plant, so de Candolle sought the basic symmetry between plants, which often was disguised by processes such as abortion, degeneration, cohesion, etc. Thought that physiological characters were of no use for taxonomy since they were important in the maintenance of life function. Author of best textbook of taxonomy to date: Le Phytographie, and the important Theorie elementaire da botanique; taxonomists will want to become acquainted with the Prodromus...

JOHN LINDLEY- an English botanist who modified system of de Candolle.

ROBERT BROWN-who believed that the orders of plants were reticulately related.

A. BRONGNIART (1801-1847)-the Father of Palaeobotany, who, in Enumeration des genres de plantes...proposed a natural system in which the amentiferae were interposed among the Dialypetalae.

GEORGE BENTHAM (1800-1884)-and J, D. HOOKER (1817-1911)-prepared an important system still in use in British herbaria, their Genera plantarum (1862-1883). Nonevolutionary for Bentham did not accept Origin of Species, v. supr. for Hooker, de Candolle was followed very closely in an arrangement which stresses union of petals.

STEPHAN ENDLICHER (1804-1849)-the German Genera plantarum...(1836-1840) which led to development of that of Bentham and Hooker and Engler, but for different reasons.

ADOLPH ENGLER (1844-1930)-great German taxonomist at Berlin who initiated Die Naturlichen Pflanzenfamilien (monographs of every family) and Das Pflanzenreich (monographs of genera), his system which may be best seen in the Syllabus der Pflanzenfamilien (many editions) views the Amentiferae as primitive and derives the angiosperms from the gymnosperms through them; cf. his list of dicta for phylogeny in Der Syllabus.

RICHARD VON WETTSTEIN-professor of botanyat Vienna, author of Handbuch der systematischen Botanik of some 1000 pages which covers the plant kingdom, also believes Amentiferae to be primitive but for different reasons, would derive the angiosperm flower from that of a gnetalean type. (Spanish translation available)

J. HUTCHINSON-botanist at Kew who creates new system with herbaceous vs. woody habit as basic dichotomy, otherwise remarkably realistic system.

H. F. WERNHEM, English botanist who discussed phylogeny of the Sympetalae.

CARL MEZ et al. Creators of the Serodiagnostische Stammbaum, employing systematic serology in an attempt to get at the basis of evolutionary relationships by using proteins. Read the review of K. S. Chester in Quart. Rev. Biol. 1937.

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WASHINGTON UNIVERSITY

Student's Name Rogers

Course 460 – Drawings + Notes

Section

Instructor or Assistant

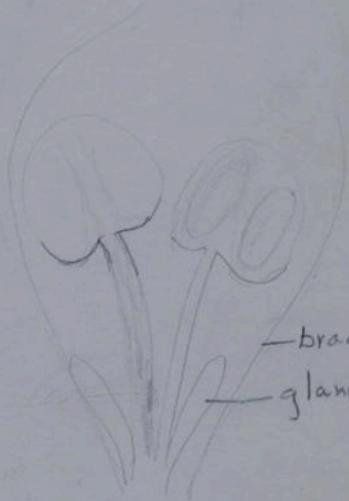
Date Presented

very uneven quality !

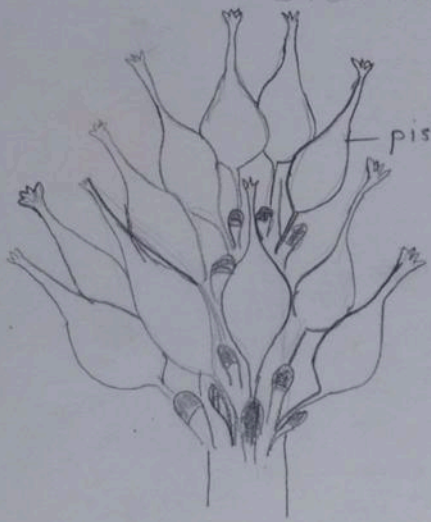
Sold by
Washington University Quad Shop
The Students' Store

DJP
Salicales
Salicaceae
Salix

Habit - Staminate Catkin

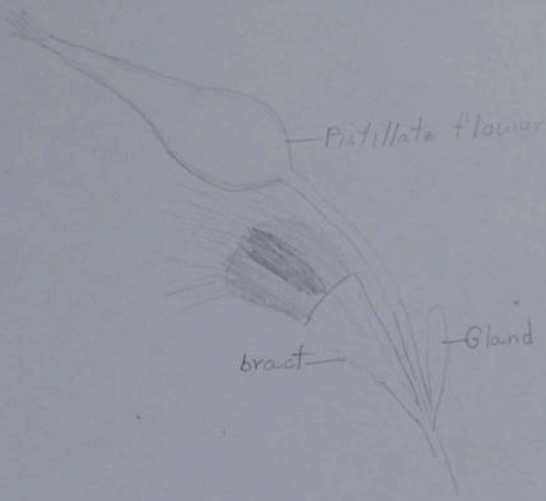


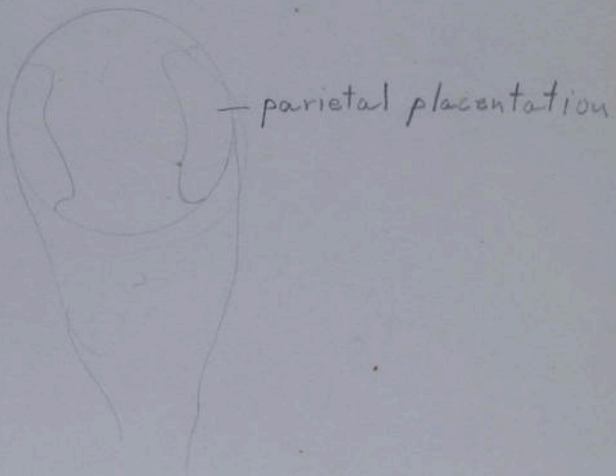
Staminate



Pistillate Catkin

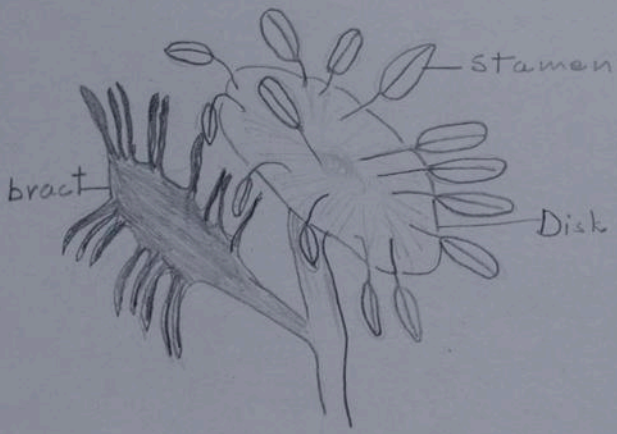
Salicaceae
Salix





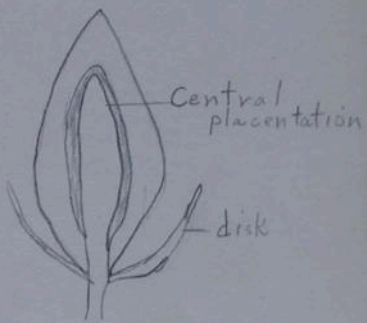
Cross section of Salix ovary

D.J.R.
Salicaceae
Populus



Staminate flower x4

Pistillate Catkin



Long. Section of Ovary

Deforge
Formula
1/26/48

I - 4
II - 9
III - 8

IV = $\frac{4}{10} = 3$

4 L 24.
6.0 = B

I. (1) Ranales - Flower parts indefinite, cyclic or spirocyclic, usually borne upon an elongated floral axis. (Hypogynous) Carpels free, seldom united.

(2) Rhoeadales - Flower parts 4-6, hypogynous carpels united.

(3) Sarraceniales - Flowers in 4's + 5's. Parasitic

(4) Parietales - Sepals and petals 5 merous, stamens numerous, hypogynous. Placentation parietals.

(5) Nutiferales - Sepals and petals 5-merous, stamens many, sometimes united at the base, hypogynous, carpels free or united.

(6) Malvales - Sepals & petals 5-merous, Hypogynous, stamens numerous, free, or united into a staminal

II An "unnatural" order of the Archichlamydeae is Parietales. A more natural order is Geraniales.

~~It~~ Nearly the whole range of variation in the Archichlamydeae is found in this order - Parietales. Numerous free parts to somewhat fused or reduced. Both hypogyny (Cistaceae) and perigyny (Passiflora) occur. The only character which holds Geraniales, on the other hand, is more or less constant threesomeness.

2. The number of stamens holds true in a natural group. In any order the number of perianth members may be quite variable, but the organs of reproduction will be less apt to change. Though in a natural group there may be a reduction in number of stamens, usually there will be some representative of the stamen - a staminode, which can be identified and counted. The development of the stamens is sometimes characteristic, be it centrifugal or centripetal. The opening of anthers may be a diagnostic character of some value either by pores or slits. The number of valves of the anthers, too, can be used in separation of natural groups

III Two aspects of floral structure of most general use in establishment of "natural" families and orders are:
1. The union of carpels (apocarpous or syncarpous)
2. The number of stamens and morphology.

II Many orders have superior ovary. others are half-superior or inferior, and quite a few have all 3 conditions. The union of carpels, however, can be used to separate orders with more facility. Ranales, for example, generally have separate carpels, hypogynous. The next order but (Rendle's system) is Rhoedales, which generally has its carpels fused. A natural order or family will generally have one condition throughout. The number of carpels is also a differentiating character which usually holds throughout a "natural" order or family

See opposite page for

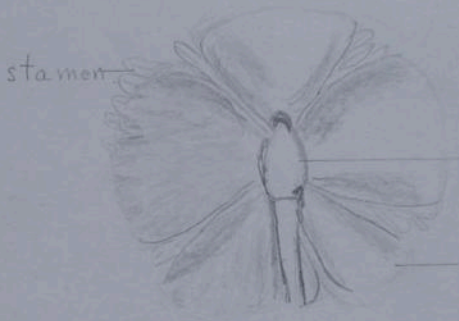
w/o = without outline
w/ = with

TV 1. Leguminosae — w/o outline
2. Capparidaceae — w/o outline
3. Cuticeae — w/ outline near thin.
4. Cacaminaceae — w/o outline.
5 Sabiaceae — w/o outline
6. Staculiaceae — w/ outline
7. Sapindaceae — w/ outline near thin
8 Marganiaceae — w/o outline.
9. Tiliaceae — w/ outline.
10. Phytolaccaceae — w/ outline

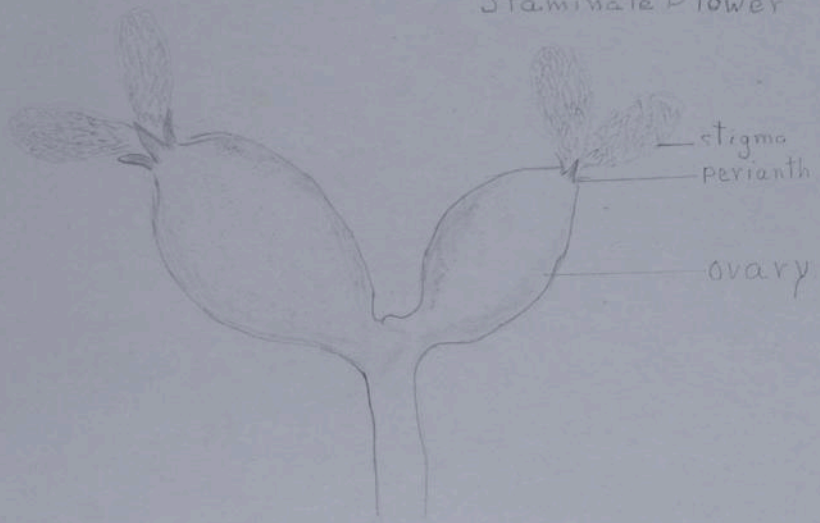
9. 5-merus, with many hairs + many subtending bracts makes it look like something in the Malvales.

