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THE ORDER RANALES IN MASSACHUSETTS

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by

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INTRODUCTION:

For some time the European scientist has been familiar with a type of descriptive botany which marks a considerable departure from the more formal ideal of the nineteenth century which still rules our current taxonomic work on this side of the Atlantic. In place of the detailed and technical description based upon herbarium specimens, he has elected to follow the ideal of the field botanist, and has incorporated his findings in a treatise which covers the morphology, ecology, history and taxonomy of the flora of a limited area.

The tendency in this direction was evident as early as 1887 when the first edition of Engler and Prantl's *Die Natürliche Pflanzenfamilien* began to appear, but it reaches its extreme in Hegi's exhaustive *Illustrierte Flora von Mittel-Europa*. This departure from a mechanical ideal to a more vital concept of the plant is distinctly a twentieth century movement, and it accords with a certain change in outlook which has accompanied the more recent discoveries in the organic world. It is, in fact, in harmony with the philosophical ideal of holism, or emergent evolution, which sees the world as an organic whole and recognizes, in consequence, the impossibility of detaching any unit of life from the totality of which it forms a part. Dr. Alexis Carrel, for example, has recently criticised the cytologists sharply for their attempt to carry forward their particular researches within the

(1) The principles of holism are set forth by J.C. Smuts in *Holism and Evolution*, while C. Lloyd Morgan's *Emergent Evolution* deals with essentially the same ideal.
artificially circumscribed limits of a single cell. (1) He avers that the cell, apart from its environment, is only an abstraction, and that the attempt to treat it as an independent and isolated entity has only delayed the advance of biological understanding.

If this be true of the cell it is likewise true of the plant as a whole. (2) No plant is "sufficient unto itself alone" - it is a part of the organic life of a hillside, of a world, of a universe, and its form, its function, its very evolution, is the resultant of all the forces which play upon it. The leading American ecologist, Clements, sets forward the same opinion forcibly when he states: (3)

"The concept of the complex organism was formulated as a logical consequence of recognizing that the development of the community is an organic process, carried on by means of functions and resulting in structures, essentially as in the individual plant and animal.

"The community thus came to be regarded as something more than the mere sum of its parts, as an entity in which the component individuals bear much the same relation to themselves and the whole as do the cells of metaphyte or metazoon. To biologists such a view appeared novel and startling when first proposed, and it was in consequence much criticized. In spite of this it is steadily gaining a wider acceptance and by dynamic ecologists generally is recognized as the cornerstone of.

(1) Dr. Carrel is a member of Rockefeller Institute for Medical Research and the article referred to is The New Cytology, which appeared in Science, March 20, 1931.

(2) A very recent article on floral morphology, A Review of Researches Concerning Floral Morphology by Helen Bancroft, The Botanical Review, March 1935 closes with this significant statement: "angiospermic flower form and structure must be approached in relation to the problems of organic form and function as a whole; no line of investigation must be overlooked." In the same article Mrs. Arber, and Troll, the latter a German worker, are mentioned as supporting this holistic or synthetic treatment of the plant, though in different "degrees".

developmental ecology. This recognition has been hastened by its more or less independent use as the basic idea in the philosophical system of the emergent evolutionists."

In the following pages an attempt is made to interpret the ranalian plants of Massachusetts in consonance with this newer and sounder biological outlook. Since the ramifications of any single fact are infinite and endless, and since the selection of material and the judgment involved in its artistic synthesis are highly subjective, it becomes obvious that no full measure of success is possible. With von Baer we can say:

"Science is, in its source, eternal; in its scope, unmeasurable; in its problem, endless; in its goal, unattainable."

In the following treatment we have tried to assimilate and unify the botanical material which, over many centuries, has accumulated about that group of angiospermous dicotyledons known as the Ranales, and focus these details upon their Massachusetts representatives. If, however, certain facts of peculiar evolutionary or economic significance pertain to members of the Order not native to our flora, we have not hesitated to transcend State or even National limits in order to deal with them. If this material should ultimately appear in print, it may possibly be of value to teachers in our schools and colleges and to that group of educated laymen who find in the plant world a source of interest and enthusiasm. Also, it is hoped that this may be but the first of a series of similar treatises, and that other students may carry on a set of studies on other plant groups so that the outcome of their combined efforts may be a worthy Flora of Massachusetts.

It is obvious that in dealing with a subject which has been cultivated and enriched by many observations extended over a
period of very many years, the assembling and collating of material scattered through the voluminous literature plays a large part. But in addition to this essential background-work, we have studied these plants with our own eyes, not only from authentic representatives in several of the larger herbaria of the eastern United States, but as they grow in their native habitats. Some peculiar morphological variations of undoubted significance have been chanced upon, but no special treatment of these observations has been attempted and they have been incorporated in the general text. We have tried to extend our acquaintance with this group of plants as a whole, taking the Ranales as a typical Order of angiosperms whose study reveals the principles which are applicable to all similar groups.

Appended to the pages of the text are thirty-six plates of drawings which we hope are not too unfaithful representations of the genera and species of Ranales of Massachusetts.
THE ORIGIN OF THE ANGIOSPERMS:

Some years ago the Order Ranales assumed a new position and one of unparalleled significance in the plant world, namely that of being the most primitive living angiosperms. (1) Formerly, this lowest station in the phylogenetic tree of flowering plants had been allotted to the Amentiferae on the basis of their simplicity. This latter (and older) scheme, sponsored by Wettstein and followed by Engler and Prantl, considered the simple, greenish, apetalous, wind-pollinated flowers of the Amentiferae as remnants of an archaic flora which had not yet attained to entomophily and, in consequence, the more highly developed petaloid forms were held to have arisen through a process of progressive evolution.

This essentially pre-Darwinian view, which generally regarded simplicity as synonymous with primitiveness, is now very seriously called in question. Many of these so-called primitive-flowered forms of the Amentiferae, and of other plant groups as well, have been found to owe their simplicity to reduction from a once more complex floral state. But the main factor which tended to relegate the Ranales as a whole to the bottom of the angiosperm "tree" was their possession of a set of morphological characters which, as was pointed out by Arber and Parkin, appeared to relate the woody members to a certain group of Mesozoic cycadalean plants known as the Bennettitales. The Bennettitales were characterized by cycad-like amphisporangiate cones with a central group of open

megasporophylls ("carpels") which were surrounded by filicinean, slightly-webbed microsporophylls ("stamens"), while the whole reproductive apparatus was encased by bracteal leaves ("perianth"). (Fig. 1) These strobili (proanthostrobilae) differed from modern flowers (euanthostrobilae) in that their naked seeds were borne on long stalks (megasporophylls?): there is no least trace of a closed carpel in these plants and the pollen was received directly in the micropyle of the ovule, as it is in most gymnosperms, instead of upon a stigma as it is in the angiosperms. The seeds of the Bennettitales are sometimes well preserved and it is known that they were endospermous and dicotyledonous.

It is, then, upon the basis of the elongated strobilar axis (torus), the hermaphrodite flowers, the indefinite bracteal perianth and multiplied free gynoecial units, that various evolutionists have seen in the Bennettitales the much-sought approximation to that group of early angiosperms whose absence from the fossiliferous rocks still remains, just as in Darwin's day, "the abominable mystery". Not that the angiosperms could come directly from the Bennettitales - such a notion would involve too many extreme morphological assumptions - but that they may have arisen from a group, cognate in time with, and allied to, the Bennettitales - such is the hypothesis to which many botanists incline. This hypothetical group has even been designated as the Hemiangiospermae by Arber and Parkin.

While most of the Bennettitales were characterized by low, squat stems, certain members of the Williamsonia suborder were slender, branching trees which bore leaves of a not-too-distant
Fig. 1 - Bennettitalian "cone" restoration, legend attached.

(From Wieland, G.R. - American Fossil Cycads, pg. 106. Photograph by Clays I. Miner.)
Fig. 2 - *Cycadeoidea marshiana* - "A branching Cycadeoidean trunk from the Black Hills as mounted in the Yale Museum (No. 300). This trunk has five branches... the three largest are formed Zamia-like, early in the life of the plant, so that there is no distinct central parent trunk (as in the case of the branching cycads of the following plate). This is the largest fossil cycad ever reported."

(From Wieland, G.R. - *American Fossil Cycads*, Plate XII and description, page 265. Photograph by Gladys I. Miner.)
Fig. 3 - Stages of Fruit Production in Branching Species of Cycadeoids, Illustrated by Trunks with Exceptionally Distinct Surface Features.

1. *Cycadeoids marahana* - "View of the lateral superior surface of three branches attached to a portion of the parent stem. The bract scars marking the numerous quite equally developed but very small and yet young lateral fructifications are plainly visible... The regularity of the leaf-base spirals is still striking.

2. *Cycadeoids superba* - "These two adjacent lateral branches constitute the incomplete type specimens originally described - the xylem cylinder of each branch extending from that of the same central parent stem... The present lateral view shows wonderfully distinct surface characters and a comparatively small number of strobili..."

(From Mieland, G.R. - American Fossil Cycads, Plate IX and description, page 264. Photograph by Gladys I. Miner.)
angiosperm pattern, and no insuperable difficulty exists to regarding such plants as vegetatively transitional to the woody Ranales.

In 1911 there was discovered in the Lower-Jurassic rocks of the Yorkshire Coast fragments of certain cycadaceous plants which seem to give even greater weight to the cycadean-bennettitalean theory of angiosperm origin. (1) The stems of these plants, now raised to a new Order Caytoniales, are as yet unknown, though it is suspected that they bore the trifoliolate leaves long known as Sagenopteris. Two genera, Caytonia and Gristhorpia, are recognized. The female parts consist of sporophylls of the nature of those of Cycas, bearing two rows of pinnae which are modified into small pouches with ovules in their interiors. Whether the pollen was actually received upon a stigma has not been positively determined, but the pouched pinnae bring us, obviously, a step nearer to the closed carpel of the angiosperms. (Fig. 5 and 6)

Fragments of caytonialian stamens have also been discovered. They consist of a central sporophyll axis beset with tufts of anthers. Each anther appears to bear four radiating wings, each wing containing a microsporangium. It is, of course, easy to see in these the homologues of the four locelli of the angiosperm anther.

It is not, however, pertinent to the present studies that we should linger upon these difficult questions of angiosperm

(1) It was H. Hamshaw Thomas who discovered these caytonialian fossils. As shown by recent publications, he is more and more convinced that from these fossil microsporangial branch systems, the present-day stamens of Ranunculus type were derived through reduction and fusion; and that in like manner, the follicles of the Caltha type were derived from these megasporangial branches. (See under Thomas in Bibliography)
Fig. 4 - *Williamsoniella coronata*. — "A member of the *Williamsoniales* whose remains were found on the Yorkshire Coast. The uppermost strobili or "flowers" are surrounded by clavate microsporophylls which bore microsporangial synangia on their inner faces. The middle of each strobilus is occupied by an ovulate mass . . . . The lowermost strobilus has shed its microsporophylls. The leaves were long called *Taeniopteris vittata*. More recent evidence shows that the "flowers" really stood in the leaf axils."

(Drawing by R.E. Torrey, adapted from reconstruction by H. Hamshaw Thomas. Photograph by Gladys I. Miner.)
Fig. 5 - *Griathorpa Nathorsti*.

A. *Sagenopteris Phillipsii*, the probably leaf of *Griathorpa*.

B. Megasporophyll with rows of seed-bearing "carpels".

C. A single "carpel" enlarged showing the basal stigma.

D. Longissection through the tip of an ovule taken from the "carpel".

(Drawings from R. E. Torrey, redrawn from H. Hamshaw Thomas. Photograph by Gladys I. Miner.)
Fig. 6 - *Caytonia Sewardi*.