Juglandales
Juglandaceae
Juglans

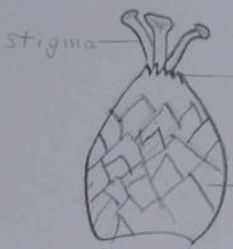
Inflorescence of
Juglans



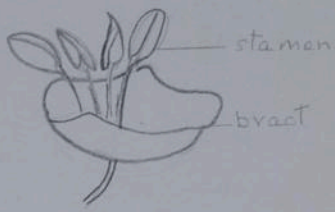
Abaxial View of
Staminate Flower



Fagales
Fagaceae
Quercus



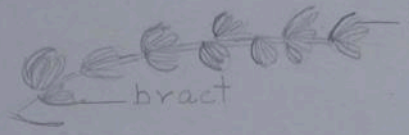
Pistillate Flower



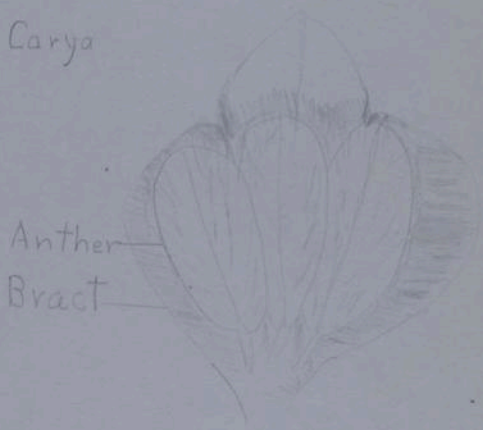
Staminate Flower

X-Section of Sterile Ovary

Juglandales
Juglandaceae
Carya



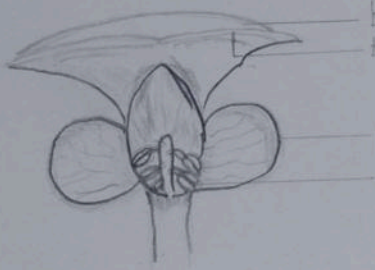
Staminate Catkin of Carya



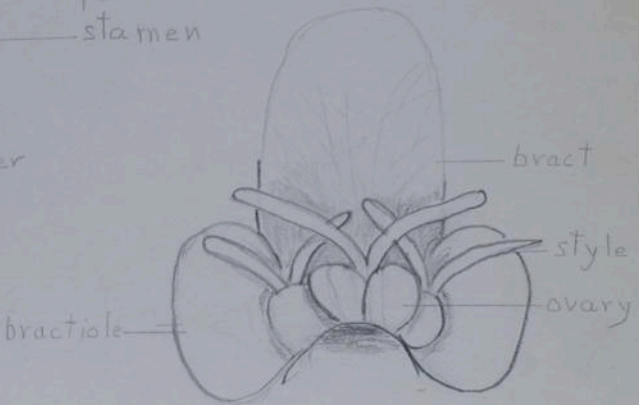
Staminate Flower

Fruit of Carya

Fagales
Betulaceae
Betula



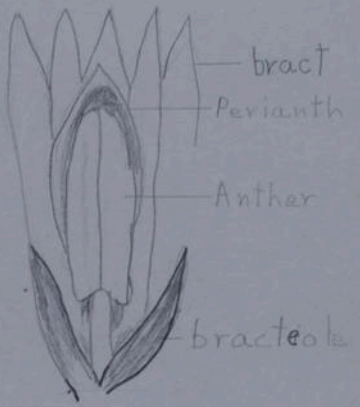
Staminate Flower



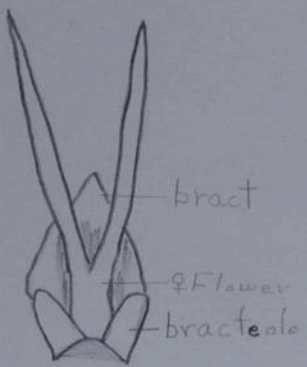
Pistillate Flower

Casuarinales
Casuarinaceae
Casuarina

♂ Inflorescence



♂ Flower

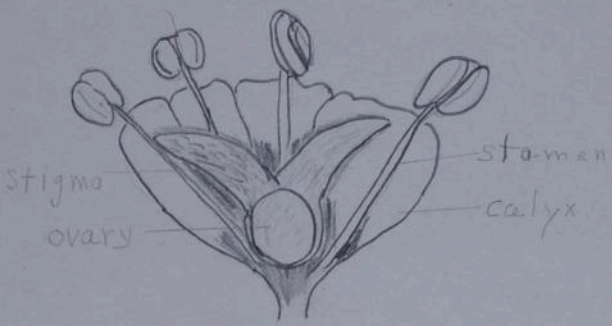


♀ Flower

♀ Inflorescence

Urticales
Ulmaceae
Ulmus

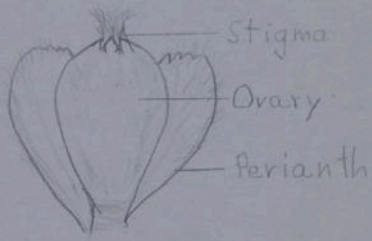
Inflorescence



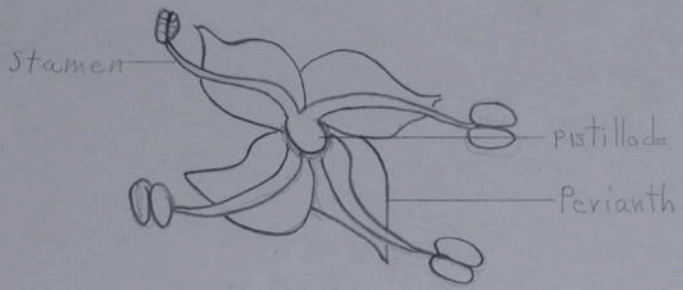
Flower

Urticales
Urticaceae
Urtica

Inflorescence



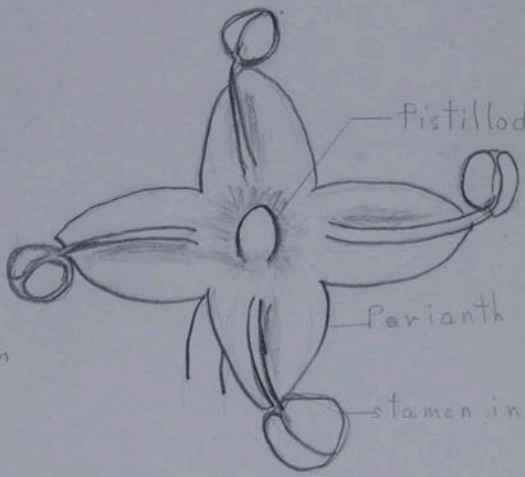
♀ Flower



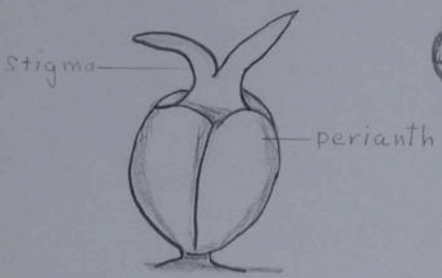
♂ Flower

Urticales
Moraceae
Morus

Staminate Inflorescence



Staminate Flower

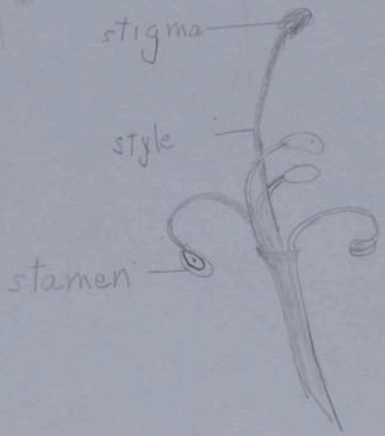


Pistillate Flower

Urticales
Cannabinaceae
Humulus lupulus

Proteales
Proteaceae
Grevillea

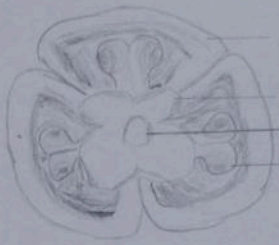
Inflorescence



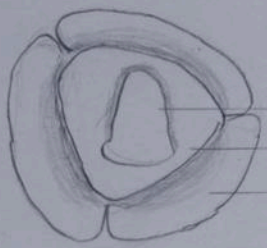
Flower

Santalales
Loranthaceae
Phoradendron

♂ Inflorescence



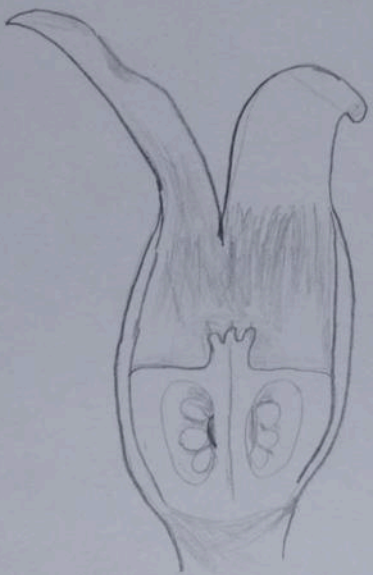
♂ Flower



♀ Flower

Aristolochiales
Aristolochiaceæ
Asarum

Habit

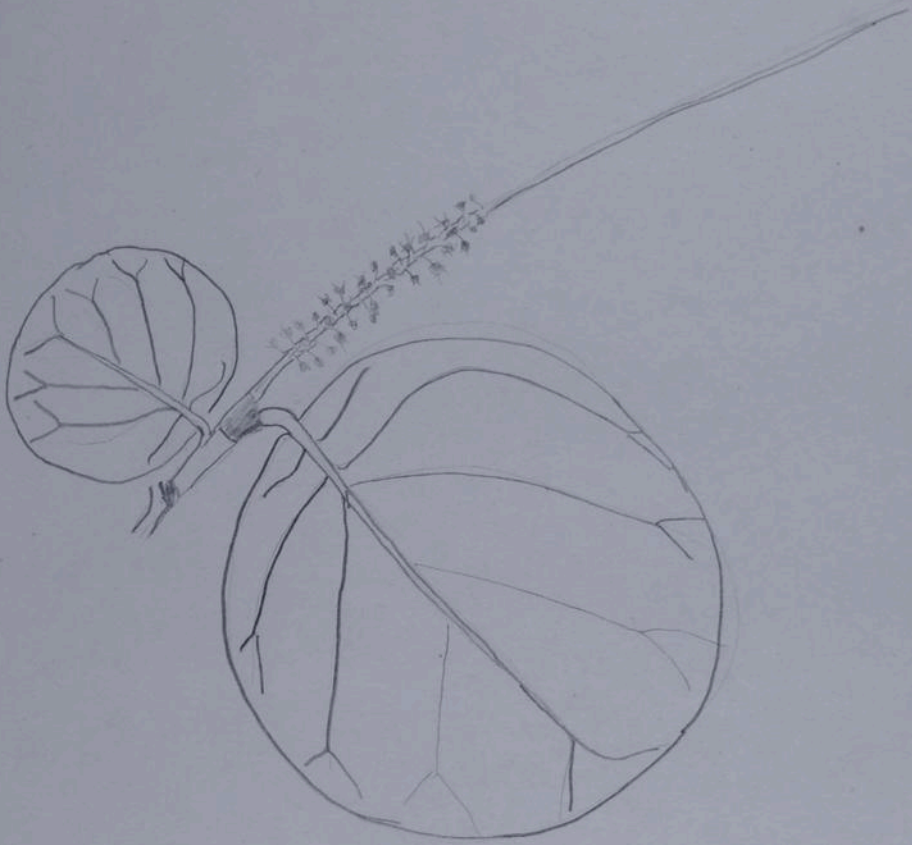


J. Jones ?

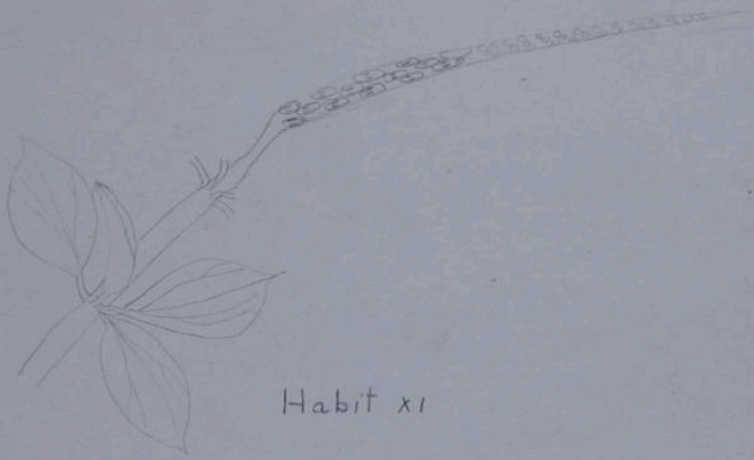
Polygonales
Polygonaceae
Polygonum

Inflorescence

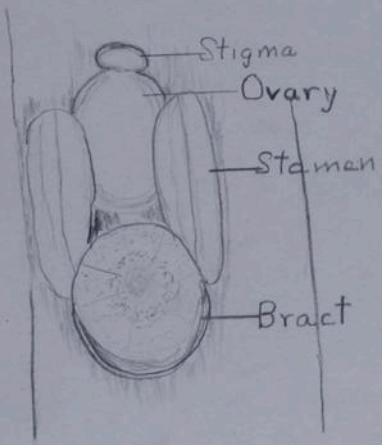
Polygonales
Polygonaceae
Coccoloba



Piperales
Piperaceae
Peperomia



Habit x1



Flower

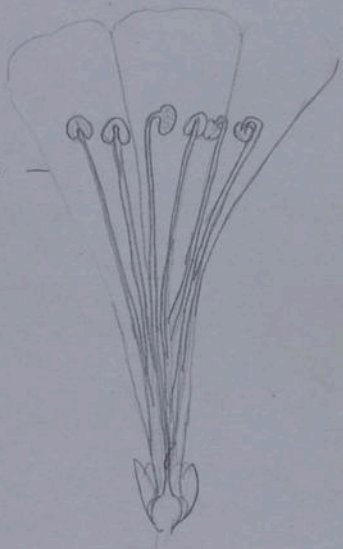
Centrospermae
Chenopodiaceae
Chenopodium

Inflorescences

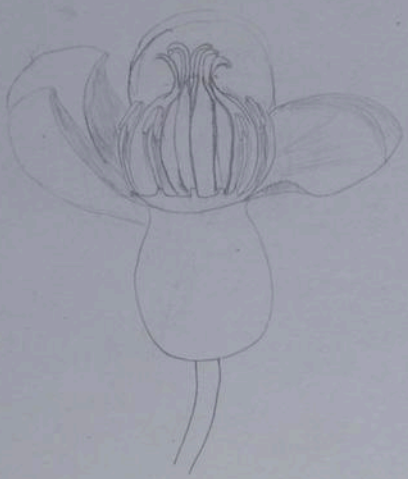
Flower

Centrospermae
Nyctaginaceae
Mirabilis

bracts

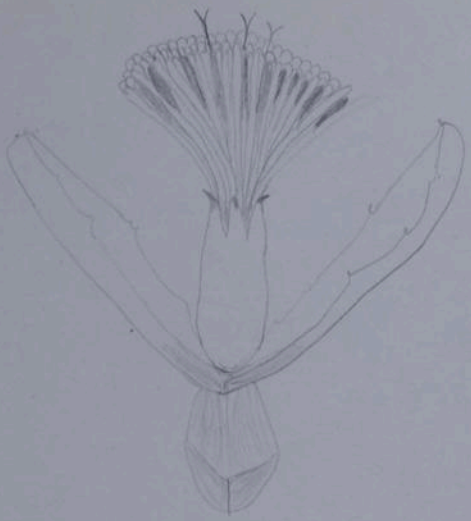


Phytolacca



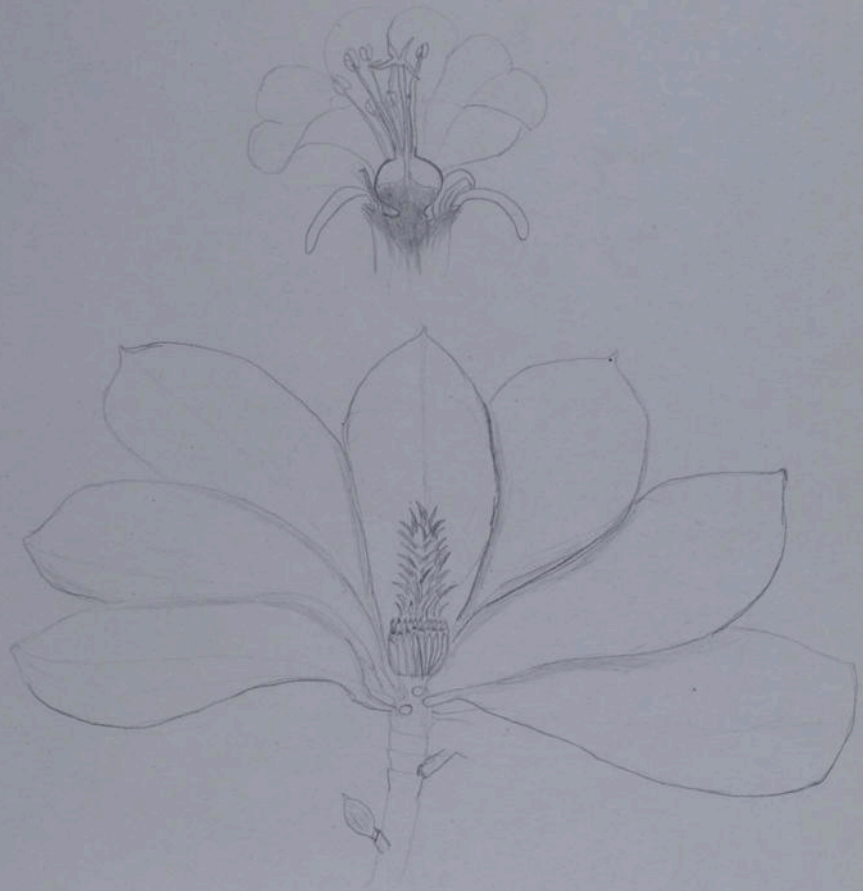
Centrospermae
Amarantaceae
Celosia

Centrospermae
Aizoaceae
Faucaria



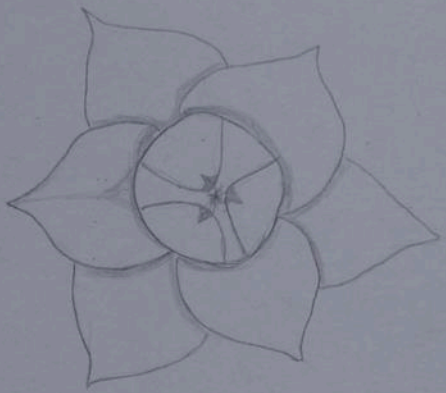
Caryophyllaceae
Dianthus

Centrospermae
Portulacaceae
Portulaca



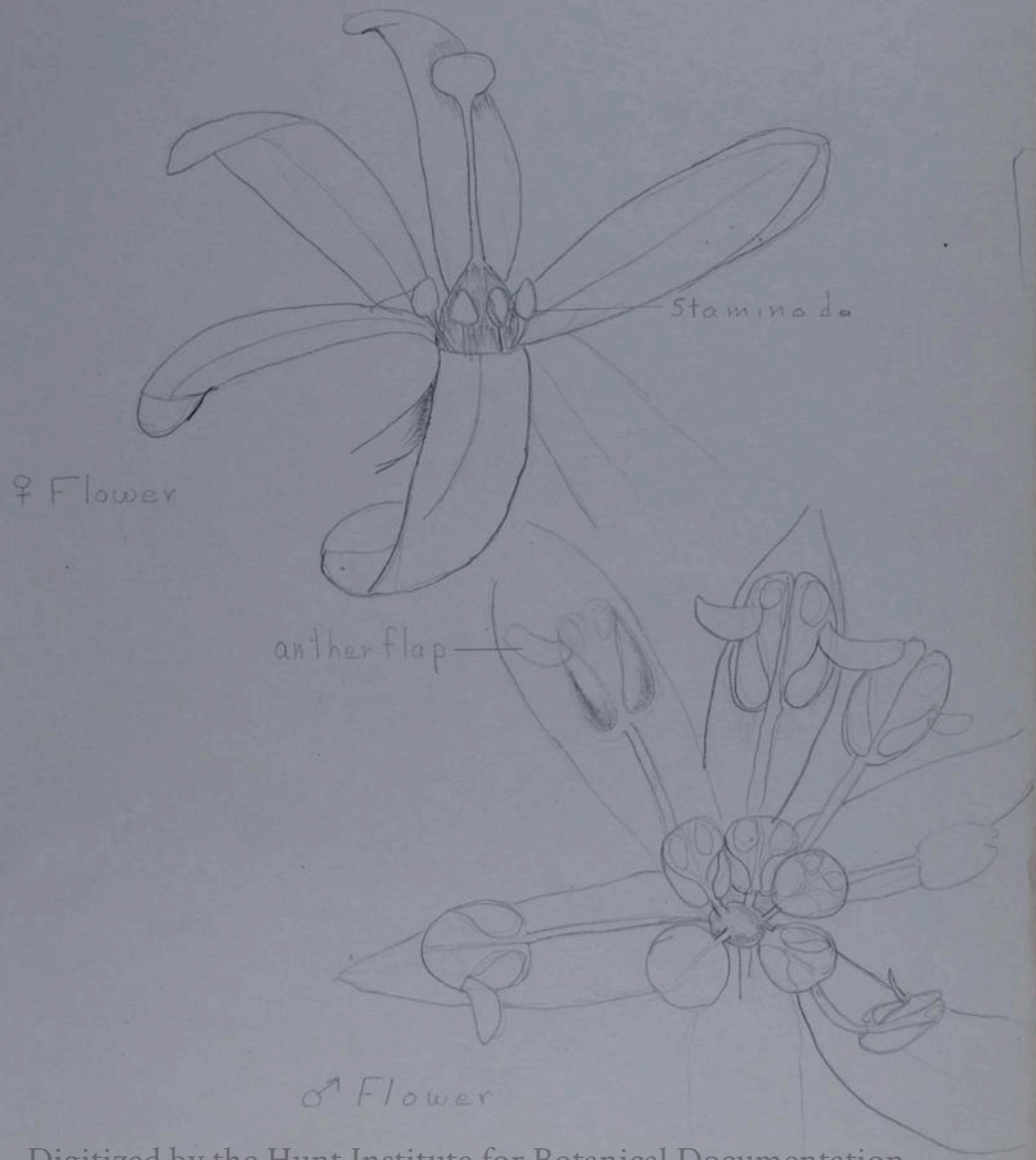
Magnolia

Ranales
Annonaceae
Annona

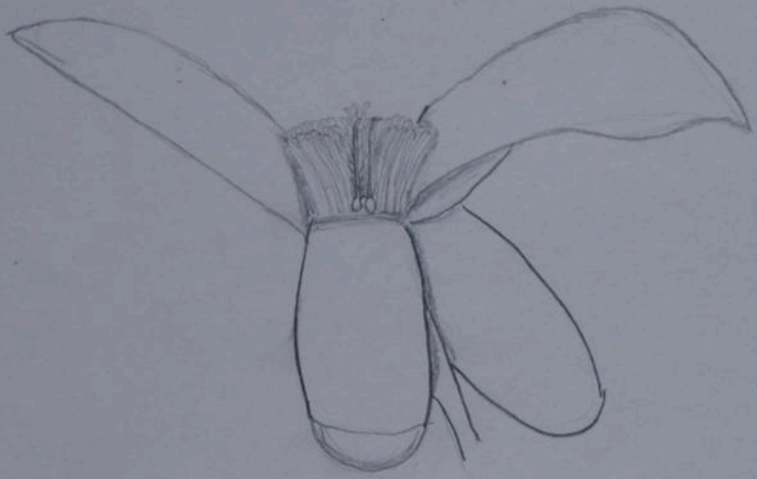


?

Ranales
Lauraceae
Sassafrass

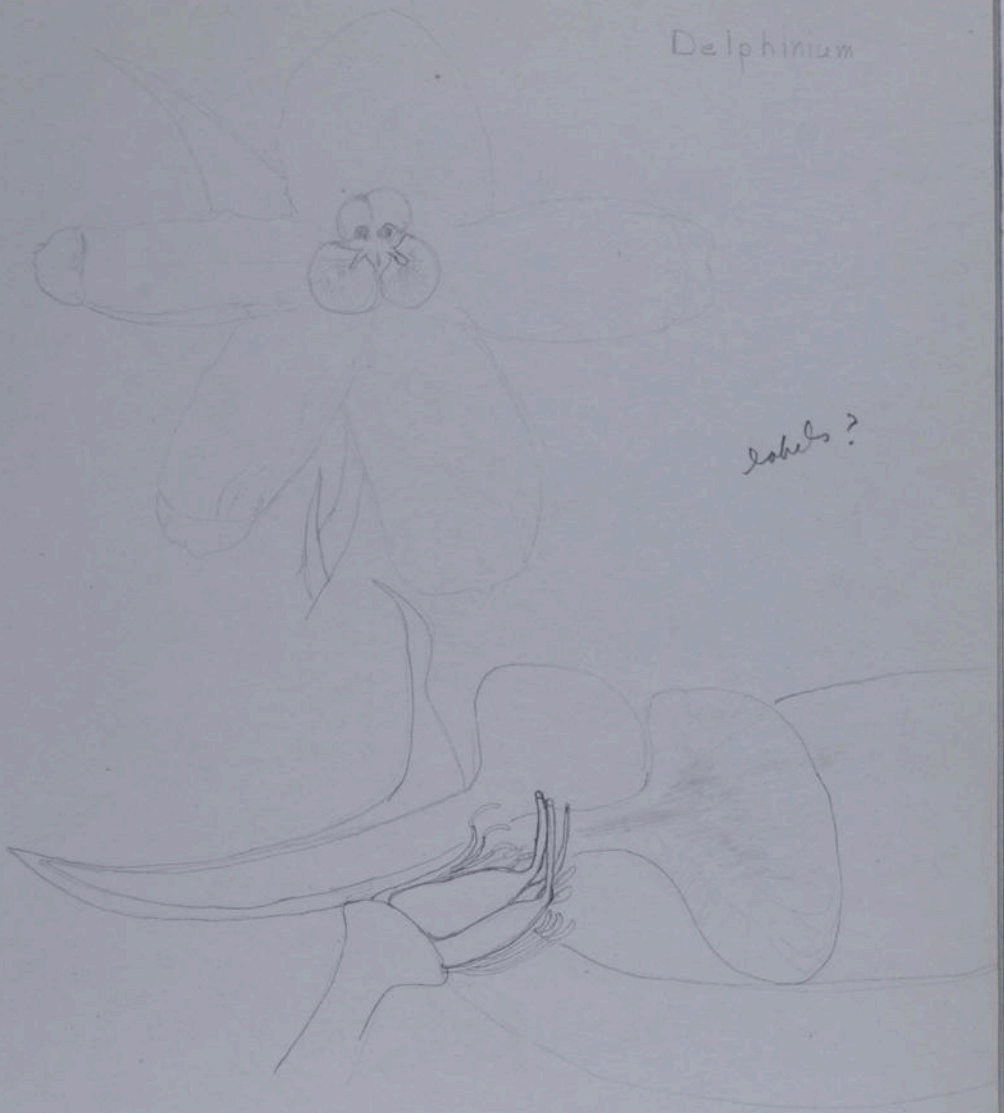


Ranales
Ranunculaceae
Ranunculus

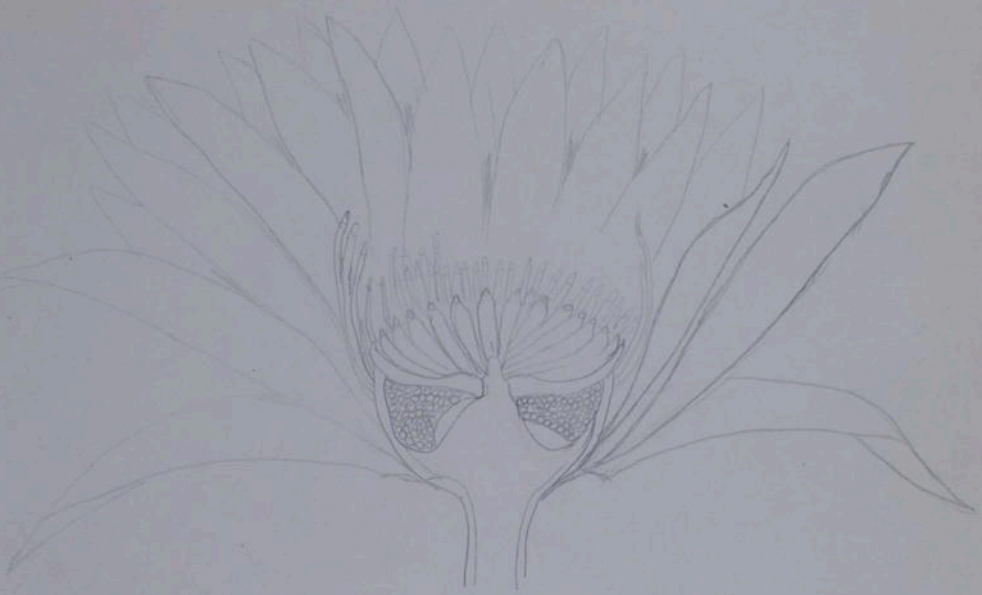


?

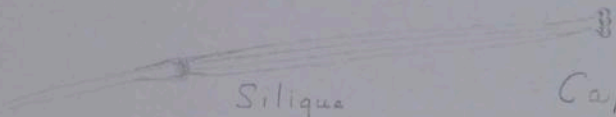
x15



Ranales
Nymphaeaceae
Nymphaea

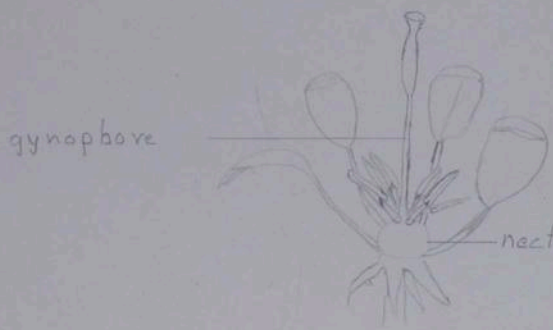


Rhoeadales
Papaveraceae
Hunnemannia



Silique

Capparidaceae
Cleome



Cruciferae
Lepidium?

?