A. The leaf – *Sagenopteris Phillipsei* var. cuneata.
B. Carpel showing attachment of ovules to dorsal wall.
C. Longisection through tip of ovule; the Cycadean structure of the ovule is evident.
D. *Antholithus Arberi*; the probable microsporophyll of *Caytonia*.
E. Single four-winged anther of *Antholithus*.

(Drawing from R.E. Torrey, redrawn from H. Hamshaw Thomas. Photograph by Gladys I. Miner.)
origin. If we tentatively accept the theory which sets the Ranales at the bottom of the phyletic tree of the flowering plants we may next proceed to put forth a set of basic morphological principles which are today quite generally regarded as valid guides to the evolutionist in his attempt to reconstruct the tree of angiosperm phylaxis. The first set of these dicta was formulated by Bessey in his classic paper on the phylogeny of flowering plants. (1) Other workers have added to them until today we may recognize the following set of thirty-four.

**GENERAL PRINCIPLES OF ANGIOSPERM PHYLOGENY:**

1. Evolution may be progressive or regressive.

2. Homogeneity of structure generally precedes heterogeneity.

3. Evolution does not involve all organs equally or simultaneously.

4. In general, evolution is consistent, and whether progressive or regressive, persists to the end of the phylum.

5. In any phylum, holophytic plants precede heterophytic.

6. The stem structure with collateral bundles in a circle is more primitive than the stem with scattered bundles.

7. Woody stems are more primitive than herbaceous.

8. The spiral phyllotaxy preceded the paired leaf arrangement. (2)

9. Simple leaves preceded compound.

10. Leaves were first persistent and later deciduous.

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(2) A recent contribution on this subject is of interest: Die phylogenetische Herkunft der gegen ständigen und wirteligen Blattstellung von Walter Zimmermann; Jahrbücher für wissenschaftliche Botanik, Jan. 1935.
11. Reticulate venation is normal, and parallel venation is a special modification.

12. Marginal teeth are held to represent rudiments of former dichotomies (telomes) obliterated by webbing.

13. Axillary flowers preceded aggregations into inflorescences.

14. The raceme is the basal type of indeterminate inflorescence.

15. The evolution of the inflorescence is towards the production of a "flower" of the second or third degree.

16. Actinomorphy is more primitive than zygomorphy.

17. Flowers with elongate torus and spiral insertion of floral parts preceded flowers with flattened or hollowed torus with cyclic insertion of parts.

18. Polymerous flowers are primitive and from them oligomerous flowers were derived.

19. The haplochlamydeous perianth preceded the diplochlamydeous perianth.

20. The apochlamydeous or archichlamydeous perianth preceded the synsepalous and sympetalous types.

21. Hypogyny is more primitive than epigyny.

22. The polystememonous condition preceded the oligostemonous.

23. Stamens of primitive flowers are apostemonous while those of more advanced flowers are often synstemonous; staminal chorisis may later bring about a secondary staminal increase.

24. Polycarpy is the primitive condition and oligocarpy is derived from it.

25. Apocarpy preceded syncarpy and the styles and stigmas are the last part of the gynoecium to remain free.

26. The multiovulate condition preceded the state with few or one ovule.

27. Endospermy is more primitive than exendospermy.

28. The small embryo in endosperm preceded the large embryo in scanty or no endosperm.

29. The dicotyledonous embryo preceded the monocotyledonous.

30. Large simple seeds, often with fleshy coats and without special distributive mechanisms are primitive.
31. Monoclinous flowers preceded diclinous.

32. In diclinous flowers the monecious condition is more primitive than the dioecious.

33. Entomophily preceded anemophily or self-pollination.

34. Entomophilous specializations are of two types:
   a. That leading to higher development of individual flowers,
   b. That leading to higher development of inflorescence.

Tested by almost any one of these principles the Ranales fall at once into a primitive position; their flowers are solitary or racemose; usually actinomorphic, hypogynous and polymerous; the torus is generally elongated and conical with floral parts arranged spirally; the perianth members are free, all alike or the inner ones colored; the stamens are numerous and free; the carpels are numerous and generally free, with many ovules which mature into endospermous seeds with small embryos; pollination is entomophilous.

THE PHYLETIC TREE OF THE RANALES:

Bessey includes in the Order Ranales twenty-four families, namely: Magnoliaceae, Calycanthaceae, Monimiaceae, Cercidiphyllaceae, Trochodendraceae, Leitneriaceae, Anonaceae, Lactoridaceae, Gomortegaceae, Myristicaceae, Saururaceae, Piperaceae, Lacistemaceae, Chloranthaceae, Ranunculaceae, Nelumbaceae, Cabombaceae, Ceratophyllaceae, Dilleniaceae and Winteranaceae. Following Hallier’s original system with but few exceptions (also the system followed by Lotsy, Rendle, etc.) we shall include in the Order Ranales only the families Magnoliaceae, Anonaceae, Myristicaceae, Calycanthaceae, Monimiaceae, Lauraceae, Berberidaceae, Menispermaceae, Ranunculaceae, Lardizabalaceae,
Nymphaeaceae and Ceratophyllaceae.

Assuming that the Order as a whole was derived from a group of woody, as yet hypothetical Menispermaceae, and that these arose from a cycadalean-bennettitalean plexus, we may first note that the arborescent or woody habit was retained by representatives of the families Magnoliaceae, Annonaceae, Myristicaceae, Calycanthaceae, Menispermaceae and Lauraceae, which are sometimes set apart as an Order Annonales or Magnoliales (Polycarpicae of Hallier), while the families Ranunculaceae, Nymphaeaceae, Ceratophyllaceae, Berberidaceae, Menispermaceae and Lardizabalaceae are predominantly herbaceous, and are often referred by themselves to the Order Ranales. Along with the difference in xylary tissues there goes also a difference which pertains to the parenchymatous parts. The typically woody Annonales have oil cells in their parenchymatous tissues while in the predominantly herbaceous Ranales (sensu strictum) no oil cells are present.

The following diagram will serve to illustrate these two distinct lines of evolution to which we have alluded and will serve as a basis and guide in the discussion of family relationships which is to follow.
Lardizabalaceae
(Monoecious or dioecious; lianes)

Menispermaceae
(Dioecious; lianes; curved embryo)

(Podophyloideae Berberidoideae) Berberidaceae
(Woody; cyclic; valvular stamens)

Ranunculaceae
(Hypogynous; actinomorphic; spiral; many stamens and carpels)
(Anemoneae - Paeoneae - Helleboreae)

Nymphaeaceae
(Water plants; apocarpous-syncaepous)
(Nelumboideae - Nymphaeoidae - Cabomboideae)

Ceratophyllaceae
(Monoecious; water plants)

Magnoliaceae

Schizandroideae

Illicioidae

Marrnolicideae

(Trees or shrubs; alternate leaves; conical elongated torus; many and indefinite parts; small embryo; much endosperm; hermaphrodite.)

Lauraceae
(Valvular stamens; sunken ovary; 1 carpel, 1 ovule; no endosperm)

Calycanthaceae
(Opposite leaves; perigyny; no endosperm; spiral embryo)

Monimiaceae
(Monoecious; stamens often valvular; free carpels sunken; embryo not spiral.)

Myristicaceae
(Dioecious; reduced perianth; pistil 1)

Anonaceae
(Ruminated endosperm)

RANALES
Herbaceous habit predominant;
No oil cells.

Woody habit predominant;
Oil cells present.

Hemiangiospermae

Caytoniales

Bennettitales
VASCULAR ANATOMY OF THE RANALES:

_Magnolia_ has been called "the most ancient living angiosperm, in fact like _Ginkgo_, almost a 'living fossil'". In consequence it occupies a peculiar position in all phylogenetic speculations and demands a rather detailed treatment here. Its xylem is characterized by the possession of fiber tracheids with reduced bordered pits, abundant wood parenchyma, very tall, though comparatively narrow wood rays, and numerous vessels with scalariform pitting (much elongated bordered pits), and scalariform or porous perforations. The phloem is composed of the characteristic dicotyledonous sieve tubes with their companion cells. All in all, the vascular anatomy is not very different from that of the oak, which, so far as its wood structure is concerned, is a relatively primitive angiosperm.

The genus _Drimys_, belonging also in the family Magnoliaceae, was formerly considered to be even more primitive than _Magnolia_ in its wood structure since it possesses no vessels, - a feature which might seem to ally it closely to gymnospermous woods. But Jeffrey and Cole discovered that queer tracheary structures, which were really abortive or reversionary vessels, appeared in the root wood after wounding. (1) According to the widely-accepted theory that traumatism may recall histological elements which have fallen into phyletic latency the argument is advanced that we are not dealing with "coniferenholz" in an

angiosperm but with a case of suppression of vessels in a plant which was derived from a Magnolia-like ancestor in whose wood vessels were normally present. Trochodendron, Tetracentron and Zygogynum, three close Magnolia-allies, likewise have no vessels. Hence, though it would be in the interest of our theoretical phylogeny to hold to the opinion that certain magnoliaceous plants had retained the simple tracheidal xylem of their cycadean ancestors, the evidence at our disposal does not make the position tenable.

The xylary structure of the other members of the "woody branch" of the Ranales is very similar to that of Magnolia. There is less wood parenchyma in the Calycanthaceae and Myristicaceae, but on the other hand the Anonaceae and Monimiaceae are characterized by more abundant wood parenchyma as well as by very broad wood rays. Vessels are present in all the families; sometimes they are marked with spiral thickenings and they usually bear both simple and scalariform perforations. Fiber tracheids generally carry simple or indistinct bordered pits and are always present, while septate fibers occur in certain of the families.

With the Ranunculaceae the herbaceous habit is firmly established, and there are but two woody members, Clematis and Xanthorrhiza, in the family. From Magnolia as a woody forerunner, the herbaceous stem of Ranunculus with its single circle of fibro-vascular bundles may be derived through a reduction of cambial activity which practically abolishes the secondary tissues. At the same time there has been an increase of
parenchymatous tissue for storage. The introduction of parenchymatous tissue in broad radial bands has isolated a circle of radial segments of xylem and phloem - or, to express the same thing in another way, the "bundles" lie in a "sea of parenchyma".

In certain genera of the Ranunculaceae there is an approximation to the monocot condition where the fibro-vascular bundles are generally scattered throughout the entire stem instead of in a single circle. This tendency is evident in Actaea, Cimicifuga and Thalictrum. "This condition is held to result from the crowding of the numerous bundles which enter from the large leaves, and, finding the ancient circular alignment impracticable, they are forced into cortex and medulla." (1)

In the stem of aquatic species of Ranunculus the vascular bundles contain no mechanical tissue but possess a schizogenous air-passage on the inner face of the protoxylem elements. In the Nymphaeaceae there is likewise a system of intercellular spaces which arise schizogenously in the ground tissue. These spaces may occur in definite circles or in a more scattered fashion. In the Nymphaeaceae cambial activity is lacking in the bundles and they are arranged irregularly. Such characters appear to be of considerable phylogenetic importance since it is held by many botanists that the source of the monocotyledons is to be sought among the plastic Ranales. We shall see later that this theory is supported likewise by certain

Also Jeffrey, E.C. and Torrey, R.E. - Physiological and Morphological Correlations in Herbaceous Angiosperms Bot. Gaz. 71: 1; 1921
features which pertain to their embryos. True vessels do not occur in the members of the Nymphaeaceae but the tracheids are elongated and bear spiral or annular thickenings. They are often destroyed during the formation of air-passages so that only a strand of phloem remains in the bundle. Nelumbium is the only member of the family whose fibro-vascular strands are enclosed in a sclerenchymatous bundle-sheath.