Sarraceniales
Nepenthaceae
Nepenthes

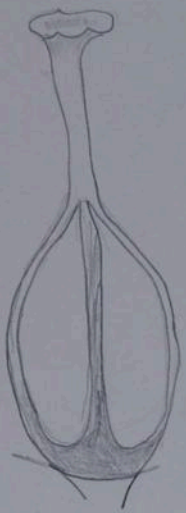
♂ Flower

♀ Flower

Parietales
Cistaceae
Helianthemum

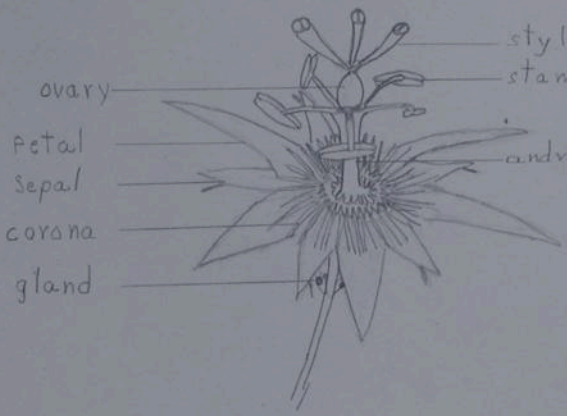
Parietales
Violaceae
Viola

Anther



Pistil

Passifloraceae
Passiflora

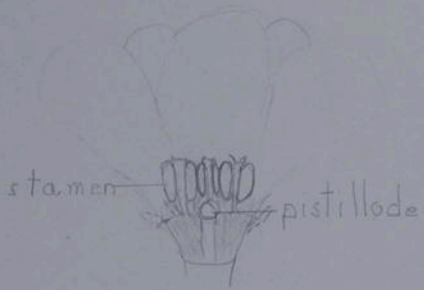


Caricaceae
Carica

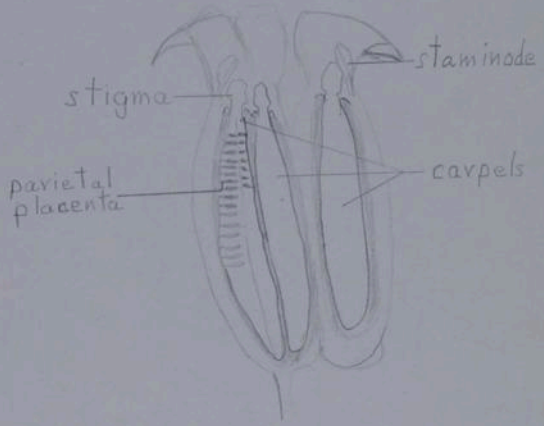
♂ Flower

♀ Flower

Peponiferae
Cucurbitaceae
Cucumis

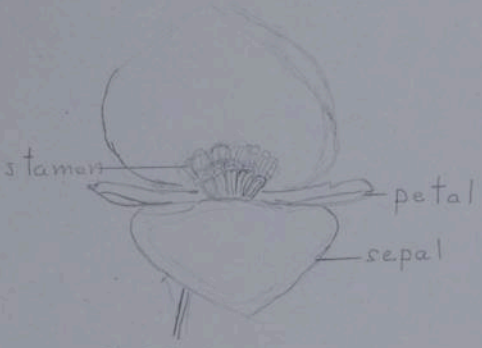


♂ Flower

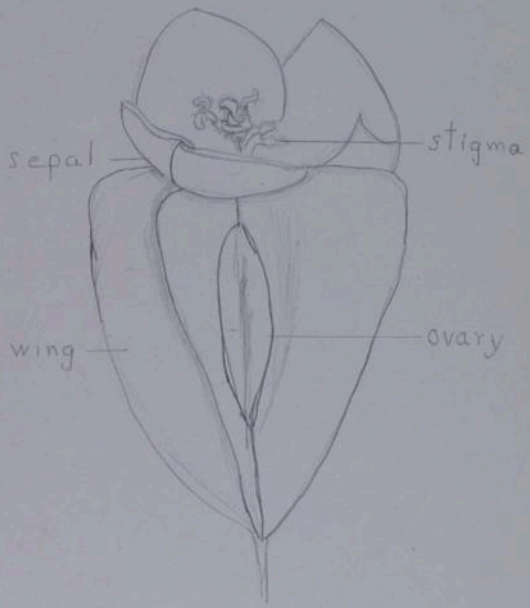


♀ Flower

Peponiferae
Begoniaceae
Begonia



♂ Flower



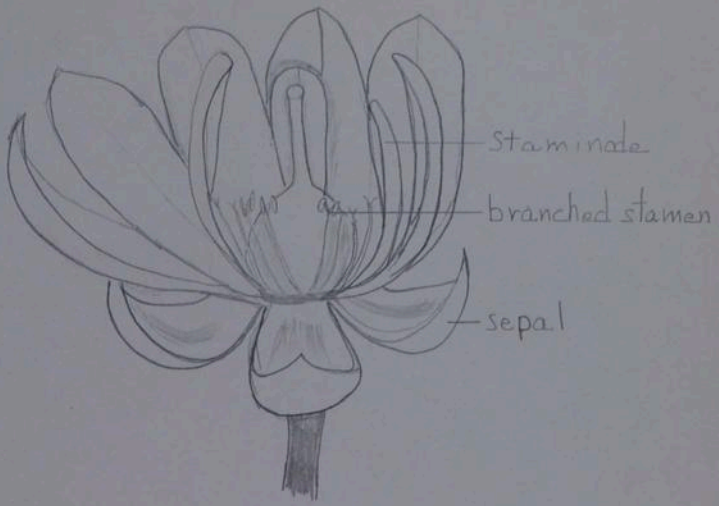
♀ Flower

X Section of Ovary

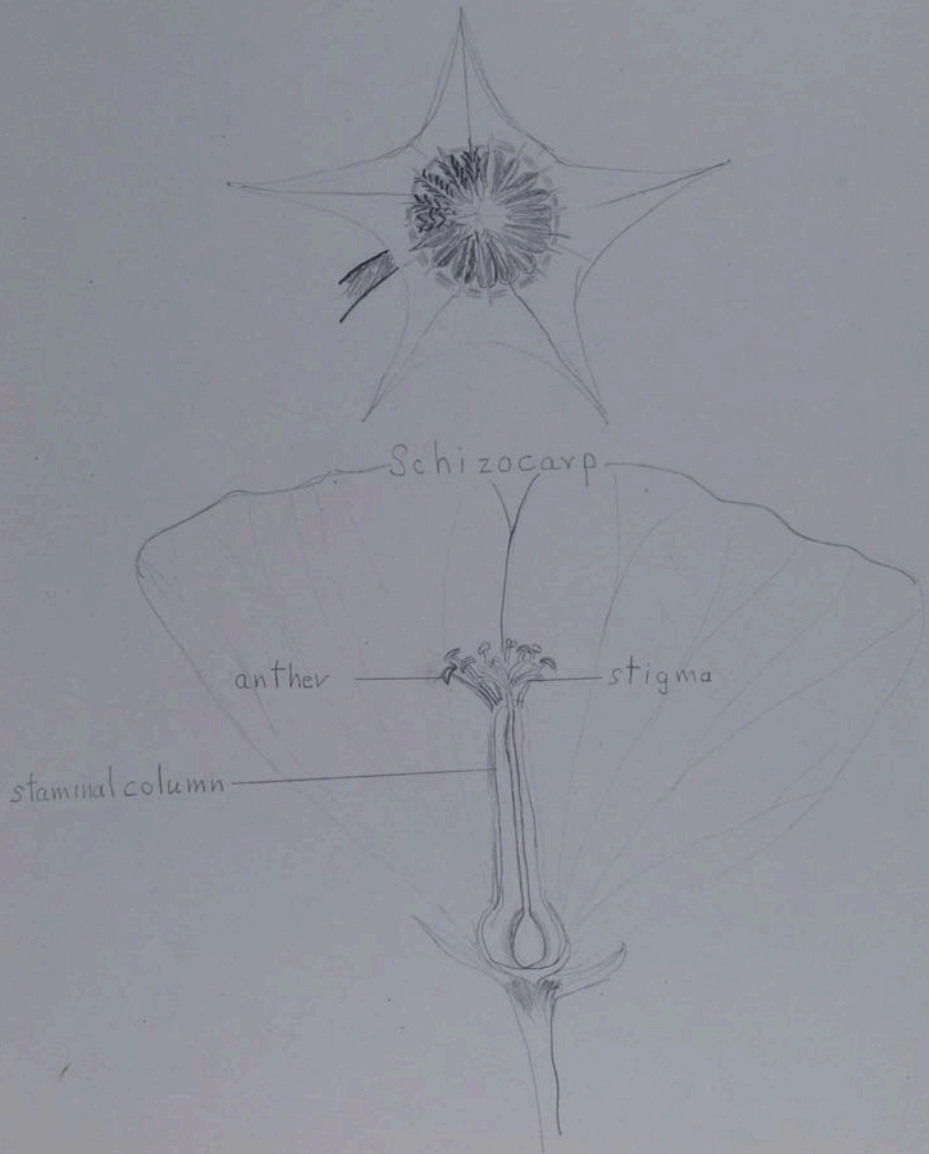
Guttiferales
Guttiferaceae
Hypericum

Dilleniaceae
Curatella
Sandpaper tree

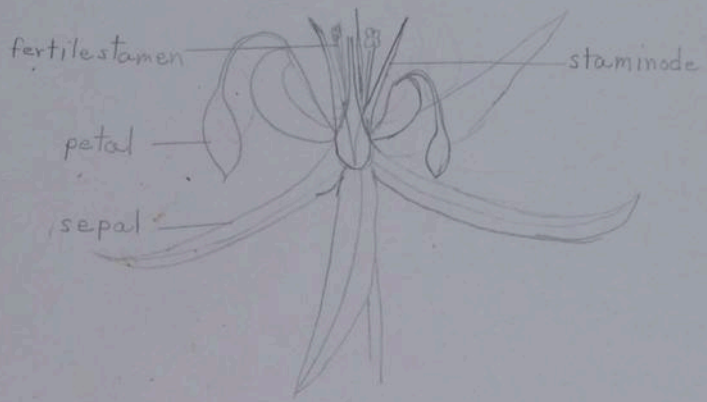
Malvales
Tiliaceae
Tilia



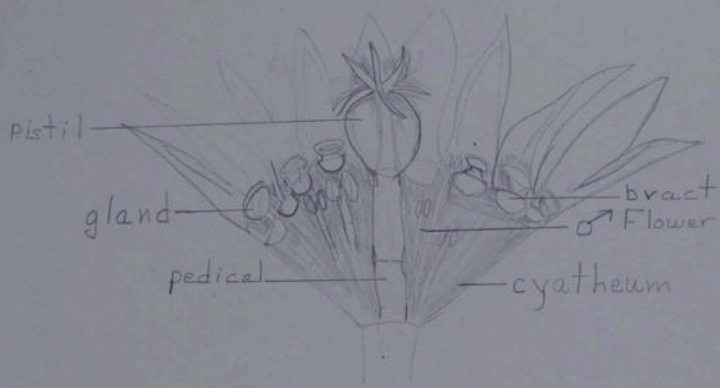
Malvales
Malvaceae
Lavatera



Malvales
Sterculiaceae
Theobroma
Cacao

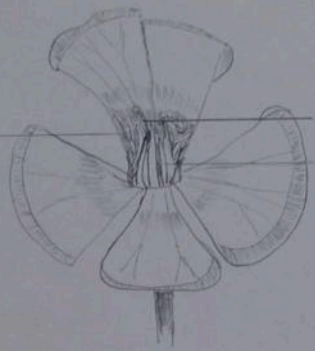


Tricoccae
Euphorbiaceae
Euphorbia

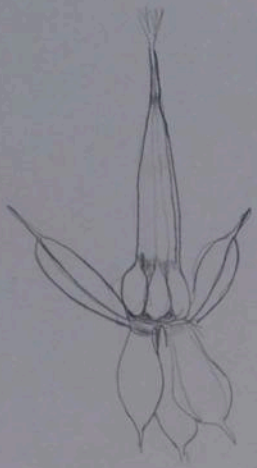


Jatropha

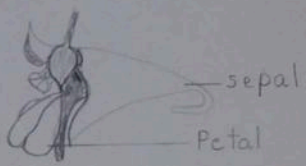
Geraniales
Geraniaceae
Pelargonium



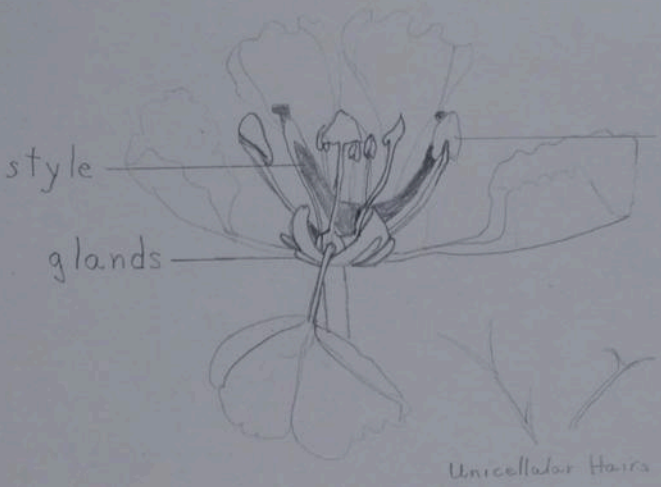
abdiplostemonous stamen



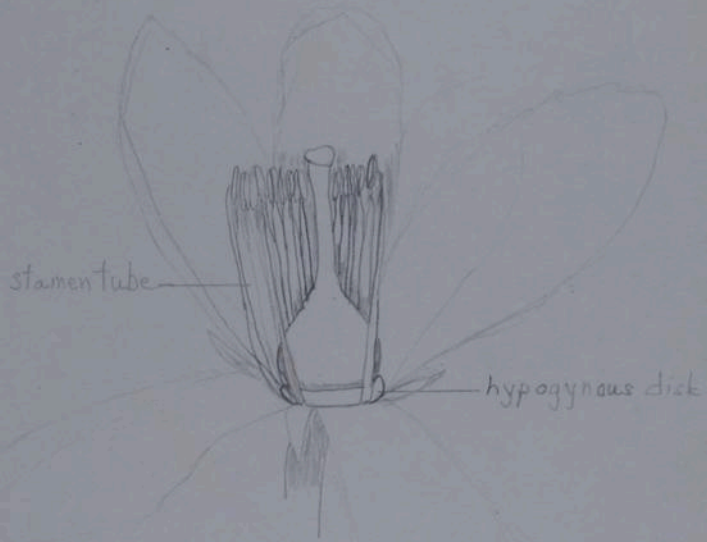
Balsaminaceae
Impatiens



Geraniales
Malpighiaceae
Malpighia



Rutales
Rutaceae
Citrus

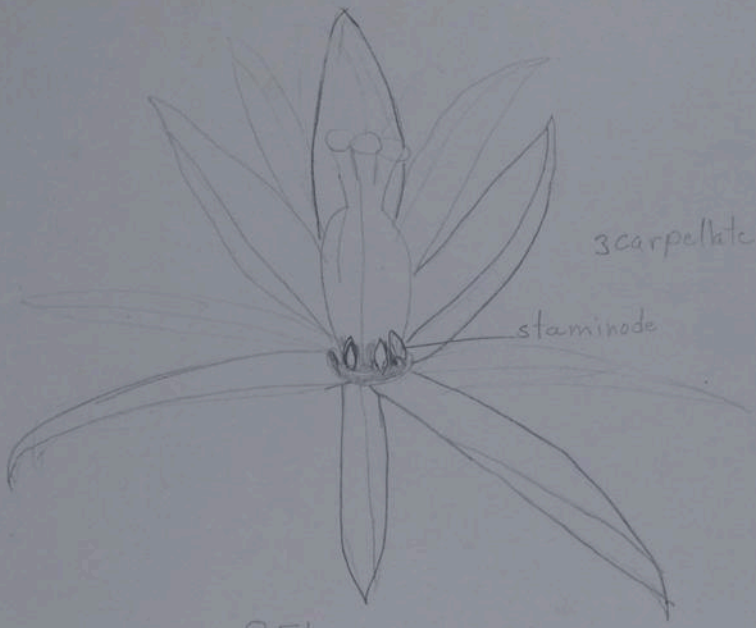


Rutales
Simarubaceae
Ailanthus

♂ Flower

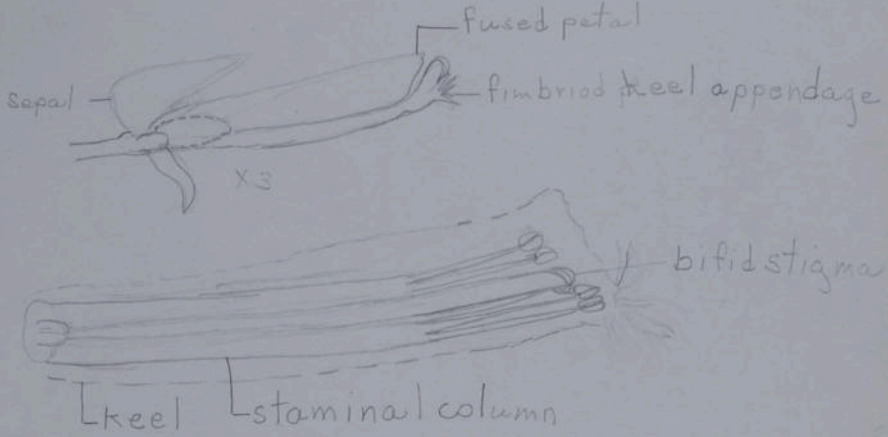
Meliaceae
Trichilia

Sapindales
Anacharidiaceae
Rhus

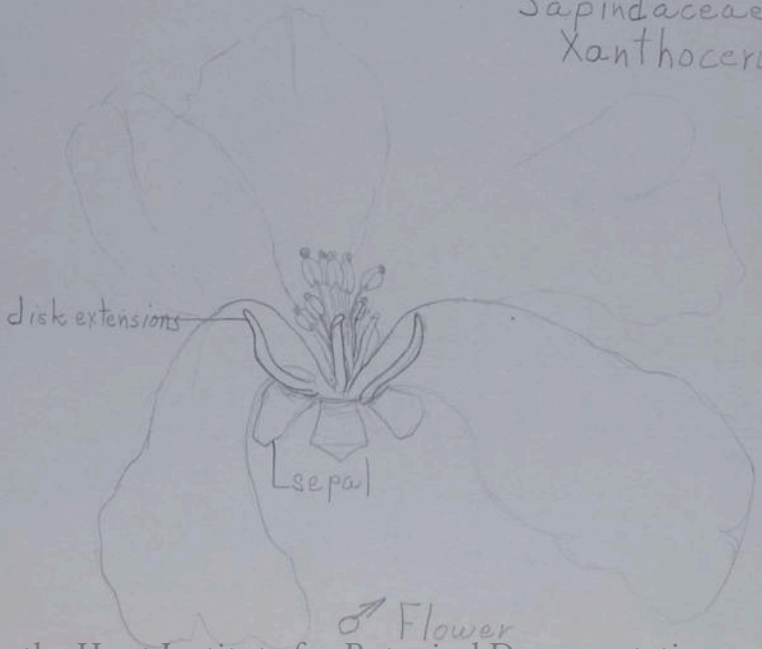


♀Flower

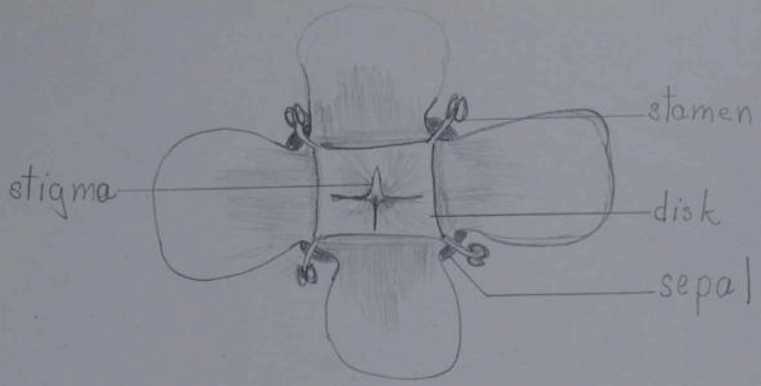
Sapindales
Polygalaceae
Polygala



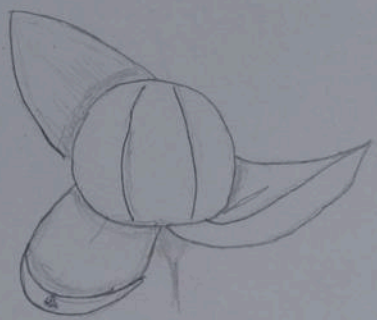
Sapindaceae
Xanthoceras



Celastrales
Celastraceae
Evonymus



Aquifoliaceae
Ilex



Celastrus

Celastrales
Staphyleaceae
Staphylea

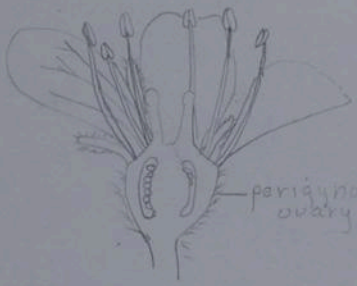
Rhamnales
Rhamnaceae
Rhamnus

Rhamnales
Vitaceae
Vitis

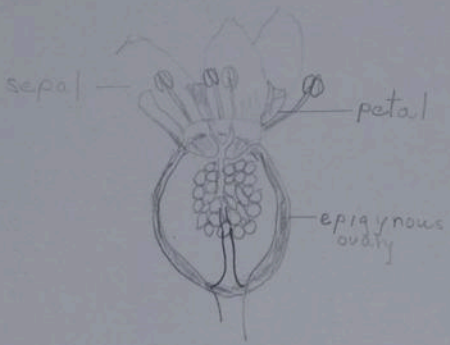
Rosales
Crassulaceae
Kalanchoe

Pittosporaceae
Pittosporum

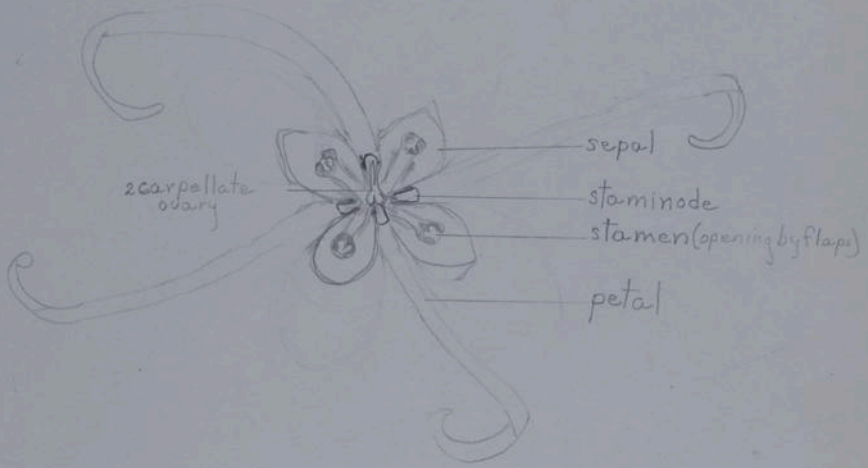
Rosales
Saxifragaceae
Saxifrago

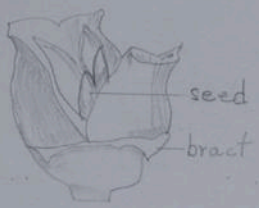


Ribes



Rosales
Hamamelidaceae
Hamamelis





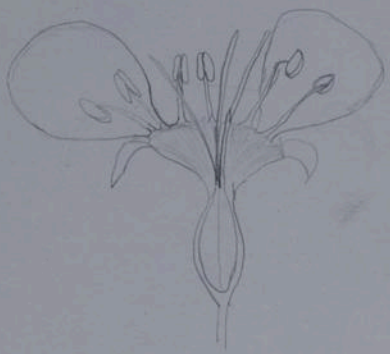
Loculicidal + Septicidal Capsule

Rosales
Hamamelidaceae
Liquidambar

x-sec. of ♂
Inflorescence

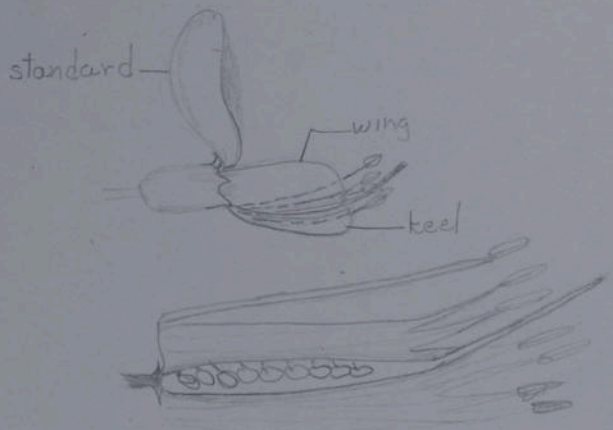
x-sec. of ♀ Fl.

Rosaceae
Pyrus



Papilionatae

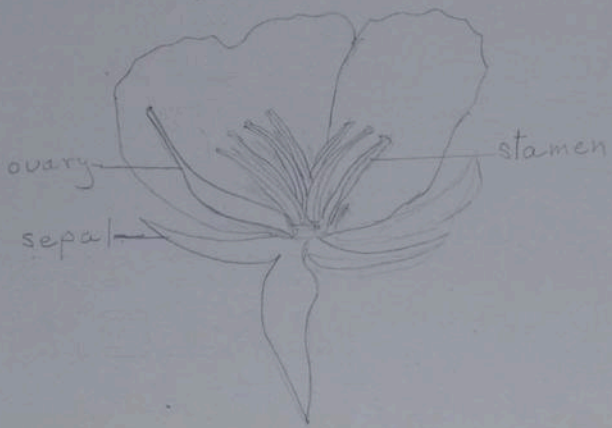
Rosales
Leguminosae
Cytisus



Diadelphus Stamens

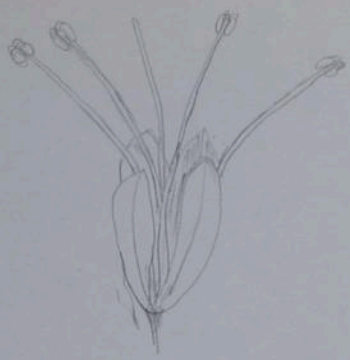
Caesalpinoideae

Cassia

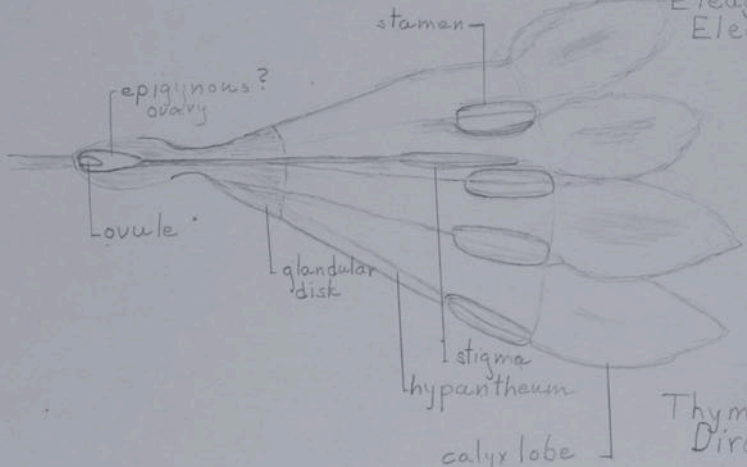


Mimosoideae

Rosales
Leguminosae
Mimosa



Myrtiflorae
Eleagnaceae
Eleagnus

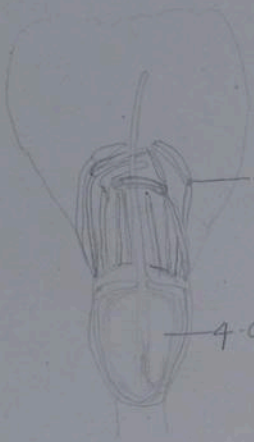


Thymelacceae
Dirca

Myrtiflorae
Combretaceae
Combretum

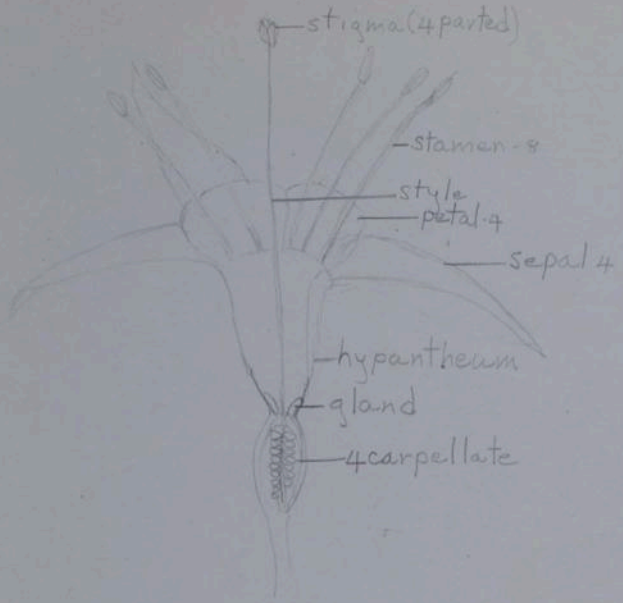
Myrtiflore
Myrtaceae
Eugenia

Melastomaceae
Conostegia



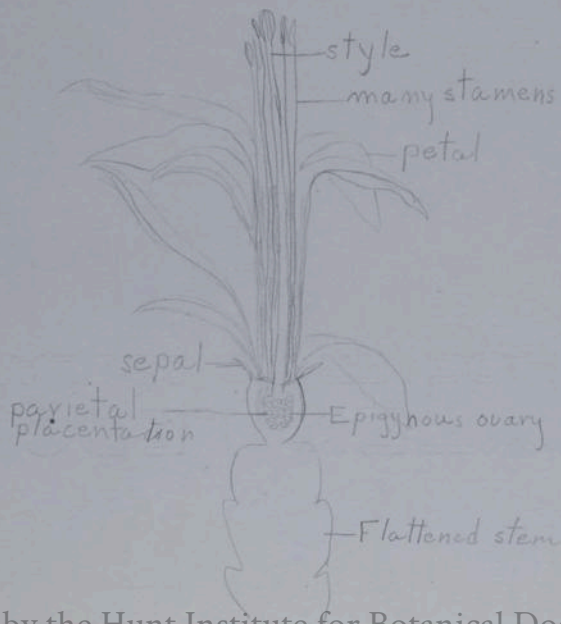
Melastoma

characteristic
3-veined leaf

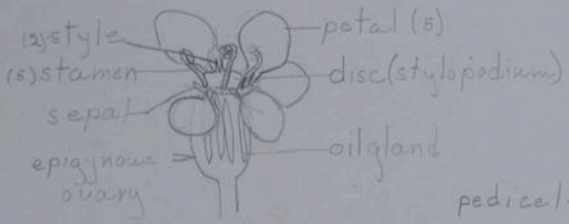


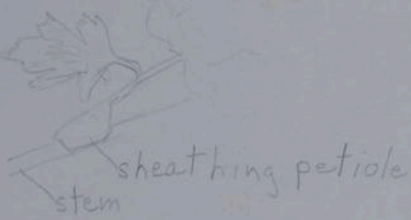
Myrtiflorae
Onagraceae
Fuchsia

Opuntiales
Cactaceae
Phyllocactus



Umbelliflorae
Umbelliferae
Daucus





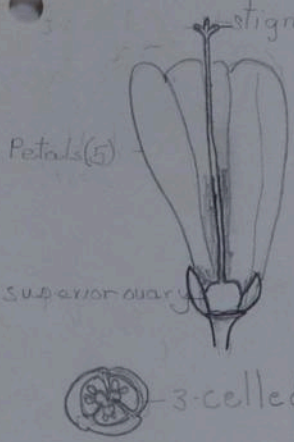
Araliaceae

Fr. of Aralia spinosa

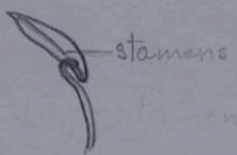
Umbelliforae
Cornaceae
Cornus

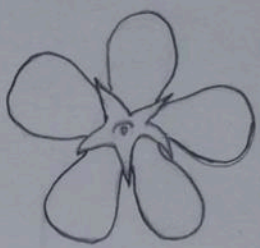
Inflorescence cymose

Sympetalae
Ericales
Clethraceae
Clethra



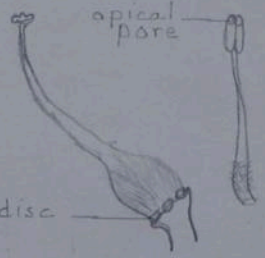
Pyrolaceae
Pyrola



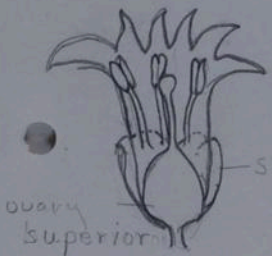


Flower (5-merous)