The members of the Berberidaceae are partly woody and partly herbaceous. In Berberis and Nandina, the chief woody members, broad rays separate individual fibro-vascular bundles, and this character is carried over into the Lardizabalaceae and Menispermaceae. The small vessels have spiral thickenings and bordered pits as do the tracheids. There is little or no wood parenchyma, and the wood fibers are simple pitted. (Lardizabalaceae and Menispermaceae differ only in the possession of fiber-tracheids with bordered pits rather than wood fibers with simple pits.) In Podophyllum, Jeffersonia, Diphylleia and Leontice the bundles are scattered as in monocots and the outermost ones are embedded in a sclerenchymatous ring which encircles the whole stem.

The theory which avers that the herbaceous stem is derived in evolution from a woody type receives confirmation from the study of various representatives of the Anonales-Magnoliales. Though our present investigation can hardly include the vast subject of evolutionary vascular anatomy it is of interest to note that Jeffrey and Torrey have used the stems of Xanthorrhiza, Clematis and Thalictrum as illustrative of types which exhibit well-marked transitional conditions between the more ancient tree
and the modern herb. (1) They see in the latter a dynamic system particularly adapted to the progressive refrigeration which culminated in the Glacial Period and which superseded the long ages of tropical and semitropical climate in which arboreal plants attained their climax.

COMPARATIVE STUDY OF THE VEGETATIVE AND FLORAL CHARACTERS OF THE RANALIAN FAMILIES

A. "Woody" Ranales

1. Magnoliaceae

The following detailed description of Magnolia grandiflora, translated from Bailion's classic Histoire Naturelles des Plantes, will serve to illustrate the character of Magnolia as "the most primitive living flower", (2)

"If one examines these flowers, one notices first that their axis or receptacle has the shape of a cylindro-conical branch and that it bears, proceeding from its bottom to its top, a perianth and a large number of stamens and of carpels, inserted in spiral order. (The phyllotaxic fraction for the magnolias is most often 2/5. Also one finds in the arrangement of the floral appendages the derivative fractions as high as 5/13 and 8/21.) In the flowers of M. grandiflora the perianth shows first three more or less greenish, free leaves, imbricated in the bud in such a fashion that usually they are, the one altogether enveloping, the other entirely enveloped, the third covered again by one of its edges and overlapping by the other. These leaves, which one generally describes as the sepals, fall early. More interiorly are found two corollas, one formed of three petals alternating with the sepals, and the other of three more interior, alternating with the first. These six leaves are imbricated or more rarely twisted in the bud, and likewise fall very shortly after the blossoming of the flower. Above commences the spiral series of members of the androecium and of the gynoecium. The stamens are


(2) Page 134-137.
of an indefinite number. Each of them is composed of a nearly sessile anther, the connective of which is apiculate, and bearing on its inner face the two sacs, adnate their whole length, and each dehiscing by a longitudinal split. The carpels, equally indefinite in number, are composed, each, of a unilocular ovary surmounted by a style in the form of a horn, recurved outward at the summit. All the inner face of the ovary and of the style is traversed by a longitudinal furrow, the revolute edges of which are covered at the top by numerous stigmatic papillae. The ovary is unilocular, and one observes in its inner angle a parietal placenta which bears two hanging anatropous ovules with the micropyle directed upward and outward. The fruit is composed of a large number of carpels inserted on the lengthened axis which has become woody and definitely dry. Each of these opens at maturity along its dorsal suture to let escape one or two seeds which remain suspended by a delicate filament for a more or less long time. Each seed is composed of a triple integument. The exterior is entirely fleshy, the middle is hard and testaceous, the inner is membranous. This last directly envelopes a fleshy endosperm which encloses, towards its summit, a small dicotyledonous embryo."

*Liriodendron* is closely allied to *Magnolia* and both genera belong to the Tribe *Magnolioidae* (or *Magnoliales*), characterized by stipulate leaves and elongated floral axis. *Liriodendron* differs from *Magnolia* in having truncated 4-lobed leaves, flowers with a perianth of three sepals and two trimerous whorls of yellow petals, and finally by the character of the fruit which is a cone-like collection of many 1-seeded samaras.

*Michelia* and *Talauma* also belong to the same tribe and are very similar to *Magnolia*.

The Tribe *Illicioideae* (or *Illiciaceae*) is characterized by possessing evergreen exstipulate leaves and short-convex floral axis. Here belong *Drimys*, *Zygogynum* and *Illicium*. The flowers are borne in terminal or axillary inflorescences and in *Drimys* they are sometimes dicondious. *Drimys* is usually considered to be the more primitive member of the tribe and the flowers resemble small white magnolias. "The six or more petals
are inclosed when young by a membranous sac which splits into 2 or 4 sepals." The multiovulate carpels form a whorl. *Zygogynum* has a cup-like calyx and few unequal petals. The many-ovuled carpels are united at the base and together form a berry-fruit. In *Illicium* the numerous perianth members are spirally arranged, as are also the stamens and the 8-30 free, 1-seeded carpels. The carpels ripen into follicles which form a sort of radiating star.

In 1905 Hallier doubtfully included *Tetracentron* and *Trochodendron* in the *Illiciaceae*, but transferred them later to the *Hamamelidales*. Baillon places *Trochodendron* and *Euptelea* in the Tribe *Eupteleae of Magnoliaceae* and does not recognize *Tetracentron* at all, while Lotsy puts *Tetracentron* in Tribe *Tetracentreae*, and *Trochodendron* and *Euptelea* in a separate family *Trochodendraceae*. Engler includes *Tetracentron*, *Trochodendron*, *Euptelea* and *Ceridophyllum* in the *Trochodendraceae*. Whether they are to be considered as members of the *Magnoliaceae* or of the *Trochodendraceae* matters very little to us since they are Asian plants, and we may simply remark that they appear to be apetalous magnolias with perfect flowers in the case of *Tetracentron* and *Trochodendron*, but with dioecious flowers in the case of *Ceridophyllum*. It is suspected that they may effect the transition from *Magnoliaceae* to *Piperaceae*.

The third tribe of the *Magnoliaceae*, the *Schizandraeideae* (or *Schizandreae*), are lianes with deciduous, exstipulate leaves and unisexual flowers in which the parts are arranged spirally on a convex axis. The berry-like fruits are borne on a much-elongated receptacle. There is but the one genus
Schizandra. Most of the species are Asian plants though one species, *Schizandra coccinea* is found from South Carolina westward to Texas.

2. *Anonaceae*

With the exception of the apetalous and perigynous *Eupomatia*, the *Anonaceae* retain, for the most part, the floral characters of the *Magnoliaceae*. The only constant difference is the ruminated endosperm of the former. The members of the *Anonaceae* are woody shrubs with alternate, exstipulate leaves; and large, regular, hypogynous (*Eupomatia* excepted), usually perfect flowers. The stamens have short, thick filaments and a pair of extrorse anthers with a prominent outgrowth of the connective between. The fruits are fleshy, many-seeded berries, or the ovaries may unite to one another and with the axis to form a fleshy syncarp — the "custard apple" fruit. The seeds are arillate.

3. *Myristicaceae*

With the *Myristicaceae* floral reduction sets in. The flowers are inconspicuous and racemose instead of large and solitary. They are dioecious with acyclic arrangement of parts, and the perianth is tubular and 3-parted. The stamens of the male flowers are many and are frequently monodelphous, being united into a column which flares out at the top into a disc. The female flowers bear but a single free carpel with a solitary, basal, anatropus ovule. We have here, then, a family which retains the aromatic character of the *Anonaceae* as well as the arillate seeds and ruminated endosperm, but new features involving dioecism, reduced perianth, coherent stamens and single carpel are introduced.
4. Calycanthaceae

The small family Calycanthaceae retains the acyclic flowers and oil cells of the previous families, but possesses opposite instead of alternate leaves, and perigyny instead of hypogyny. The seeds of the Calycanthaceae differ from those of the other families in having scarcely any endosperm, and in possessing very large spirally-rolled cotyledons. The flower parts are still free and many as in the magnolias, but perigyny and the conversion of the inner stamens of the androecium into staminodia leads to the next two families, Monimiaceae and Lauraceae.

5. Monimiaceae

The family Monimiaceae shows affinities to the Magnoliaceae and the Calycanthesae and probably effects the transition to the Lauraceae. The monimias are shrubby plants with aromatic woods. Numerous stamens, free carpels, and a small embryo with straight embryo embedded in non-ruminate endosperm, all seem to indicate affinity with the Magnoliaceae. The inconspicuous, monoecious, and perigynous flowers, often possessed of staminodia, suggest a linkage with the Calycanthesae, while the Lauraceae are foreshadowed by the perigyny, occasional valvate dehiscence of the anthers, appended filaments, presence of staminodia and reduction of carpels to two in Gonortega (sometimes put in separate family).

6. Lauraceae

If one includes the hernandias in the family, the Lauraceae represent the "end of the line" in the evolution of the woody Ranales. Often, however, the hernandias are put in a separate family because of their wholly inferior ovary and single row of
stamens. Since they differ from the laurels only in these two characters, we may include them in the **Lauraceae**.

Except for the parasitic **Cassytha**, the **Lauraceae** is a family of aromatic and woody plants with coriaceous, simple, entire, exstipulate and alternate leaves. (Though by shortening of the internodes the leaves may appear opposite or whorled.) The flowers are in many-flowered racemes or dichasia, and are bisexual, or unisexual by reduction; regular, with parts generally arranged in trimerous whorls, and the members more or less united at their base and attached with the stamens to the edge of the concave receptacle. Typically there are four whorls of stamens, but generally the inner whorl is reduced to staminodia, or is absent, and further reduction occurs in some genera until but two whorls of stamens, or only one, remains functional. There is much variation in the androecium as to number of anther-sacs (2-4) and dehiscence (introrse or extrorse), but a constant character is the valvate dehiscence of the anthers.

There appears to be but a single unicovulate carpel present in the lauraceous gynoecium, yet the stigma is sometimes deeply 3-cleft and the ovary may be deeply sutured, while cases are known where many ovules instead of the normal one are produced. Miranda concluded from this that we are dealing with a syncarpous, tricarpellary gynoecium, the one posterior member being prolonged into the style and stigma and the two lateral-anterior carpels having aborted. (1) The berry or drupaceous

(1) **Comptes Rendus**, Paris, CXLV, 570 (1907) - Quoted by Rendle.
fruit is more or less enveloped by the cup-shaped receptacle; and the single seed possesses a large embryo.

The Lauraceae, then, carry on the perigyny, valvular stamens and staminodia of the Calycanthaceae—Monimiaceae, and have merely gone another step in gynoecial and androecial reduction.

B. "Herbaceous" Ranales

1. Ranunculaceae

Having reached the end of the woody branch of the Ranales, we turn now to a consideration of the predominantly herbaceous group with its "keynote" family, the Ranunculaceae. Hallier characterizes the group as follows: no oil cells in the parenchymatous tissues; barberry a wide-spread compound; axis and embryos pointing toward monocots; leaves inclined to threefold divisioning; nucellus large with one or two integuments; and embryo usually small and short, embedded in much endosperm.