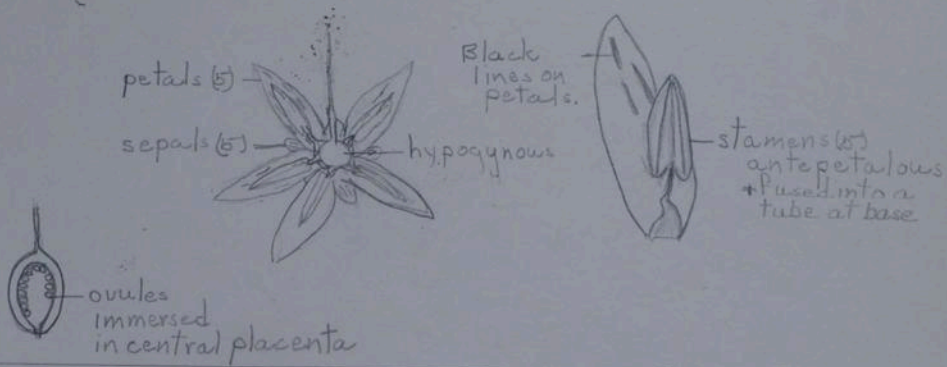
Ericaceae
Rhododendron



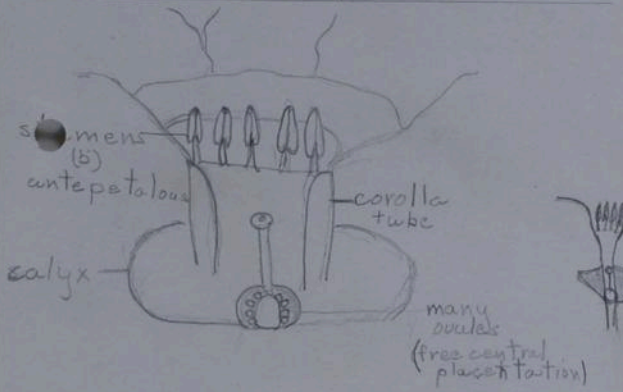
Primulales
Theophrastaceae
Jacquinia



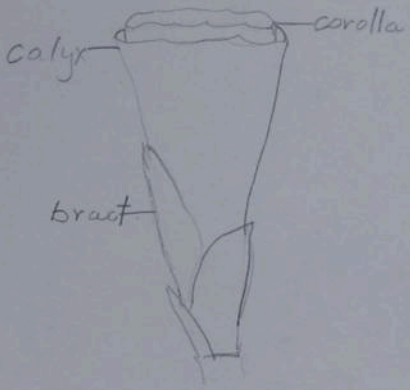
Primulales
Myrsinaceae
Ardisia

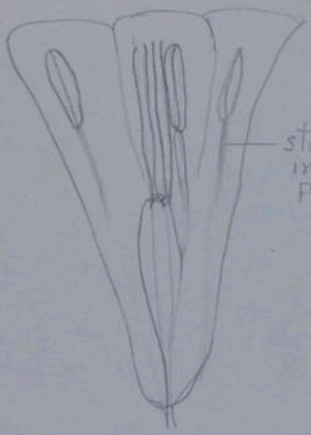


Primulaceae
Primula

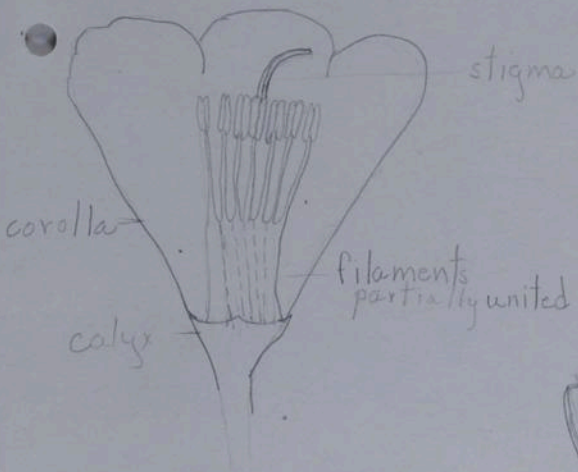


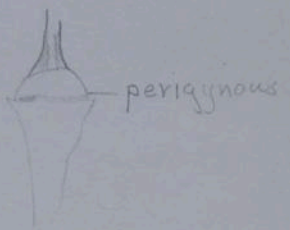
Plumbaginaceae
Statice



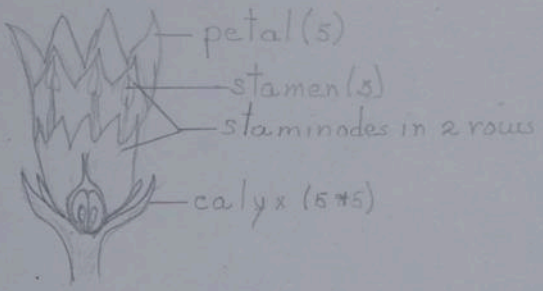


Ebenales
Styracaceae
Halesia

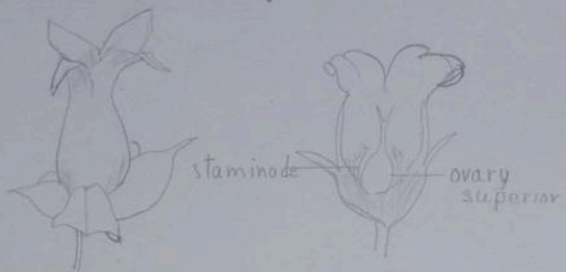


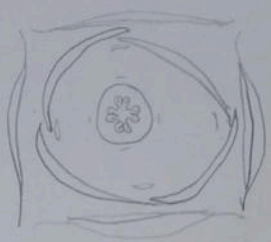


Ebenales
Sapotaceae
Bumelia



Ebenaceae
Diospyros

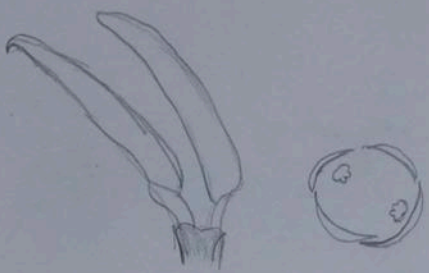


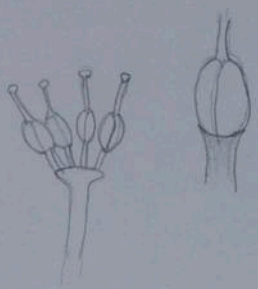


Oleales
Oleaceae
Forsythia

Forestieria ♀

Fraxinus ♂

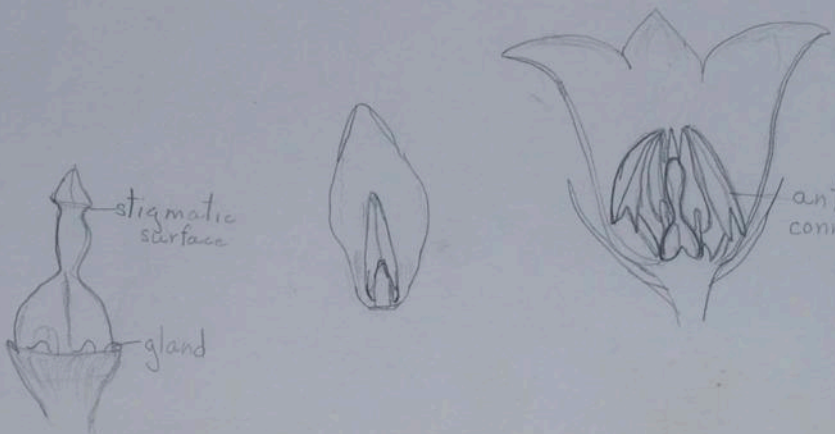




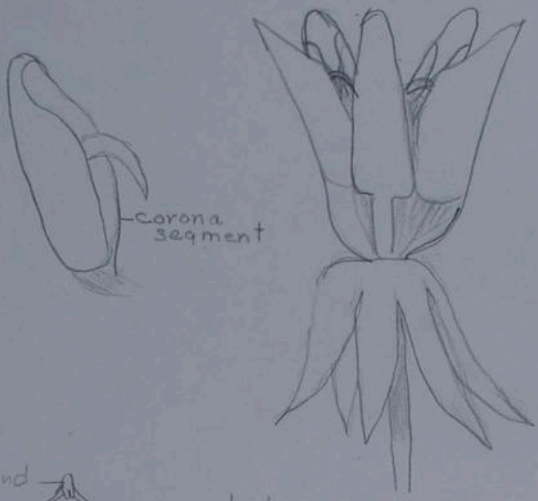
Contortae
Loganiaceae
Buddleia

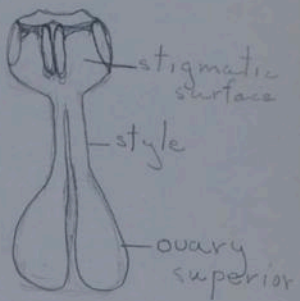
Gentianaceae
Sabbatia

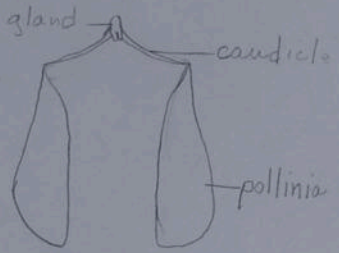
Apocynaceae
~~Amsonia~~ apocynum

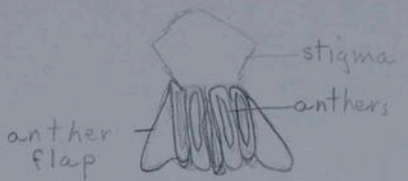


Asclepiadaceae
Asclepias



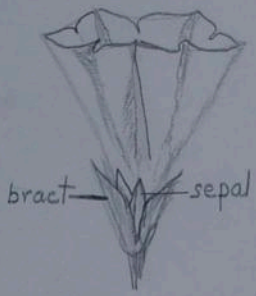


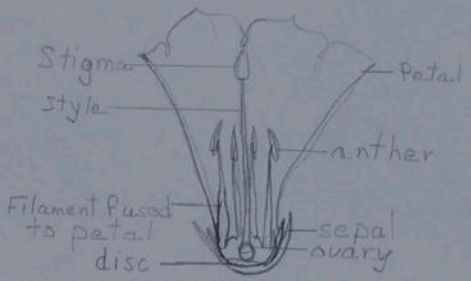




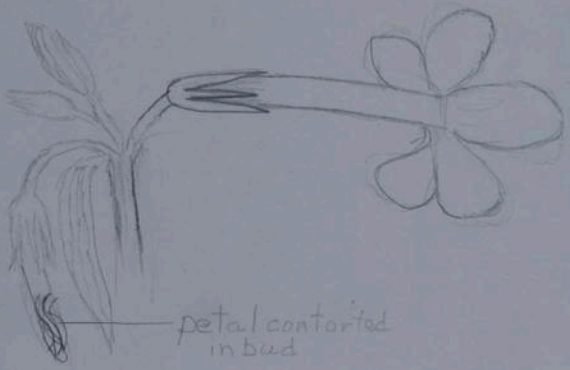
Anther

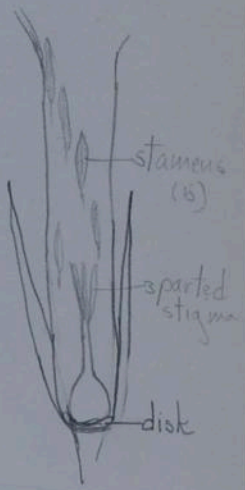
Convolvulales
Convolvulaceae
Calystegia



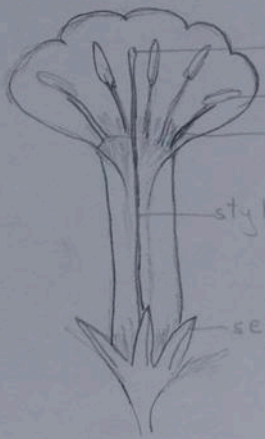


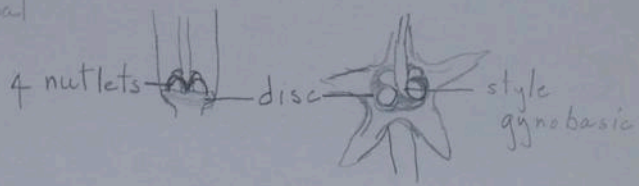
Tubiflorae
Polemoniaceae
Phlox



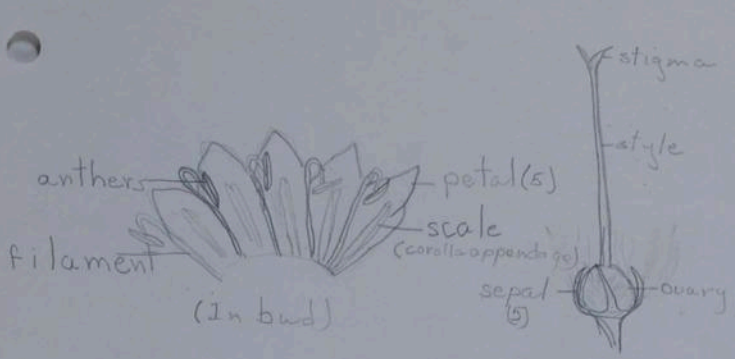


Boraginaceae
Mertensia

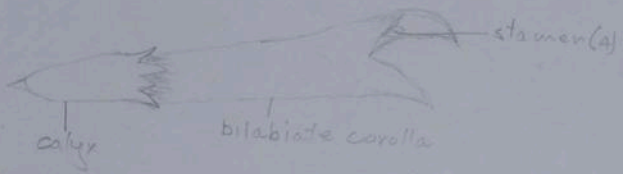


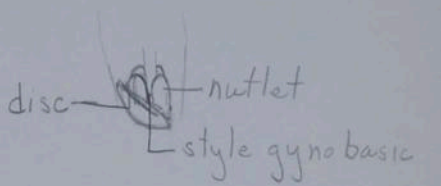


Hydrophyllaceae
Hydrophyllum

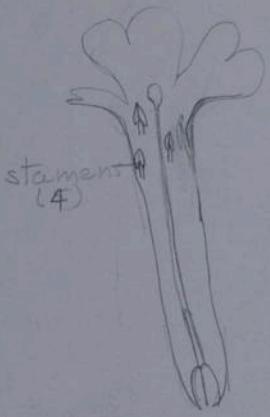


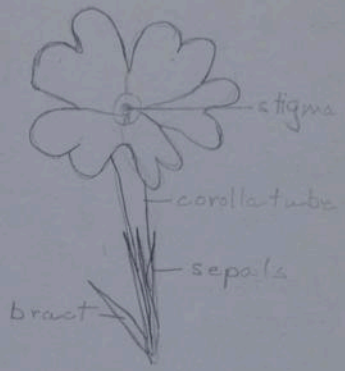
Labiatae
Scutellaria



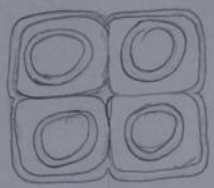


Verbenaceae
Verbena



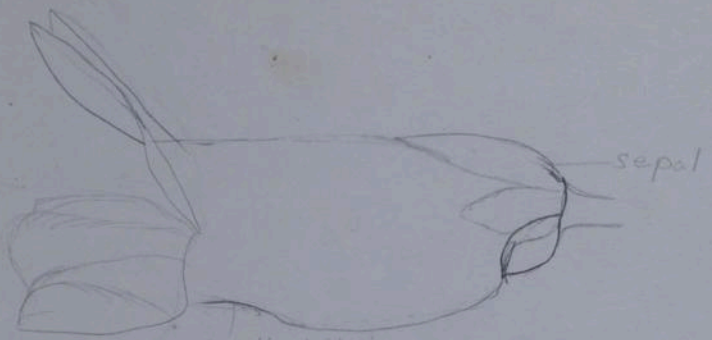


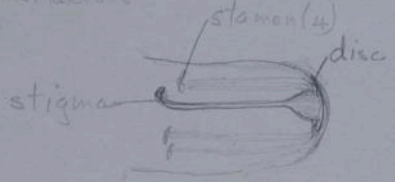
Fl. slightly zygomorphic



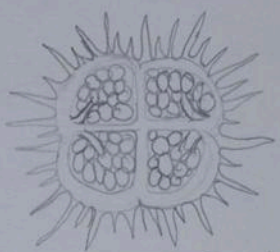
X-Sec. of 4 carpels

Tubiflorae – Solanineae
Scrophulariaceae
Antirhinum



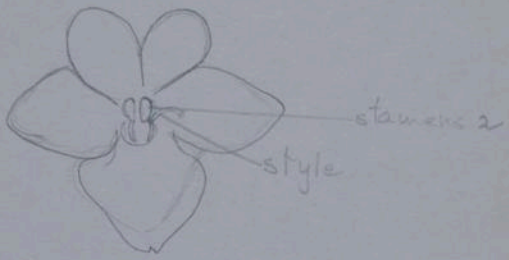


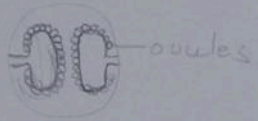
Solanaceae
Nicotiana



ovary of Datura
axile placenta

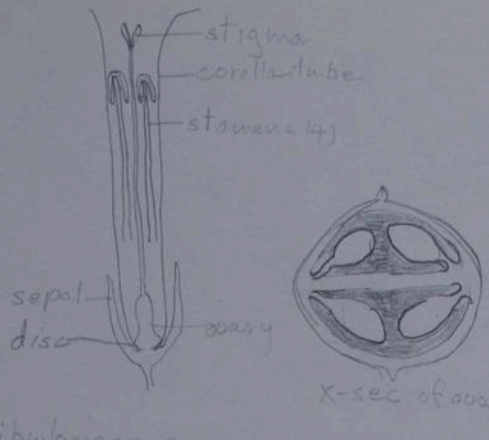
Gesneriaceae
Saint Paulia



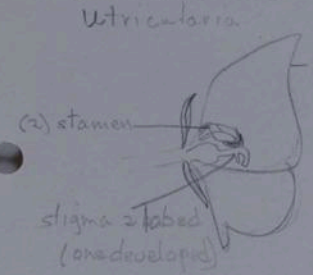


X-sec. of ovary

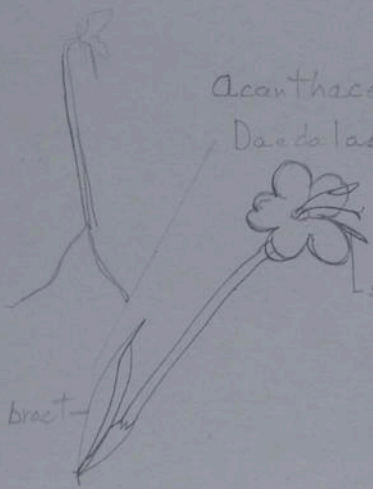
Bignoniaceae
Campsis

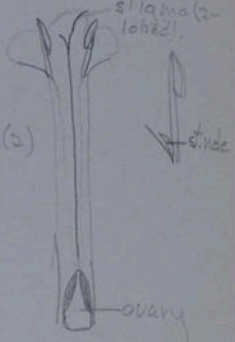


Lentibulariaceae
Utricularia



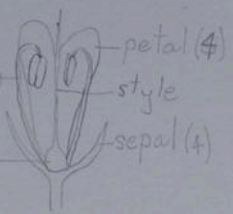
Acanthaceae
Daedalacanthus





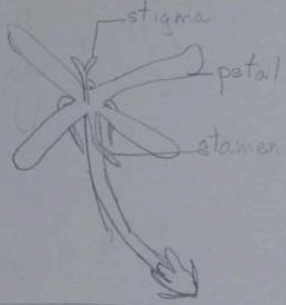
Plantaginaceae
Plantago

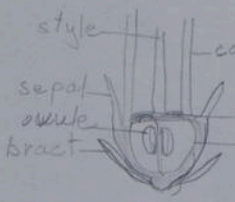
Inflorescence

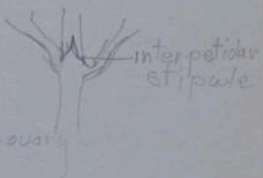


Fruit (a Pyx)