The family Ranunculaceae is very close to the Magnoliaceae as regards the floral structure. These are hermaphrodite, actinomorphic, seldom zygomorphic, spiral or rarely cyclic; there is a single or a double perianth and many stamens, and many to one, usually free carpels with numerous to few seeds; the seed contains a small embryo with copious oily endosperm. All these characters are likewise exhibited by the Magnoliaceae. Evolutionary advance, however, has instituted the perennial herbaceous habit and a more or less divided leaf. The flowers are solitary or cymose. Of particular interest is a tendency towards monocotyledony in the embryo. Curiously, too,
the cauline axis also begins to assume the character generally associated with monocotyledonous plants, and the scattered state of the vascular bundles in *Actaea*, *Cimicifuga* and *Thalictrum* has already been mentioned. In *Caltha* and in certain species of *Anemone* and *Delphinium*, the cotyledonary stalks are fused together to form a tube through which the plumule breaks laterally at the time of germination, while in *Eranthis* and *Ranunculus Ficaria* the cotyledons, too, may fuse so completely that in the strict etymological sense of the word they are monocotyledons. Hence monocotyledony seems to be appearing in the *Ranunculaceae* through syncotyly.

Hallier divides the family *Ranunculaceae* into two Tribes: the *Helleboreae* and the *Anemoneae*. In the former the ovules are borne in two rows along the ventral suture of the carpels which mature into follicles or berries; while in the latter the ovule is solitary and arises at the base of the ventral suture of the carpel which matures into an achene. Rendle adds a third Tribe, the *Paeonieae* with ovule arrangement as in the *Helleboreae* and fruit a fleshy follicle.

The tribes may be further divided according to the following classification of the genera:

**Tribe Helleboreae**

A. *Isopyroideae* - corolla members when present alternating with the sepals; flowers actinomorphic.

1. *Helleborinae* - *Helleborus*, *Eranthis*

2. *Isopyrinae* - *Leptopyrum*, *Isopyrum*, *Aquilegia*

B. Trollioideae - corolla when present episepalous; higher members zygomorphic.

1. Trolliinae - Trollius, Caltha, Callianthemum
2. Nigellinae - Nigella, Cardiella
3. Delphiniiinae - Aconitum, Delphinium

Tribe Anemoneae

A. Anemoninae - herbaceous; whorl of 3 stem leaves forming involucre; no petals; ovule pendulous. Anemone, Hepatica, Thalictrum

B. Clematiciinae - woody; opposite leaves; valvate aestivation; no petals; pendulous ovule; achene long-tailed. Clematis

C. Ranunculinae - herbaceous; both sepals and petals present, the latter generally with nectariferous glands; ovule pendulous or erect. Myosurus, Adonis, Ranunculus.

Tribe Paeoneae - with single Genus Paeonia.

Lotsy gives the following relationship:

\[
\begin{array}{ccc}
\text{Helleboreae} & \text{Anemoneae} \\
\text{Isopyroideae} & \text{Trolliceideae} & \text{Pro-ranales}
\end{array}
\]

Caltha is considered to be the basal and most archaic genus of the Ranunculaceae. It is characterized by a spiral series of from 5-15 deciduous, yellowish-green sepals (probably modified foliage leaves), 80-150 stamens in 21 rows, and 5-10 carpels. There are no petals or "honey leaves" but nectaries are present on the carpels. Trollius is very similar to Caltha in flower structure but possesses a varying number of small honey leaves which are quite clearly derived from the specialization of the outer row of stamens. In Nigella the
perianth is reduced to 5 petaloid members and there are 8 honey leaves and 8 rows of stamens while the gynoecium consists of 5-12 carpels more or less united to form a sort of compound ovary, each of whose cells is traversed by a tangentially placed membraneous septum.

"The zygomorphic genera (Delphinium and Aconitum) are derived from a Nigella-like flower. The stamens and carpels are spirally arranged and show no trace of the median symmetry which is determined by the structure of the calyx and corolla. The calyx is arranged in the quincunial whorl, so frequent in Dicotyledons, that is the second-developed sepal is median and posterior; in Delphinium this is spurred. There are originally, as in Nigella, eight honey leaves, a pair opposite each of the three older sepals and one opposite each of the two younger sepals. Of these the four in the lower part of the flower are either suppressed or form slender functionless structures; the median lateral form attractive petal-like structures which have lost the nectar-secreting function with the median posterior pair which have a projecting blade and a nectar-secreting spur sunk in the spur of the back sepal. In the section Consolida (which includes D. Ajacis) -- -- the two median petals have become united into a single structure with one spur. In Aconitum the completely free median petals are less conspicuous and are borne on long slender stalks and hidden in the large hooded dorsal sepal. In both genera there are usually three carpels which are free, but the Consolida section of Delphinium has only one." (1)

(1) Rendle, A.B. - Classification of Flowering Plants, Vol. II, page 142-144
Helleborus does not differ greatly from Caltha. The palmately-cut foliage leaf is said to be basal to all other types of ranalian leaf. (1) The perianth consists of five greenish or reddish leaves which are persistent and these are followed by a varying number of short, tubular honey leaves and by very many stamens in 13 radiating rows; sometimes it is the first member of each row which is transformed into a honey leaf. In some species only 8 or even 5 of the outer stamens form these nectarial leaves and such cases effect the transition to Isopyrum with its whorl of 5 honey leaves alternating with 5 sepals. In the latter there are also fewer stamens though they still stand in 13 radiating rows.

From Isopyrum, Aquilegia is derived by reduction to 5-merous whorls throughout. In both Isopyrum and Aquilegia the leaves are ternately divided.

Eranthis resembles Helleborus in floral structure but the sepals, which vary in number from five to nine (generally six) are smaller, yellow, and deciduous; the radical leaves are palmate and the cauline leaves form an involucre just below the flower. The floral formula of E. hyemalis is P 3+3 A 6+6 G 3-10, which suggests a close approach to the typical monocotyledonous plan.

The Genera Anemopsis, Cimicifuga, Actaea, Coptis and Xanthorrhiza of the Cimicifuginae resemble Isopyrum and Aquilegia in the generally ternately divided foliage-leaf and the tubular

nectarial petal, but differ in the toothed margin of the leaf segments and the more open character of the nectary. In Actaea and Cimicifuga, which are sometimes united as a single genus, four caducous sepals generally occur. These are followed by four or fewer, petal-like honey leaves which are sometimes devoid of nectar. The stamens are generally numerous and the carpels range from one (Actaea) to several (Cimicifuga). Flowers with trimerous calyx and corolla also occur. In Coptis there are generally five sepals and alternating with them five smaller, spoon-shaped honey leaves, some of which are, however, often incompletely developed and without nectar. The numerous stamens are often arranged in 13 rows, and the carpels (10-1) are often stalked. The flowers of Xanthorrhiza, like those of Aquilegia, are cyclic and pentamericous, but they are small and inconspicuous with fewer staminal whorls and the nectarial leaves are cupped.

In the Helleboreae, the fruit is generally a few-to many-seeded follicle, but the following exceptions may be noted: Actaea's single carpel ripens into a many-seeded berry; Xanthorrhiza forms a single-seeded follicle; and, in Nigella, a septicidal capsule is formed with large hollow spaces between the inner and outer layers of the pericarp.

The Anemoneae are wholly actinomorphic and, as a consequence are sometimes considered a more primitive group than the Helleboreae. Anemone and Thalictrum are both herbaceous or rarely shrubby. In Anemone the leaves are usually palmately-cut and a whorl of 3 stem-leaves forms an involucre. In the closely allied Genus Hepatica this involucre simulates a calyx. The
flowers of the *Anemoneae* are usually solitary with 5 or more petaloid perianth leaves and no true petals, with numerous stamens in 13 rows and with carpels possessing a single pendulous ovule. In *Thalictrum* the leaves are ternately decompound and the numerous small flowers are borne in corymbs or panicles with 4-5 small, greenish, early-deciduous perianth members and no involucre. The stamens are very long (either the filament or the anther giving the great length), and the fruit is a small head of achenes sometimes reduced to a single achene.

In the shrubby climbing *Clematis* the leaves are opposite and usually compound. The flowers are valvate in the bud and possess four or more petaloid sepals, many stamens and many carpels; the latter with long hairy and persistent styles. Some species of *Clematis* are dioecious.

In *Myosurus* and *Adonis* the ovule is pendulous. In the flower there are five narrow yellowish sepals with small basal spurs, and five petals with stalk and narrow limb bearing a shallow nectar pit. The stamens are few but there are numerous carpels borne on a very much elongated torus. The solitary flowers of *Adonis* differ in having 8-16 flat nectar-less petals and numerous stamens (21 rows) and carpels on a convex axis. In *Ranunculus* the ovule is erect. The flowers are solitary or cymose, generally with five green sepals which are early deciduous and five or more petals, usually larger than the sepals and bearing a nectary at the base of each. The numerous stamens are in thirteen rows.

The Genus *Ranunculus* may be divided into several sections, but the only one of particular phylogenetic interest is the water-
buttercup section, the Batrachiums, for it is the members of this section with their much divided submerged leaves and small white flowers which seem to point to the Cabomboideae of the Nymphaeaceae and to the Order Helobiales.

*Paeonia* is the only member of the Tribe Paeoneae and is of interest because of the particularly well-developed outer integument of the ovule, in contradistinction to that found in most members of the Family Ranunculaceae. This character is likewise found in the Berberidaceae. The leaves are deeply cut, and the flowers are large and showy with no nectar-secreting structures. The flowers have five sepals and many large petals, an indefinite number of stamens and 2-5 free carpels with a double row of ovules. The carpels mature into fleshy-walled follicles.

2. Berberidaceae

The Berberidaceae are very closely allied to the Ranunculaceae, differing only in the possession of cyclic flowers with solitary carpel; the members are usually woody in habit. However, the section Podophylloideae is composed of herbaceous plants and the Genus *Hydrastis* has several carpels. The shrubby or woody character of the family as a whole led to the establishment of a hypothetical ancestral group, the Pro-Ranales, (1) from which the Ranunculaceae, Berberidaceae and Nymphaeaceae could be derived. For since the flowers are of a modified ranunculaceous type, though born by woody plants, the argument is that the ancestral race which bore true ranunculaceous flowers must, likewise, have consisted of woody-stemmed plants.

(1) Lotsy, J.P. -Vortrage über Botanische Stammengeschichte, Dritter Band, Erster Teil; pg. 586. 1911
The leaves of the members of the Berberidaceae are either simple or compound, and the flowers are borne either singly or in cymes or racemes. The flowers are perfect and cyclic, regular and hypogynous, usually 2- or 3-merous, the perianth being composed of 2-4 whorls of members differentiated into calyx and corolla, and 2 whorls of honey leaves comparable to those found in the Ranunculaceae. The 4-6 stamens in 2 whorls have anthers generally opening by uplifted valves as in the laurels. The carpel is usually solitary, superior, one-loculed with one or many, basal or lateral ovules. The fruit is a follicle, berry or achene with seeds, sometimes arillate, possessing copious endosperm and usually a small straight embryo.

The family is usually divided into two sections: the Podophylloideae and the Berberidoideae. The former section is characterized by flowers without honey leaves and with foliage leaves not pinnately divided. It includes Hydrastis, Podophyllum, Jeffersonia, Diphylleia and Achlys. In the latter section honey leaves are present in the flowers and the foliage leaves are pinnately compound. To this latter section belongs Berberis (with Mahonia), Mardina, Epimedium and Leontice.

Hydrastis with 3-petaloid, caducous sepals, no petals, numerous stamens with longitudinal dehiscence, and several carpels with two ovules on ventral suture of each carpel, suggest a linkage with Paeoneae of the Ranunculaceae. In habit and sympodial rhizome it resembles Podophyllum. Their resemblance is enhanced by the trimerous perianth and numerous stamens with longitudinal dehiscence. Podophyllum differs chiefly in having 6-9 petals and a single pistil. Jeffersonia and Diphylleia are closely allied
but have valvular stamens, while Achlys has no perianth, 9 stamens and carpels with solitary ovule, forming achene fruits.

Berberis (with section Mahonia) bears flowers in raceme-like lateral inflorescences and its leaves are simple or compound, often reducing to thorns. The flowers are trimerous with nectaries above the short claw of the inner set of petal-like leaves, 6 stamens with valvular dehiscence and the fruit a 1–few-seeded berry. In Nandina, Epimedium and Leontice the inflorescences are terminal, with Nandina shrubby and Epimedium and Leontice herbaceous. Nandina has bi- or tri-pinnate leaves, a compound inflorescence, trimerous many-whorled flowers with 2-ovulate carpels. In Epimedium the leaves are ternate or decompound and the dimerous flowers are in simple or compound inflorescences. The carpels are many-ovulate and mature into 2-valved capsular fruits. Leontice has trimerous flowers in racemes, a dry fruit and a large tuber-like rhizome.

In Podophyllum and Leontice the cotyledonary stalks are united and the plumule breaks through laterally as in the monocots. This, along with the scattered fibro-vascular bundle arrangement of Podophyllum, Diphylleia, and Leontice and the trimerous character of the flowers all suggest a phylogenetic relationship to the monocots.

3. Lardizabulaceae

The Lardizabulaceae is a family of lianes with the exception of the shrubby Decaisnea. The flowers are racemose, regular, trimerous and often unisexual by reduction of either the stamens or carpels. The stamens dehisce by a longitudinal
cleft (extrorsely), and the carpels are always free and multiovulate. The seeds of the berry-fruit possess a large quantity of endosperm. *Akebia* has 3 perianth members and no honey leaves, 2 whorls of free stamens and carpels. In *Lardizabala* the flowers are dioecious with 6 perianth members, 6 honey leaves, 6 stamens united by their filaments and 3 free carpels. The male flowers still produce rudimentary pistils and the females carry abortive stamens. The family seems to be an offshoot of the *Berberidaceae* with inclination toward unisexual flowers.

4. *Menispermaceae*

The *Menispermaceae* are generally lianes and they often exhibit the abnormal secondary growth of the stem which is characteristic of many other lianes. The flowers are dioecious and are borne in axillary racemes. They are cyclic, usually three-parted, regular, with petals sometimes absent. A union of parts occurs in the calyx, corolla, and more frequently in the androecium so that a central column may be formed. The carpels are three or more and free, or sometimes reduced to one. The fruit is a drupe with a moon-shaped seed.

5. *Nymphaeaceae*

In the *Nymphaeaceae*, composed wholly of water or marsh plants, there is great variety in form of leaves and flowers, suggesting an old family much changed for water life. The leaves are submerged, floating, or raised above water; they are sometimes much dissected. The flowers are solitary, perfect, regular, hypogynous to perigynous or even epigynous, cyclic, hemicyclic or cyclic; with 6 to many free perianth leaves generally
differentiated into a calyx and corolla, and with petals passing gradually into stamens. The numerous carpels are free or united, with one to many ovules on the inner walls, each with two integuments. The seed is often arillate and possesses both endosperm and perisperm; the embryo is well developed.

As was previously mentioned, the xylem and phloem of the vascular bundles, as well as their distribution, suggest a relationship to the monocotyledons.

The family is generally divided into three sub-families - the Cabomboideae, the Nelumbonoideae, and the Nymphaeaceae, the first two groups with free carpels and the last with carpels united.

To the Cabomboideae are referred the two genera Cabomba and Brasenia. Cabomba is characterized by erect sympodial rhizomes with closely arranged scale-leaves in whose axils the floating stems arise. They bear decussate, deeply-cut submerged leaves and spirally arranged peltate floating leaves. The flowers originate later and are cyclic with 3 sepals, 5 petals, 5-6 stamens and 2-3 free, few-ovulate carpels. The seeds have an embryo with small amount of endosperm and copious perisperm. Brasenia resembles Cabomba in habit but only peltate floating leaves are produced. The calyx and corolla are trimerous; the androecium is composed of many stamens and there are six or more carpels. These two members recall the Batrachium section of Ranunculus in their habits, their small flowers with free hypogynous parts and free, indehiscent, achene-like fruits.

The Nelumbonoideae includes but the one Genus Nelumbium, whose long-stalked, concave, peltate leaves and large
showy flowers are carried high above the water. The perianth leaves are numerous and free, the stamens are many and are arranged spirally beneath a large obconical receptacle in whose flat upper surface numerous carpels are sunken. The carpels are uniovulate and ripen into indehiscent nut-like fruits with hard pericarp. They are completely filled by the embryo which is differentiated into two cotyledons and a well-developed plumule and radicle.

The members of the Nymphaeoidae are characterized by flowers which are hypogynous, perigynous or epigynous. In Nymphaezanthus the rootstock creeps in the mud and bears thin, crumpled, submerged leaves without stomata, and roundish floating leaves with stomata on their upper surface. The yellow flowers rise from the axils of small bracts. They have 5 or 6 large sepals, numerous small scale-like petals with nectaries on the back. There are gradual transitions to the numerous stamens. The large syncarpous pistil is composed of 10-16 carpels with as many chambers and ray-like stigmas. The seeds are numerous and the small embryo lies in scanty endosperm surrounded with copious perisperm. Nymphaea has a short, stout rhizome with large floating leaves and extra-axillary flowers. The flowers are composed of 4 sepals and many spirally arranged large petals which pass gradually into numerous perigynous stamens. The 5-35 carpels are sunken in the receptacle with the back of each carpel prolonged into a stylar process. There is a varying degree of lateral union of carpels which is indicative of a fairly recent apocarpous ancestry. Euryale and Victoria bear completely epigynous flowers and the organs of the plant are covered with prickles.
We have, then, in the Nymphaeaceae a family which seems to stand close to the Ranunculaceae. This affinity is most clearly expressed by the Cabomboideae. A relation to the Berberidaceae is indicated by the arillate seeds of most genera. The scattered distribution of the cauline bundles suggests the parallel condition in Actaea, Cimicifuga, Thalictrum, Podophyllum, Leontice and Diphylleia of the Ranunculaceae and Berberidaceae. The large peltate-rayed stigmas, the superficial (or parietal?) placentation of the ovules, as well as the presence of latex in the tissues point toward the Papaveraceae.

6. CERATOPHYLLACEAE

The Ceratophyllaceae with its single genus Ceratophyllum, is composed of submerged water plants with whorled, dichotomously much-dissected leaves and unisexual flowers. The hypogynous perianth, and numerous stamens spirally arranged on a convex receptacle indicate its relation to the Ranunculaceae and the Nymphaeaceae. Further relation to the Nymphaeaceae may be seen in the habit of the plant and in the separation of the lower part of the embryo sac into an haustorium during embryology.
Order RANALES (1)
(The Buttercup Order)

Herbs or woody plants; shrubs, trees or vines.
Flowers spiral or spirocyclic or cyclic; regular (actinomorphic), or in higher forms irregular (zygomorphic). Development of floral parts acropetal. Flower hypogynous with floral axis usually convex, sometimes much elongated; or, in derived forms, flower perigynous or epigynous with floral axis concave and more or less united with the pistil. Perianth petaloid or differentiated into calyx and corolla, or lacking. Sepals and petals always separate. Stamens generally numerous. Carpels solitary to many, generally free but sometimes united. Ovules usually anatropous, with one or two integuments. Seeds usually with copious endosperm and sometimes with perisperm; embryo small and short. Flowers generally bisexual and pollination entomophilous.

The twelve Families Magnoliaceae, Annonaceae, Myristicaceae, Calycanthaceae, Montiaceae, Lauraceae, Ranunculaceae, Berberidaceae, Lardizabalaceae, Menispermaceae, Nympheaeeae, and Ceratophyllaceae constitute the Order Ranales and contain in all some two hundred and eighty genera and over four thousand species. (2)

Of the seven families Magnoliaceae, Lauraceae, Ranunculaceae, Berberidaceae, Menispermaceae, Nympheaeae and Ceratophyllaceae, twenty-three genera and fifty-two species are native to Massachusetts. Many other Ranalian plants have been introduced into our gardens and are as well-known as our native members.

(1) All the following technical material including keys and describing the Order Ranales or any of its families, genera and species is, in most cases; taken from Gray's Manual, Britton and Brown's Manual, Bailey's Encyclopaedia, Rendle's Classification of Flowering Plants, Warming's Systematic Botany, Engler and Prantl's Die Pflanzen Familien and Bailon's Histoire des Plantes.

(2) Rendle, A.B. - Classification of Flowering Plants, Vol.II (1925)
The woody members of the order are probably closer to the ancestral forms, as our earlier discussion of the phyletic tree of the Ranales has made clear. They are characterized by oil-containing cells in the parenchymatous tissue. The herbaceous members, on the other hand, are the later or derived types and possess no oil-containing cells. However, these herbaceous types usually possess other chemical compounds which are common to a whole family, or even to several families. Highly characteristic is berberin, \( \text{C}_20\text{H}_17\text{NO}_4 \), which is found in all members of the Berberidaceae and in many of the Ranunculaceae.

It is interesting to note that in the majority of the ranalian families the numbers three and five, or their multiples, prevail, but the number two is seldom met with in either calyx or corolla.

Perhaps the most characteristic feature of the order is the apocarpous and usually multicarpellary gynoecium, while the most significant feature is the anatomical resemblance to the monocotyledons which is particularly notable in the cauline axis and in the embryo of certain species.

The Ranales are of economic importance chiefly because of their decorative value, although some are of use in medicine and some for food.
A. Plants woody; oil cells present in parenchymatous tissue

1. Flowers generally large, solitary; calyx and corolla present; stamens very numerous; carpels coherent, and fruit cone-like

MAGNOLIACEAE

1. Flowers small, many, in terminal or axillary racemes; calyx absent; stamens 9-12; anthers opening by uplifted valves; pistil solitary, 1-ovuled; fruit a drupe

LAURACEAE

A. Plants generally herbaceous; oil cells absent

2. Plants immersed aquatics with floating leaves (sometimes emersed or mud-plants at low water)

a. Calyx and corolla present

(1) Leaves simple, cordate or peltate

NYMPHAEACEAE

(1) Leaves compound or much dissected, never all cordate or peltate

RANUNCULACEAE

a. Calyx absent; involucre simulating a calyx; leaves whorled, finely dissected; flowers minute and unisexual

CERATOPHYLLACEAE

2. Plants not aquatic

b. Plants climbing

(2) Leaves opposite; petals small or none; fruit a head of achenes

Clematis

(2) Leaves alternate; both calyx and corolla present; fruit a 1-seeded drupe

MENISPERMACEAE

b. Plants not climbing

(3) Anthers opening by uplifted valves; corolla present; stamens equal to petals and opposite them

BERBERIDACEAE

(3) Anthers not opening by uplifted valves

(a) Corolla present; stamens twice the number of petals; leaves peltate, lobed

Podophyllum

(a) Corolla often lacking, or if present, staminodial or nectarial; stamens numerous; leaves more or less divided

RANUNCULACEAE
Family Magnoliaceae
(The Magnolia Family)

Trees or shrubs with bitter, aromatic bark, and pinnately-veined, alternate, entire, rarely lobed, often more or less leathery and persistent leaves. Leaf buds covered by large, foliaceous and deciduous stipules. Flowers large, generally solitary; terminal or axillary; bisexual; actinomorphic; hypogynous; spiral or apiculocyclic. Floral axis convex or elongated. Perianth sometimes whorled; differentiated into calyx and corolla; the numerous deciduous sepals and petals often alike in color, in rows of three and imbricated in the bud. Stamens numerous, free, with adnate anthers; often spirally arranged. Carpels many, free, sometimes whorled, rarely united but generally packed together covering the prolonged receptacle and cohering with one another in fruit to form a sort of fleshy or dry cone. Ovules parietal, anatropous, with two integuments. Fruit a follicle, winged nut, or berry with one or two seeds, conicus oily endosperm and minute embryo.