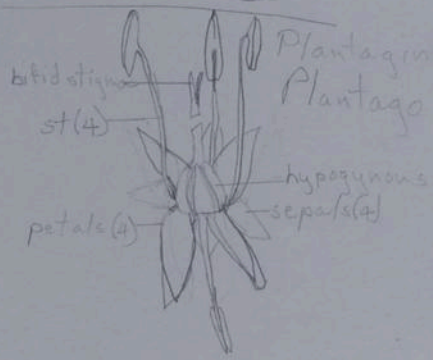
Rubiaceae
Ixora



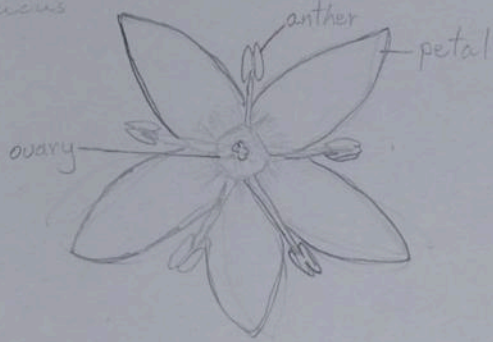


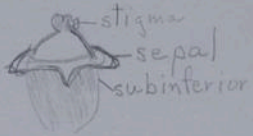


Plantaginaceae
Plantago



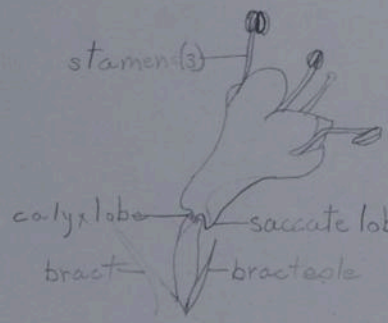
Caprifoliaceae
Sambucus

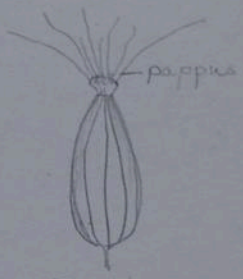




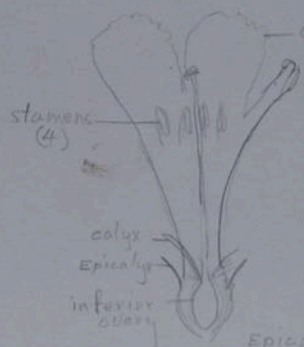
X-sec. of ovary

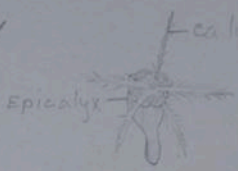
Rubiales
Valerianaceae
Valeriana



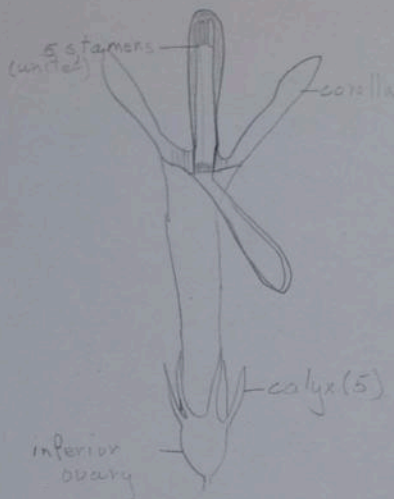


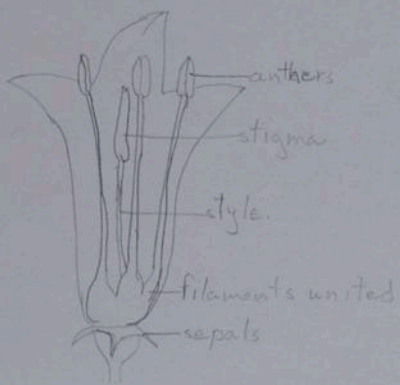
Dipsacaceae
Dipsacus





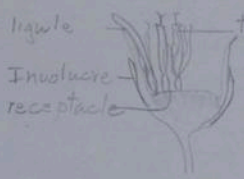
Campanulales
Lobelia

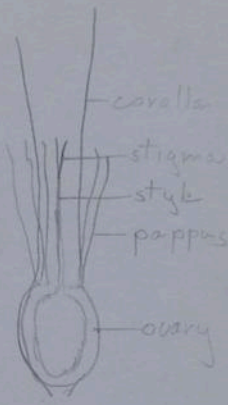




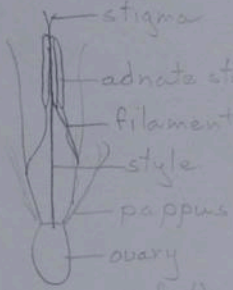
Compositae
Aster

Inflorescence





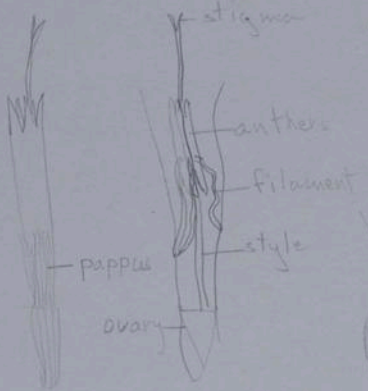
Ligulate ♀

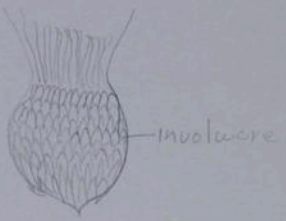


Tubular (perfect)

Vernonia

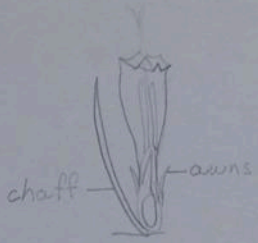
Tubular only





Helianthus

Inflorescence

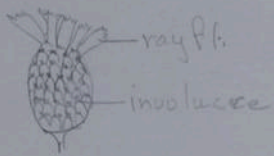


Tube flower
perfect

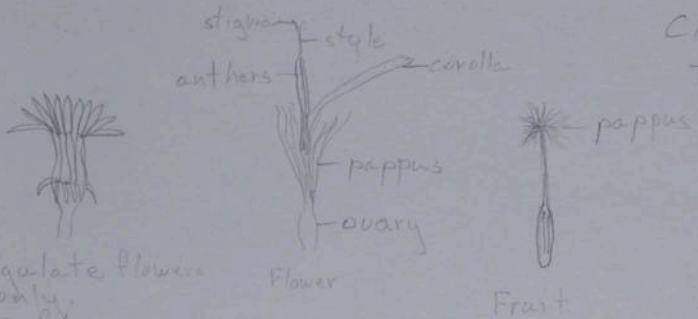
ray flower
neutral

Compositae
Senecioneae
Senecio

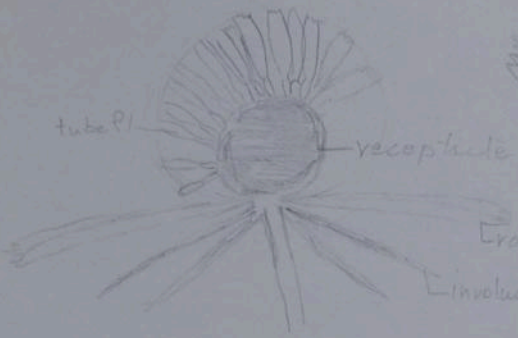
Cynareae
Centaurea



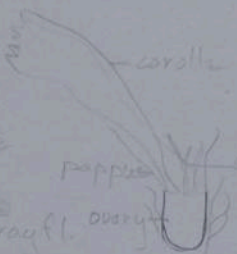
Cichoreae
Taraxacum



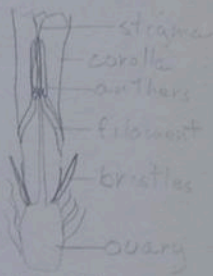
Compositae
Helenium



Inflorescence



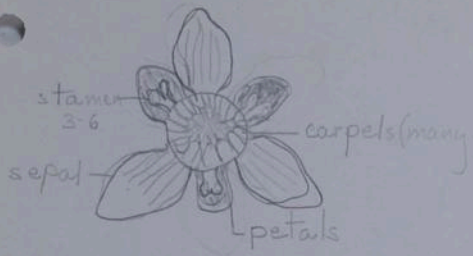
ray floret



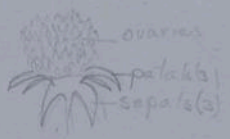
tube floret

Anthemideae
Achillea

Monocotyledone
Helobieae
Alismaceae
Alisma

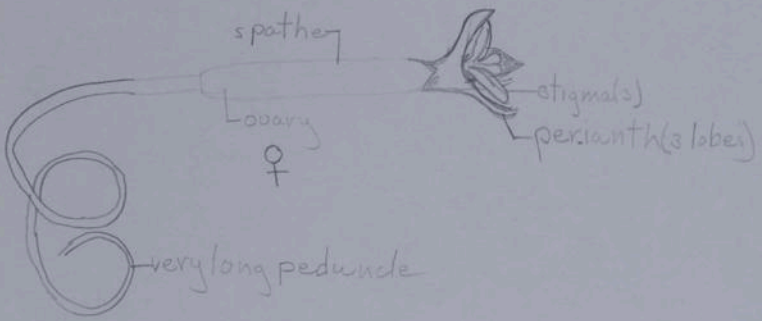


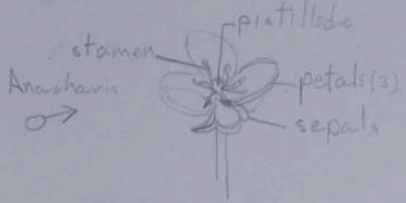
Alisma



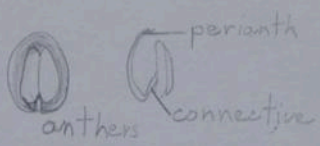
Sagittaria ♀Fl.

Hydrocharitaceae
Vallisneria

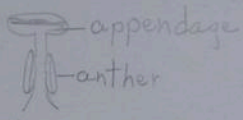




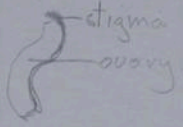
Scheuchzeriaceae
Triglochin



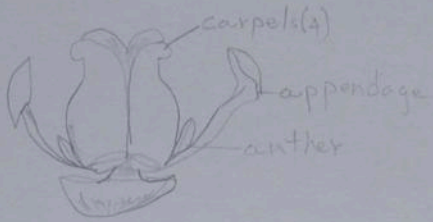
Potamogetanaceae



stamen



pistil



Flower

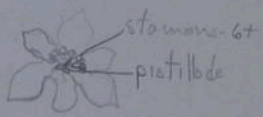
Liliales
Dioscoreaceae
Dioscorea

♀ Inflor.

♂ Infl.

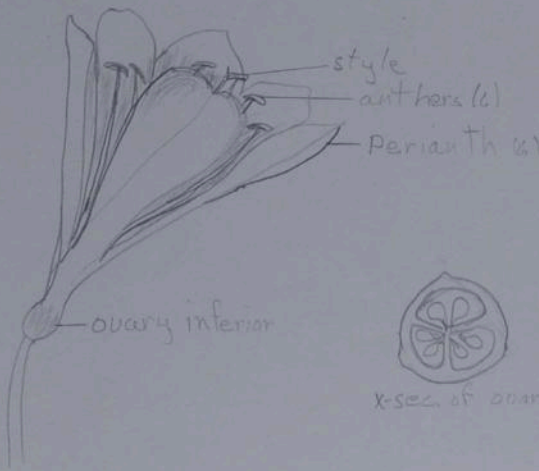
♀ Fl.

♀ Fl.



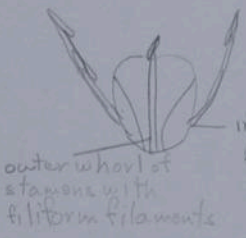
♂ Fl.

Amaryllidaceae
Clivea



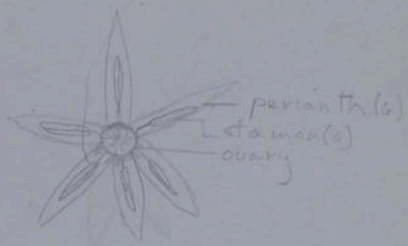
x-sec. of ovary

Liliaceae
Ornithogalum



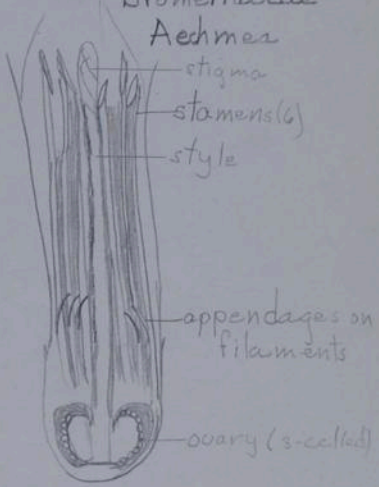
Iridaceae
Gladiolus

Juncaceae
Juncus

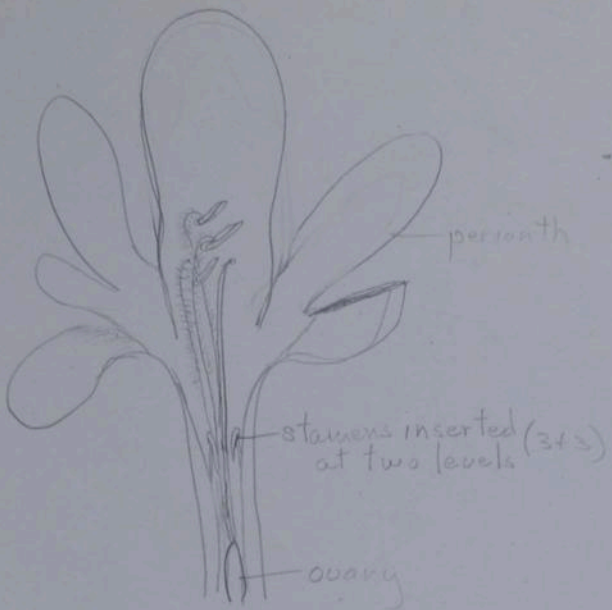


Inflorescence
(Helicoid cyme)

Farinosae
Bromeliaceae
Aechmea



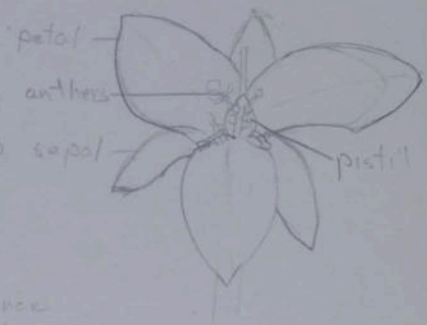
Pontederiaceae
Eichornia



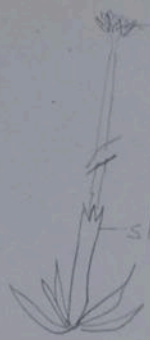
Commelinaceae
Rhoeo

Inflorescence

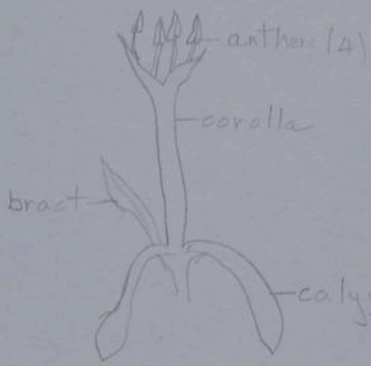
Inflorescence
(scorpioid cyme)



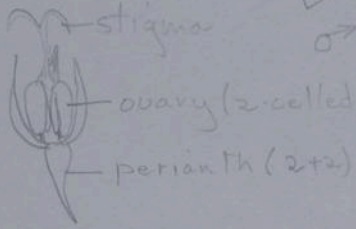
Farinosae
Eriocaulaceae
Eriocaulon



Habit



♂ Fl.



♀ Fl.