The name of the family is derived from the seventeenth century French botanist, Pierre Magnol, professor of medicine and prefect of botanic garden at Montpellier.

The family Magnoliaceae is a group of about nine or ten genera and seventy-five to one hundred species of wide geographic distribution. They are found in the tropics of Asia and America, extending into the north temperate zone in the Himalayas, eastern Asia and Atlantic North America. The genus Drimys extends into the south temperate zone and Australasia. There are no representatives of this family in Europe or Africa. In Tertiary times the distribution was circumpolar. (1)

Berry says of the Magnoliaceae (2): "No family is more


(2) Berry, E.W. - Tree Ancestors, pg. 165-170.
obviously of northern origin, none is better represented in the forest floras of Upper Cretaceous times throughout the northern lands, or better exhibits the southward extension so characteristic of many other types... the fossil record of the magnolias is a long and extensive one... From sediments of the Upper Cretaceous, no less than twenty-three species of magnolias have been described. Several of these early magnolias were widely distributed, especially a group of forms found in western Greenland which ran southward along what is now the Atlantic Coastal Plain from Martha's Vineyard to Texas. In the Dakota sandstone of Kansas and Nebraska identical forms have been found, as well as one species from Canada, one from Vancouver Island, and a later form found in Wyoming and Tennessee. As for European forms, one has been reported from Portugal and three slightly later forms from Bohemia and Moravia.

About twenty species with a wide distribution in North America and Europe have been described from the Eocene, and these are all different from the Upper Cretaceous ancestors, "thus hinting at a long time interval that we know intervened between the marine deposits of these two geological periods when the present land areas of the globe were elevated and the seas were restricted". Not only are the leaf remains of these magnolias known but their flowers and fruits have been well preserved.

During the Oligocene eight species were distributed over the Old World, and probably these existed in North America as well; though our fossil records do not show them since all plant records are particularly deficient for that period. Sixteen Miocene species have been described, including both Europe and North America. Pliocene deposits have yielded eleven species from North America, Europe and Eastern Asia. Pleistocene magnolias are restricted to the remains of the existing sweet-bay, Magnolia virginiana, found in deposits of that age in southern Florida.

The magnoliacean genera fall quite naturally into three sub-families or tribes characterized by the degree of development of the floral axis, and the presence or absence of stipules, and the habit. (1) The sub-family Magnoliid (or the Tribe Magnoliaceae) contains the most primitive members of the family and includes the genera Magnolia, Liriodendron, Michelia and Tilia. They are shrubs or trees characterized by leaves with stipular sheaths or stipules which enclose the first younger leaf in the bud-stage, and the flowers with elongated floral axis and carpels arranged spirally. The second sub-family, Illiciaceae (or the Tribe Illiciaceae) includes the three genera Drimys, Zygophyllum, and Illicium. They are trees or shrubs characterized by extispulate leaves and a short, convex floral axis. The third sub-family, Schizandraceae (or the Tribe Schizandraceae) contains two genera, Schizandra and Aedusa. They are climbing shrubs with exispulate leaves and unisexual flowers, with parts arranged

Solereder gives the following review of anatomical features common to all the Magnoliaceae: (1) ... "The occurrence of secretory cells, the wood parenchyma with bordered pits (fiber tracheids), the tendency to the formation of scalariform perforations in the vessels, as well as the absence of unicellular hairs and of glandular hairs. Further, the type of stoma is characteristic, although not always equally clearly marked; the guard cells are usually accompanied by two subsidiary cells parallel to the pore. Where hairs are present, they always consist of only one row of cells. There is no ring of sclerenchyma in the cortex; in the pericycle only isolated groups of bast fibers are present. The origin of the cork is superficial, i.e. in the epidermis, or immediately below it, or at least, in a superficial layer of the primary cortex. Oxalate of lime is present in the form of small octahedral or prismatic crystals, or of clustered crystals, more rarely in the form of relatively large individual crystals."

The secretory cells present in the parenchymatous tissues of the leaf and stem are spherical or lenticular and filled with resin or ethereal oil. Mucilage cells occur in the palisade tissue of the leaves, and sometimes in the epidermis and certain cells of the veins.

The chemical compounds present in the Magnoliaceae are cyanogenetic glucosides (glucosides which yield HCN on hydrolysis - in Drimys, Liriodendron, Magnolia), sapinin (Liriodendron), alkaloids (Michelia, Magnolia) and volatile oils (all genera). Certain bitter and acrid substances (which are probably glucosides) are common to each genus; such, for instance, as magnolin, liriodendrin, tulipiferine, etc. (2)

Most members of the Magnoliaceae are sweet scented and secrete nectar at the base of the carpels or under the inner row of petals. Bees and butterflies seek out these sheltered and nectariferous places and effect pollination. A pronounced protogyny prevents self-pollination. (3)

The Magnoliaceae have played an important role in the attempts of botanists to trace the origin of the angiosperms, as was mentioned in the introductory discussion, but aside from the strictly botanical importance of the family, we find it of value economically. Here are the well-known magnolias and the tulip tree, to be considered later, as well as several other genera valued as ornamentals and useful in medicine.

(2) Pammel; Haas and Hill; Merck’s Index.
(3) Knuth, P. - Handbook of Flower Pollination, Vol. 2: 64
Michelia fuscata Blume, the popular "banana shrub" of southern gardens is a member of this family and comes to us from China. M. Champaca L. with its golden-yellow, highly fragrant flowers comes from the southern part of Asia and adjacent islands. It is a sacred tree of India.

"The maid of India blest again to hold
In her full lap the Champacs leaves of gold."


The flowers of this plant yield the famous "champak" perfume, of which Shelley speaks thus:

"The wandering airs, they faint
On the dark, the silent stream;
The champak odors fail
Like sweet thoughts in a dream; . . ."

- The Indian Serenade

Illicium gives us several species of importance because of their volatile oils. I. verum Hook. f. of China is the true star-anise or Chinese anise used medicinally (to improve the taste and odor of unpleasant medicines, linaments and ointments), and in the manufacture of liquors. The small star-shaped cluster of fruits have an odor resembling anise. Bailey says of this species: "The star or Chinese anise — much used in oriental countries in cookery, and exported to some extent, is said to be used in flavoring certain French wines ("Anisette de Bordeaux") and comes from China. It has been supposed to be the product of I. anisatum of Linnaeus, but that plant is a Japanese tree and it contains a poison. In the American trade are the names I. anisatum and I. religiosum. It now transpires that these names belong to the same plant and that the star-anise is produced by another species. This other species, or the true star-anise, was first accurately described and figured (as I. verum, Hook. f.) in B.M. 7005 (1833) where the confusion of two or three centuries is elucidated. There is probably only one East Asian Illicium in the trade (floricultural) with North America, as follows: I. anisatum". (1) This I. anisatum from Japan has seeds which are very poisonous, and have been the cause of the death of several children who have eaten them. The poison causes paralysis of the respiratory system and of the heart. (2) It is held sacred by the Japanese and wreaths of its flowers are used to decorate tombs of deceased friends. The fragrant bark of this species (usually called I. religiosum Sieb, and Zucc.) yields an incense often burned on the altars in Buddhist temples around which the trees are frequently found growing. This incense is exported to some extent and powdered it is burned in tubes graduated to mark the passing of time. (3) I. floridanum Ellis

(1) Bailey, L.H. - Encyclopedia of Horticulture: pg. 1641
(2) PammeL, L.H. - A Manual of Poisonous Plants: pg. 474
(3) Smith, John - Dictionary of Economic Plants: pg. 17-18
and *I. parviflorum* Michx. of the southern United States have aromatic bark and pods.

**Talauma macrocarpa** Zucc. of Mexico yields a haemolytic substance capable of dissolving the red blood corpuscles. (1)

**Drimys**, a genus of ten species has "coniferen-holz", but this is due to loss rather than primitiveness. The best known species is *D. Winteri* Forst. of South America, a beautiful tree with columnar trunk running up ten meters or more and crowned with an ovoid mass of shining, evergreen leaves. The flowers are small and Magnolia-like, jasmine-scented and the fruit is "eagerly eaten by parrots". The strongly aromatic bark is known in medicine as "Winter's Bark". It is a tonic and stimulant and valuable in gastric troubles. Captain John Winters who brought the bark back with him to England from the Straits of Magellan (in 1578) used it as an antiscorbutic and "found it very efficacious in cases of scurvy among his crew." (2)

**Schizandra** gives us *S. coccinea* Michx., a handsome ten to twenty foot vine with scarlet berry-like fruits on an elongated receptacle. This is a much valued ornamental shrub in the South, from Carolina to Texas. Certain oriental species have fruits which are eaten in their native lands and the Japanese and Chinese *S. chinensis* Baill. (Rupr.) is a vine hardy in northern United States. It is used to cover rocks, trees, shrubs and fences, and thrives best in partly shaded and somewhat moist places. Since the fruits are the most attractive parts and the plants are dioecious, it is necessary to plant both the staminate and pistillate plants near together. (3)

**Kadsura japonica** L. grows as far as thirty-five degrees North latitude and is a small procumbent shrub often advertised by the Japanese dealers. There are eight species and Charles S. Sargent writes of one: "The flowers are not at all showy but it is a plant of extraordinary beauty in autumn when the clusters of scarlet fruit are ripe, their brilliancy heightened by contrast with the dark green, lustrous, persistent leaves . . . It might well be grown wherever the climate is sufficiently mild, as in autumn no plant is more beautiful." (4)

(2) Smith, John - *Dictionary of Economic Plants* - pg. 441
(3) Bailey, L.H. - *Encyclopedia* - pg. 3110
(4) Ibid - pg. 1731.
KEY TO MAGNOLIACEAN GENERA NATIVE OF MASSACHUSETTS

Leaves entire; fleshy fruits with one to two seeds which at maturity hang from the carpel by an extensile thread — — MAGNOLIA

Leaves four-lobed; fruits one to two seeded, winged and samara-like, forming a dry cone and falling away separately at maturity from a persistent axis — — LIRIODENDRON

MAGNOLIA L. Sp. Pl. 535. 1753

Deciduous or evergreen trees or shrubs with rather stout branches. Leaves alternate, entire, generally large and thick. Buds covered with "conduplicate sheathing stipules". Flowers terminal, solitary, usually large and fragrant; enclosed in stipular spathe when in bud. Sepals three, often petaloid. Petals six to fifteen, imbricate, in two to four series. Stamens numerous, imbricated; filaments short; anthers linear, introrse. Carpels numerous, "connate on elevated or elongated receptacle"; developing into cone-like, somewhat fleshy, leathery, or woody red fruits with one to two anatropous ovules. Seeds large; usually scarlet; fleshy; suspended from each carpel (which has opened on back at maturity) by an "extensile thread", the funicle.

Magnolia is a genus with about thirty living species and thirty fossil ones. The living species are widely distributed through the northern hemisphere, being found in eastern and tropical Asia, and eastern North America. Massachusetts is about the northernmost limit of the genus in North America. In Tertiary times magnolias extended across the North Temperate zone and as far north as Greenland and Spitsbergen; the area of distribution also included Australia. (1)

(1) Rendle, A.B. - Classification of Flowering Plants, Vol. II pg. 127
As Loudon says: "No one is ignorant of the grandeur of the Magnolias, or of the delicious, though sometimes dangerous, fragrance of their blossoms." (1) It is chiefly for their large, showy, white, pink or purple sweet-scented flowers that the magnolias are cultivated, though the large evergreen leaves add to their attractiveness as ornamental trees. The bark and flowers have aromatic properties and so are considered of some medicinal value. The wood is valued for fine cabinet work. (2)

Of the Old World species, the earliest in cultivation seems to have been M. conspicua Salisb. (M. Yulan Desf.) of China and Japan, (3). It is hardy fifty foot tree, and a favorite with the Japanese as well as the Chinese. It is extremely free-flowering and the early, white flowers which appear before the leaves, are often six inches across and very fragrant. The Chinese not only use the flower buds medicinally but also pickle them after removing the calyx and use them for flavoring rice. (4) This species was introduced to Europe in 1789 and from there it came to America where it is now much cultivated. (5) One of the original plants from China is still at Kew. (5) Of the Japanese magnolias, M. Kobus (DC.) Thunb., a pure white, deciduous, early flowering and very desirable species; and the purple-flowered, odorless, M. liliflora Desrouss. (M. obovata Willd.) were well known as early as 1690 and were introduced into England in 1709 and 1804 respectively. (3) M. liliflora is a tender shrub with small, scentless, purple flowers, most important because of the hybrid which results from crossing it with M. conspicua. The result of this cross is M. Soulangeana Soul., a strong tree whose flowers retain the color of M. liliflora and the odor of M. conspicua. The very dwarf Magnolia M. pumila Ands. (M. Coco DC.) comes from China and was introduced in 1766. It is nearly evergreen and has "deliciously scented flowers" - like pineapple. (3) It will not stand ten degrees below freezing, so here can be grown only in the conservatory. It blossoms nearly all year and its delicate fragrance is unsurpassed. It is strange that it is so little known. (6) M. stelidata Maxim. is the earliest blooming species in cultivation and is an Asiatic deciduous shrub, very hardy, of dwarf habit, with bitter, aromatic flower-buds officinal in Japan. Bailey mentions M. hypoleuca Sieb. and Zucc. (M. obovata Thunb.) as handsomest of the deciduous species, with very large, silvery white leaves and showy, sweet-scented flowers. M. hypoleuca is used instead of the oldest name M. obovata to avoid confusion "as latter name has been applied erroneously by most botanists to the plant named here M. liliflora".

(1) Loudon's Encyclopedia - pg. 1055
(2) Bailey, L. H. - Encyclopedia - pg. 1965
(3) Encyclopedia Brittanica - Magnolia - pg. 672
(4) Sturtevant's Notes on Edible Plants - pg. 549
(5) Smith, John - Dictionary of Economic Plants - pg. 256
(6) Bailey, L. H. - Encyclopedia - pg. 1965
(1) M. Campbellii (Hook. f. and Thoms.) is a very beautiful tree from the Himalayas but hardy only in the South.

It is interesting that in all the above mentioned cultivated species where flowers precede leaves, the species are of Asiatic origin. (2)

Of the New World representatives of the family, M. virginiana (M. glauca) will be considered later. M. grandiflora L. is considered by floriculturists one of the grandest of all broad-leaved evergreen trees but precariously hardy north of Philadelphia. It was the first American species taken to Europe by Banister in 1686. (3) It is a native of the South and often grows as high as seventy to one hundred feet. At Kew there is a tree over one hundred years old which is but twenty-three feet with a girth of three feet. (4) This species has evergreen leaves nine to ten inches long, smooth and shining on the upper side and rusty grown beneath. The flowers are very large, sometimes ten to twelve inches in diameter, pure white and very fragrant. It was originally discovered by Catesby in 1719 in South Carolina and Florida and introduced into England in 1734 where it is customary to train it against a wall. The original species is surpassed by the Exmouth variety which originated as a seedling at Exeter from the first tree raised in England by Sir John Collitan. (3)

\[ M. \text{ acuminata} \ L. \text{, the cucumber tree of western New York and the South, was found in Virginia by Catesby in 1712 and introduced into England in 1736. (5) Michaux considered it one of the most magnificent trees in North America. (5) Its wood is yellow and sometimes used for bowls. The fruits are three inches or so long and resemble small cucumbers, hence the name cucumber tree. From them a tincture is prepared which has had the reputation of removing attacks of rheumatism. (6) M. tripetala L. is the umbrella tree of southern Pennsylvania and the South. This also was discovered by Catesby and taken to England in 1752. (3) The flowers are very large, white and highly scented, and the deciduous leaves placed at the end of the branches in a circular manner like an umbrella gave it its name. This species tends to escape here in Massachusetts as has been pointed out by Dr. Stone. (1) Dr. Stone's attention was called to the occurrence of this species of Magnolia in Springfield, Massachusetts several years ago, and in the summer of 1912 Dr. Stone, accompanied by other}

(1) Bailey, L. H. - Encyclopedia - pg. 1967
(2) Nash, G. V. - Under Magnolia Robus, Addisonia 3 : 55
(3) Encyclopedia Brittanica - Magnolia - pg. 672
(4) Smith's Dictionary of Economic Plants - pg. 255
(5) Emerson, G. W. - Trees and Shrubs of Massachusetts, pg. 602
(6) Loudon's Encyclopedia, pg. 1055
members of this botany department, visited the location. 
M. tripetala is included by Goodale in his list of ranalian plants of Massachusetts (2), and it is by most botanists considered eligible to a position in our native flora. M. Fraseri Wait. is another deciduous southern species of less importance. M. macrophylla Michx. is perhaps the most striking species of the genus. It is found from Kentucky south, and is much cultivated now in Europe and America. It is hardy as far north as Boston. It has the largest leaves and flowers of any Magnolia and "in fact there is nothing like it outside of the tropics". The leaves are a yard long and the flowers as large as a man's head. The petals are white with a splotch of purple at the base and very attractive. The only drawback is that the wind tears the leaves easily and the flowers discolor when bruised, which tends to lessen the ornamental value. The odor is usually described as disagreeable.

Most of the deciduous species of magnolias are hardy as far north as northern New York and Massachusetts, while M. acuminata, M. Kobus and M. stellata can be grown even further north.

Magnolias are usually planted as single species on the lawn. They are perhaps most striking when placed against a background of dark green conifers. They thrive best in a somewhat rich, moderately moist and porous soil, preferring sandy or peaty loam with the exception of M. virginiana which does well in moist and swampy situations and a heavier soil. The transplanting of magnolias is difficult and is most successfully performed when the new growth is just starting. They may be propagated by seeds sown immediately or stratified, or by layers of the last year's growth put down in the spring and tongued or notched. Layers are usually severed and transplanted the following spring. Or a safer way is to take them off in July, when the new growth has ripened, plant in pots and keep in closed frame until they are well established. Varieties and rarer kinds are often veneer- or side-grafted in early spring or summer on potted stock in the greenhouse or frame. M. tripetala is perhaps best on account of better roots which render transplanting safer; but M. acuminata is also good stock. (2)

(1) Stone, G. E. - Rhodora 15 : 63
(2) Goodale, Alfred S. - A Check List of Pteridophyta and Spermatophyta in the Connecticut River Water Shed of Massachusetts.
(3) Bailey, L. H. Encyclopedia - pg. 1984
MAGNOLIA VIRGINIANA L.

(White Bay, Sweet Bay, Laurel Magnolia, Swamp Magnolia, Beaver-Tree.)

M. virginiana and var. glauca L. Sp. Pl. 525. 1753
M. glauca L. Sp. Pl. Ed. 2: 735. 1763

Magnolia - after Pierre Magnol, Professor of Medicine and Prefect of Botanic Garden at Montpelier.

virginiana - of, or from Virginia.

Shrub or tree fifteen to seventy-five feet high; trunk five inches to three and one-half feet in diameter. Leaf buds pubescent; bud scales stipulate. Leaves all scattered along the branches; deciduous in the North or persistent in the South; coriaceous; dark green above and glaucous beneath; oval to oblong-lanceolate; obtuse or blunt acuminate; acute at base; petioles about 2.5 cm. long. Flowers white; depressed-globose; deliciously fragrant; 5-6 cm. in diameter. Sepals three, nearly as large as petals, spreading, obtuse. Petals nine to twelve, broad, roundish-obovate. Fruiting cone pink; small, 2.5 - 5 cm. long; ellipsoid. (Plate 1)

May - July from Cape Ann and New York south near the Coast to Cumberland County, Pennsylvania. In swamps and swampy woods.

Magnolia virginiana is a species "which post glacial climatic changes have left stranded in Essex County, Massachusetts, and on Long Island, and which ranges southward to peninsular Florida and eastern Texas." (1) It is the only Magnolia found in the Pleistocene deposits.

(1) Berry, E.W. - Tree Ancestors - pg. 188
Magnolia virginiana "is a very desirable shrub with its handsome glossy foliage and sweet-scented, creamy-white flowers," and as a consequence it is much valued as an ornamental. The horticultural variety longifolia Loud. has lanceolate leaves and continues blooming during a longer period of time than the type species and so is more desirable. (1)

At one time the twigs with a single flower were sold on the streets of New York for ten cents, having been brought there from the swamps of New Jersey and Pennsylvania. Because of the demand for them and because they will grow in the waste land it has been recommended that the swamps of New Jersey be planted with them. (2) Best flowers are usually obtained on suckers which arise after severe pruning. The wood has been made use of for joiner's planes. Loudon, quoting Bilienius says: "that the flowers never open in the morning, that the calyx falls off at the second opening of the flower, but that the petals dry on, and that the scent resembles that of a lily-of-the-valley, with a mixture of aromatic." (3)

The history of the "sweet bay" and particularly its connections with the stations on Cape Ann is one of the most interesting things about M. virginiana. (4) Cape Ann represents the northernmost station for this species, and the plant is not found again until one reaches the swamps of New Jersey.

Under the date of October 30, 1748, Peter Kalm, who was at that time traveling along the Atlantic Coast, entered the following in his Journal:

"October the twentieth. The Beaver Tree is to be met with in several parts of Pennsylvania and New Jersey, in a poor swampy soil, or on wet meadows. Dr. Linnaeus calls it Magnolia glauca. Both the Swedes and English call it Beaver tree, because the root of this tree is the dainty of the beaver, which are caught by its means; however the Swedes sometimes gave it a different name, and the English as improperly called it Swamp Sassafras and White Laurel. The trees of this kind drop their leaves early in autumn, though some of the young trees kept them all winter. I have seldom found the beaver tree north of Pennsylvania, where it begins to flower about the end of May. The scent of its blossoms is excellent, for by it you can discover within three quarters of an English mile, whether these little trees stand in the neighborhood, provided the wind be not against it. For the whole air is

(1) Bailey, L.H. - Encyclopedia - pg. 1987

(2) Rogers, Julia E. - The Tree Book, pg. 251 - referring to Prof. Gifford's recommendation. Prof. Fernald has also mentioned this.

(3) Loudon's Encyclopedia - pg. 479

(4) Kennedy, George G. - Rhod. 16:205-213.
filled with this sweet and pleasant scent. It is beyond description agreeable to travel in the woods about that time, especially towards night. They retain their flowers for three weeks, and even longer, according to the quality of the soil on which the trees stand; and, during the whole of their being in blossom, they spread their odoriferous exhalations. The berries likewise look fine when they are ripe, for they have a rich red color, and hang in bunches on slender stalks. The cough, and other pectoral diseases, are cured by putting the berries into rum or brandy, of which a draught every morning may be taken; the virtues of this remedy were universally extolled, and even praised for their salutary effects in consumptions...and it was thought that a decoction of it could stop the dysentery. Persons who had caught cold, boiled the branches of the beaver tree in water, and drank it to their great relief."

Clayton in his Flora Virginica of 1762 cites M. glauca, and Mark Catesby in 1771 gives an account of it with excellent plate and descriptions for that time. In 1787 one of the earliest volumes on Materia Medica Americana came out, written by David Schoepf. In it was a list of the pharmaceutic uses of the plant "from the aromatic bitter of its bark to its ashes made into an ointment for ulcers."