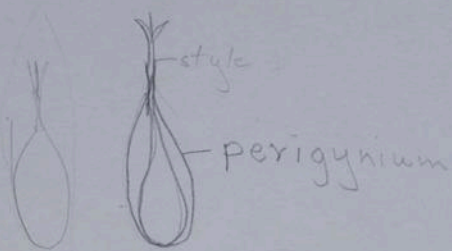
Glumiflorae
Cyperaceae
Cyperus

Spike x 5

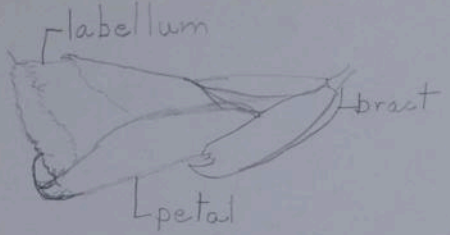
Eleocharis

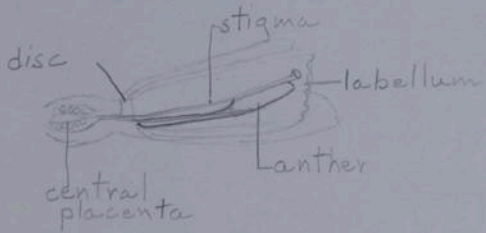
Fruit

Carex

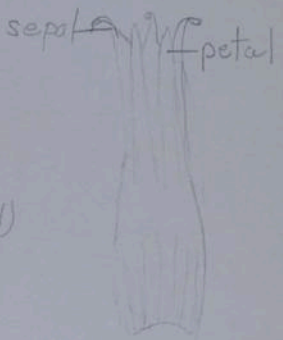


Scitamineae
Zingiberaceae
Alpinia

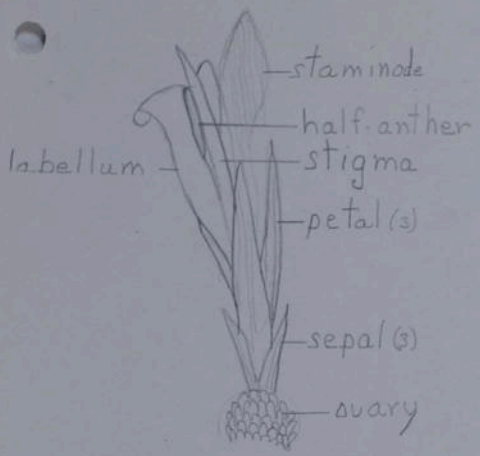




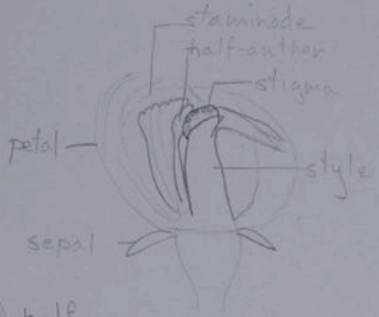
Musaceae
Musa

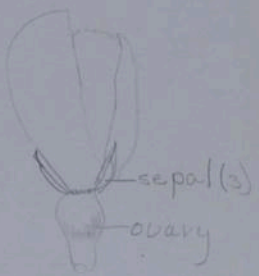


Cannaceae
Canna

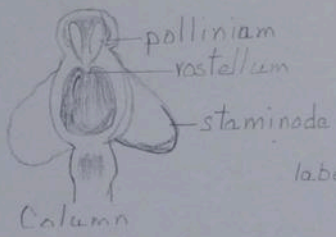


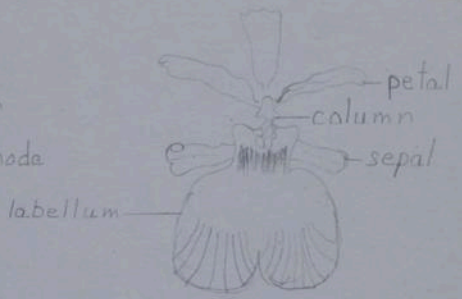
Marantaceae
Thallia

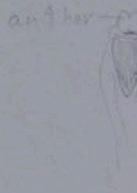




Microspermae
Orchidaceae
Oncidium

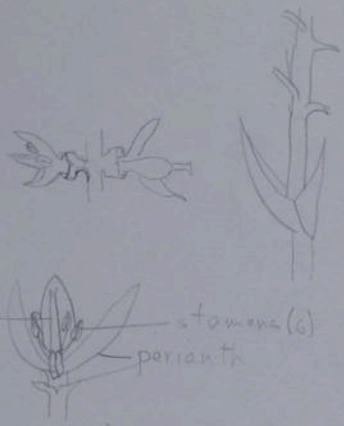




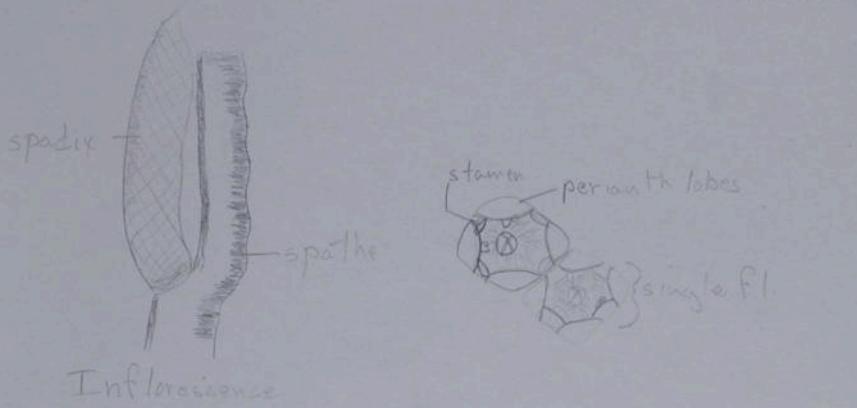


Cattleya

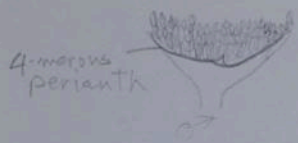
Palmaceae
Euterpe



Araceae
Acharas



Arales
Cyclanthaceae
Carludovica



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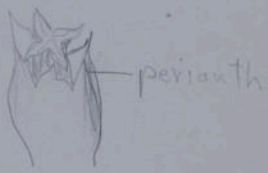
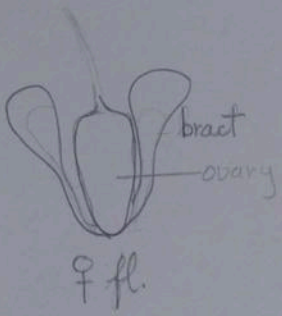
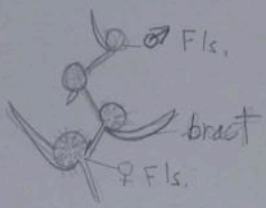


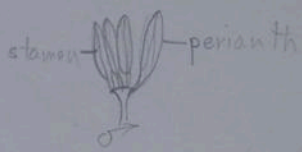
Fruit

Pandanales
Typhaceae
Typha



Sparganiaceae
Sparganium





SALICALES

Salicaceae

Salix

Populus

Flowers dioecious, in catkins, each flower subtended by a bract; bracteoles absent. No perianth, but with subtending gland or disc; staminate flowers with 2 or more stamens; the female of two carpels united to form a one-celled ovary with parietal placentas bearing numerous anatropous ovules. Fruit a dehiscing capsule.

Salix has single bud scale, and narrow lanceolate leaves.
Populus has cordate leaves; numerous bud scales, waxy or resinous.
Seed comose (with silky hairs)

Leaves subtended by a stipule.

Largely north temperate plants, a few in warmer regions, and others extending into the arctic.

A constant anatomical character is the superficial origin of the periderm, which in Salix arises from the epidermis, in Populus from the next lower layer.

JUGLANDALES

Flowers unisexual (monoecious) in catkins (at least the male) naked or with a simple scale-like perianth which is more or less united to the ovary in the female. Male flower with a variable number of stamens; female of two united carpels; ovary unilocular, containing a basal orthotropous ovule with usually one integument. Fruit a nut or drupe-like; often more or less enveloped by the persistent bracteoles.

Trees or shrubs with alternate simple or pinnately compound exstipulate leaves; rich in aromatic compounds.

A constant and important distinguishing feature is found in the unilocular ovary of Juglandales with its single orthotropous ovule. The present of aromatic compounds in the leaves is also distinctive.

Family 1. Myricaceae: Flowers monoecious or dioecious, naked; pistili supported by 2 bracteoles adnate to fruit; fruit a small drupe usually secreting wax. Leaves simple or pinnately divided.

Myrica

Comptonia

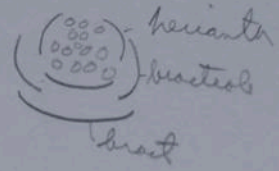
Family 2. Juglandaceae: Flowers monoecious. Male inflorescence a many-flowered catkin, each flower in the axil of a bract, with a pair of bracteoles and often a perianth of a few scale-leaves; stamens 3-40 a rudimentary pistil is sometimes present. Bract and bracteoles in the female flower free or more or less united with the ovary, as is also the inconspicuous usually 4-merous perianth; carpels two, median or transverse with a pair of stigmatic style-arms. Fruit a drupe or nut with a thin or fleshy exocarp; endocarp hard with 2 or 4 incomplete septa. Embryo with fleshy four-lobed corrugated or foliaceous cotyledons.

Trees with generally large compound imparipinnate aromatic leaves.

Juglans--walnut, butternut; in fruit the husk (bracts) are indehiscent; has perianth.

Carya--hickory, pecan; epicarp dehiscent, has no perianth.

These two genera ~~xxxxx~~ separated by the leaflets.



Betula--Birch. Sterile flowers 3 (the bractlets 2) to each shield-shaped scale or bract of the catkins, consisting each of a calyx of one scale bearing 4 short filamen s with 1-celled anthers (or strictly of two 2-parted filaments, each division bearing an anther-cell). Fertile flowers 2 or 3 to each 3-lobed bract, without bractlets or calxy, each a naked ovary, becoming a winged and scale-like nutlet (or small samara) crowned with the two spreading stigmas. Outer bark often separable in sheets, that of the branchlets dotted. Buds sessil , scaly. the Male catkins longer than the female.

Alnus--Alder. Sterile catkins with 4 or 5 bractlets and 3 (rarely 6) flowers upon each short-stalked shield-shaped scale; each flower usually with a 3-5 parted calyx and as many stamens; filaments short and simple; anthers 2-celled. Fertile catkins ovoid or ellipsoid; the fleshy scales each subtending 2 flowers and group of 4 little scalelets adherent to the scales or bracts of the catkin, which are woody in fruit, wedge-obovate, truncate or 3-5-lobed.

Family 2: Fagaceae.

Trees, with watery juice, sl nder terete branchlets marked by numerous usually pale lenticels, alternate stalked penniveined leaves, and narryow mostly deciduous stipules. Flowers monoecious, rarely dioecious, the staminate usually in catkins, the pistillate usually few, sometimes solitary; staminate flowers often with scale-like perianth, with varying stamens; pistillate flowers usually with a 3-celled (rarely 6-celled) pistil with 2 penduleous anatropous ovules with 2 integuments in each cell; fruit 1-seeded, invested at maturity by a bracteate cupule.

Staminate

Quercus--Oaks. Cupe doesn't cover fruit, has 1 acorn. /Flowers in slender aments. Pistillate flowers solitary, in few-flowered unisex. spikes.

Castanea--Chestnut. Nut inclosed in a prickly burr. Pistillate flowers in 2-5 flowered clusters below the staminate, in bosexual aments.

Fagus--Beech. Staminate flowers fascicled in globosex-stalked heads; the pistillate in 2-4 flowered clusters.

Nothofagus--Beech. This genus confined to the southern hemisphere.

Order 6. Casaurinales.

FAGALES--Flowers unisexual, in catkin-like generally compound inflorescences; the femal flowers often a few together. Male flowers generally adnate to the bracts, sometimes with a simple inconspicuous perianth; female protected by the bract and bracteoles, sometimes with an inconspicuous superior perianth, of two or three (rarely 6) carpels forming an ovary of as many cell , each with one or two pendulous ovules. Fruit a one-seeded nut associated with the persistent bract and bracteoles. Endosperm absent, embryo straight.

Family 1: Betulaceae--Flowers monoecious in unisexual catkin-like compound inflorescences. Perianth, when present, of small scale-leaves which vary in number and are free or united; superior in the pistil ate flower. The male flowers adhere to their bract and contain 2-12 stamens which are generally divided; there is no rudiment of a pistil. The female flowers have a bilocular ovary with two styles; each chamber contains a pendulous anatropous ovule with one integument. Fruit with one seed; during its ripening the bracts undergo considerable development. The embryo with its large oil-containing cotyledons fills the seed.

Corylus--Sterile flowers consisting of 8 stamens with 1-celled anthers, their short filaments and pair of scaly bractlets cohering more or less with the inner face of the scale of the catkin. Fertile flowers several from a scaly bud; ovary tipped with the short limb of the adherent calyx, one of the ovules;sterile; style short; stigmas 2, red, elongated and slender. Nut ovoid or subglobose, inclosed in a leafy or partly coriaceous cup or involucre, consisting of the two bractlets enlarged and often grown together and lacerated at the border. Hazelnut, Filbert

Ostrya--Sterile flowers consisting of several stamens in the axil of each bract; filaments short, often forked, bearing 1-celled anthers; their tips hairy. Fertile flowers a pair to each deciduous bract, each of an incompletely 2-celled 2-ovuled ovary, crowned with the short bearded border of the adherent calyx, tipped with 2 long-linear stigmas, and inclosed in a tubular bractlet, which in fruit becomes a closed bladdery ellipsoid bag, very much larger than the small smooth nut; these inflated involucres loosely imbricated to form a sort of strobile, in appearance like that of the Hop.

Carpinus--Hornbeam, Ironwood. Sterile flowers similar to those of Ostrya. Fertile flowers several, spiked in a sort of loose terminal catkin, with small deciduous bracts, each subtending a pair of flowers; th single involucre-like bract open, enlarged in fruit and foliaceous, merely subtending the small ovate several-nerved nut.

The bracts are 3-parted.

Order 6. Casaurinales

Casaurinaceae

Casaurina--Australian Pine. Flowers monoecious, extremely simple; staminate flowers in whorls in clustered twiggy spikes at ends of young stems, with 1more or less cleft stamen and a caducous 2-leaved perianth with 2 bracteoles; pistillate flowers capitate on short side branches, naked but with 2 bracteoles, the pistil 2-carpellate, 2-celled but 1 abortive, the second usually with 2 ovules, one abortive; fruit a woody samara enclosed by the woody bracteoles. Trees and shrubs with green fluted stems and whorled scale-like leaves.

Order 6a. Leitneriales.

Family 1. Leitneriaceae: Flowers dioecious, naked, in catkins; pistil 1-carpellate with 1 ovule; fruit a drupe. Shrubs with alternate, simple exstipulate leaves.

Leitneria

Order 7. Urticales: Flowers generally unisexual, small, regular, and monochlamydeous (one perianth leaf)or rarely naked; tepals 2-7, greenish and more or less united; stamines 4-5, opposite, pistil superior, 1-2 carpellate, usually 1-celled, 1-ovulate; fruit a nut, drupe, or samara. Herbs, shurbs, or trees; leaves usually simple, alternate, and stipulate; usually cymose inflorescences. Stipules caducous, found only with bud. Usually, families are either all woody or all herbaceous.

Family 1. Ulmaceae; Flowers often bisexual; stamens erect in bud; styles 2; ovule pendulous and anatropous; endosperm usually absent. Trees and shrubs without latex; leaves often oblique, stipules deciduous.

Two sub families

1. Ulmoidae
   Ulmus--Bisexual flowers; fruit a samara; leaves unequilateral, many pinnate veins, almost parallel.
2. Celtoidae--
   Celtis--Unisexual flowers; fruit a drupe; leaves with 3 equal veins at base, not parallel. Hackberries.

Family 2. Urticaceae: Flowers 2-merous (monoecious, unisexual); stamens inflexed in bud (filament turns, with anther toward center); style 1; ovule erect, orthotropous; endosperm oily. Herbs, rarely woody, often with stinging hairs; leaves stipulate.

Urtica--nettle. Sepals 4 in both fertile and sterile flowers. Achene straight and erect, inclosed by the 2 inner and larger sepals. Stigma capitate-tufted. Leaves opposite.

Boehmeria--ramie, (sp. nivea). Flower-clusters spiked, not involucrate. Style long and thread- haped, stigmatic down one side. Leaves opposite, serrate.

Maclura--osage orange.

Family 3. Moraceae--Mulberry. Flowers 2-merous; stamens inflexed or straight in bud; styles 2; ovule pendulous; endosperm present. Trees or shrubs, rarely herbs, with latex; leaves stipulate, often lobed.

Morus monoecious or dioecious flowers in racemes. Stamens inflexed. Pistil with 2 styles; 2 perianth leaves at base; fruit aggregate, the pulpy parts are the perianth lobes. Leaves dentate, 3-nerved.

Ficus--fig. Peculiar inflorescence, axis or peduncle flattened and rounded into a synconium.

Artocarpus--breadfruit. Pistillate inflorescence with a spathe.

Dorstenia--contrayerba. Flowers in a synconium.

Cecropia--tropical genus.