The date of the discovery of this shrub in Massachusetts was July twenty-second, 1806. The Hon. Theophilus Parsons wrote the following letter to Dr. Manasseh Cutler on the subject:

"Reverend and Dear Sir:

In riding through the woods in Gloucester, that are between Kettle-Cove and Fresh-Water Cove I discovered a flower to me quite new and unexpected in our forests. This was last Tuesday week (July 22, 1806). A shower approaching prevented my leaving the carriage for examination, but on my return, on Friday last, I collected several of the flowers, in different stages, with the branches and leaves, and on inspection it is unquestionably the Magnolia glauca. Mr. Epes Sargent has traversed these woods for flowers and not having discovered them supposed it could not have been there many years. It was unknown to the people of Gloucester and Manchester until I showed it to them. I think you have traversed the same woods herborizing. Did you discover it? If not, how long has it been there? It grows in a swamp on the western or left side of the road as you go from Manchester to Gloucester, and before you come to a large hill over which the road formerly passed. It is so near the road as to be visible even to the careless eye of the traveler. Supposing the knowledge of this flower, growing so far north, might gratify you, I have made this hasty communication.

Your humble servant,

Theoph. Parsons.

Rev. Dr. Cutler."
Dr. Jacob Bigelow's *Plants of Boston* (first edition 1814 and subsequent editions) reports *M. glauca* at Gloucester, and in his *Medical Botany* he calls it an aromatic tonic.

The next significant date of its mention is by Dr. Francis Peyre Porcher in 1863 who "speaks entirely of its pharmaceutical value in many cases of typhoidal character", as follows:

"The bark of the root according to Griffith, was employed by the Indians to fulfill a variety of indications; the warm decoction acts as a gentle laxative, and subsequently as a sudorific; whilst the cold decoction, powder of, or tincture, is tonic. ... It is supposed by many residing in the lower portions of the state that this tree prevents the water of bogs and galls from generating malaria. It certainly seems that the water is much clearer in which the bay tree grows."

George B. Emerson in his *Trees and Shrubs of Massachusetts* mentions the Cape Ann Swamp and gives a foot note that "it (*M. glauca*) is said to have been found, in a single spot, in the county of York, Maine; but no specimen from Maine is known to exist in any herbarium.

J.G. Jack in *Garden and Forest* 1889 devotes nearly a page to the *Magnolia* of Essex County and an unsigned correspondent in the same volume suggests the following as to its possible introduction there:

"Magnolia Swamp contains several hundred acres, and it is one and a half miles in length and from ten to over one hundred yards in width. I am of the opinion that this swamp has furnished the shrub to all the others. In regard to three of the smaller swamps I know that this is a fact, the Magnolia shrubs having been transplanted by men. The inhabitants of Gloucester are firm in the belief that *Magnolia glauca* is a native shrub, but I cannot think so. I believe that it was introduced by the old settlers some of whom may have lived in and removed from a more southern state. "The Old Salem Road", deserted by the traveling public for over one hundred years, skirts the eastern side of Magnolia Swamp. Along the line of this road are the ruins of old cellars, and in the swamp one of the cellars, near a spring, may be found Magnolias which appear the oldest in the region. The root crowns below the moss are often found to be two feet in diameter. In no other place can I find such a growth, and it is here, I think, that the shrub first started. It must be evident to any careful observer that *Magnolia glauca* is struggling here in an unnatural climate. The primary roots go straight down into the muck, and in the fall are quickly covered with rootlets, snowy white in color. In the spring these rootlets are mostly dead, and a greater part of young shoots die down to the moss, and a certain per cent of the old plants are winter-killed, which indicates that there is no harmony between shrub and climate,"
In 1913 C.E. Faxon reported the condition of the swamp and the necessity for some protection against the inroads of boys who picked the flowers to sell in Boston as he found but two little plants remaining where forty-five years before there had been many shrubs fifteen or more feet high.

In 1928 R.J. Eaton reported that he had visited the famous Swamp which had recently been made a part of Ravenswood Park. He said there were a dozen or more trees some four meters high which could be counted without leaving one of the paths through the Park.

On August 6, 1933 and again on July 7, 1934 (after the severely cold winter of 1934) the present writer visited this swamp and was surprised to find there more than a dozen very healthy trees and many young seedlings. Under the protection of the Park attendants it is probable that the trees will flourish and that this famous northernmost stand of the Magnolia will be preserved indefinitely.

**LIRIODENDRON** L. Sp. Pl. 535. 1753

Large, deciduous trees. Leaves alternate; long petioled; truncate or broadly emarginate; four to six lobed or rarely entire. Stipules deciduous, united at the base and serving as bud scales during the winter. Flowers large; terminal; solitary; slightly fragrant. Sepals three, petaloid, reflexed. Petals six, in two rows; connivent, forming a bell-shaped corolla. Stamens numerous with long, linear, extrorse anthers. Carpels numerous; flat and scale-like, narrow; imbricating and cohering on the elongated receptacle; ovules one to two at base of small ovary. At maturity, cone dry, with carpels samaroid and falling away whole, indehiscent. Seeds pendulous by short slender funiculus at maturity.

*Liriodendron* is a genus of but two species, one native of China, *L. chinensis* Sarg., and one native of eastern North America, *L. tulipifera* L.
The following history of *Liriodendron* taken from Berry is of interest. (1) Today the tulip tree is not native in Europe yet it was "not at all uncommon for thousands of years previous to the Ice Age and before the advent of man in that region. . . Time was once when the sun never set on the tulip-tree" but now the Chinese and eastern North American species represent the "last survivors of an ancient race."

The ancient leaf type was simple and ovate or lanceolate and *Magnolia*-like. The modern seedlings bear the same kind, and these are connected to the bilobed leaf by many transitions. The winter buds of the tulip-tree, as well as those of the *Magnolia*, are protected by scales which are morphologically the basal stipules. The transitions from simple leaves to bilobed ones, and the origin of stipules from basal leaf lobes is illustrated in the accompanying plate of atavistic leaves of *Liriodendron tulipifera* which Berry has collected and figured. (Fig. 7) We have also included here several figures of fossil leaves of the tulip-tree. (Fig. 8) The two plates taken together show "how the life history of a modern form tends to repeat the life history of its ancestral line," or how "ontogeny recapitulates phylogeny". The fossil *L. alatum* is the phylogenetic analogue of the abnormal present state.

Turning to the geological record of the tulip-tree we find a great variety and wide range of Upper Cretaceous forms, the oldest known being those of the Atlantic border in New Jersey. "This in itself is interesting because much of North America and the Arctic archipelago to the northward had been a land area for many millions of years previous to the marginal flooding by the Upper Cretaceous sea" (or ever since the dwindling of the Carboniferous sea - during all of the Permian, Triassic, Jurassic and Lower Cretaceous). "When this land first emerged from the Carboniferous sea it was clothed with a strange vegetation made up of entirely extinct types, such as the seed-ferns, calamites, lepidodendrons, and sigillarias. During the interval between the Carboniferous and the Upper Cretaceous the foregoing species had become entirely extinct and flowering plants had evolved and had rapidly spread toward that dominance in the flowering world which they occupy at the present time, which position they had reached as early as Eocene times." The tulip-tree remains were also prominent in the forests that clothed the shores of the Upper Cretaceous sea that about the same time spread northward from the Gulf of Mexico up the Mississippi Valley over the present prairie States. In the shore sands of this advancing sea, which geologists call the Dakota sandstone" - there were at least nine species of tulip-tree leaves preserved, ranging from the small *Liriodendron meekii* to *L. giganteum* which is seven inches in diameter. *L. meekii* is also found in Western Greenland, Saxony and even in Argentina.

At this same time two other forms were present on the Pacific Coast,

(1) Berry, E.W. - *Tree Ancestors* - pg. 173-180
Fig. 7 - Some Singular Atavistic Leaves of the Existing Tulip-Tree, Liriodendron Tulipifera.

9. Leaf with incipient lobes. The right has peculiar arrangement of veins similar to arrangement in modern stipules.
4. Basal lobes becoming separate leaflets like stipules but at the top of leaf stalk.
3. Leaf stalk not yet elongated. Winged on one side as in fossil L. alatum, and on other side stipule-like separation from the rest of the blade.
1. Elongation of leaf stalk from state in No. 3.
2. Succeeding stage.
7. Separation of stipules from leaf stalk of form like No. 2.
8. Bud scale with midrib or leaf stalk between scales of original blade elongated.
6. Similar elongation expanded into ovate-shaped blade.
5. Similar elongation expanded into more normal-shaped leaf.

(From Berry, E.W. - Tree Ancestors, pg. 174-175. Photograph by Gladys I. Miner.)
Fig. 8 - Fossil Leaves of the Tulip Tree, Liriodendron.

2. *Liriodendron quercifolium* Newberry - Upper Cretaceous of New Jersey (Raritan formation).
7. Same - from Pliocene of Italy.

(From Berry, E.W. - *Tree Ancestors*, pg. 176-177. Photograph by Gladys I. Miner.)
and somewhat later, in Cretaceous time, one species occurred in Saxony, another in Tennessee and Wyoming, while a third, \(L.\) \textit{alatum}, spread over Colorado and Utah.

"With the close of the Cretaceous times there was a widespread land emergence" and finally, after a very long period "a renewed submergence which ushered in the Tertiary". This "resulted in mild and comparatively uniform climates, and fossil floras show a poleward expansion of equatorial floras of that time, so that no tulip-trees were present in eastern North America. Instead they occurred in British Columbia, Greenland, Iceland and England during later Eocene. The Oligocene furnished no representatives but two or three species appear from the Miocene of Italy, Switzerland and Bohemia. None have been discovered in Miocene or Pliocene floras of North America but that is not strange since those deposits are not at all well known here. At least three species of \textit{Liriodendron} survived in Europe during the Pliocene and immediately preceding the Glacial Period. These were found in Italy, France and Holland, and "the Holland species cannot be distinguished from the still existing American tulip-tree, which adds another item to the long array of facts which show that the similarities in the existing floras of North America and eastern Asia and the dissimilarities shown with the flora of Europe, are due very largely to the havoc wrought on the last continent by the intense glaciations combined with the peculiar geography and topography of transverse mountain chains and mediterranean seas which largely prevented the southward retreat of the forests. Another link in the chain of distribution is the presence of fossil leaves like those of existing species in the Pliocene of the Altai mountains, north of Tibet in central Asia. The extremely slight differences between \textit{Liriodendron tulipifera} of southeastern North America and \textit{Liriodendron chinensis} of southwestern China probably date from Pliocene times. Finally in Pleistocene times we find the fossil fruits and leaves of the existing American form in Maryland, North Carolina and Alabama."

\textbf{LIRIODENDRON TULIPIFERA} \textit{L.}

(Tulip Tree, White-wood, Yellow Poplar, Lime Tree)

\textit{Liriodendron Tulipifera} \textit{L.} Sp. Pl. 535; 1753

\textit{Liriodendron} - from the Greek \textit{lily} and \textit{tree}.

\textit{Tulipifera} - from the French \textit{tulipe}, tulip, and the Latin \textit{ferre}, to bear. Both names refer to the lily- or tulip-like flowers borne on the tree.

Tree growing sixty to one hundred and fifty feet or rarely one hundred and ninety feet high, with a trunk four to.
twelve feet in diameter. Branches diverging, curved, smooth. Leaves glabrous; very broadly ovate or nearly orbicular in outline; truncate or broadly notched at apex; truncate, rounded or cordate at base; 7.5 - 15 cm. long with two apical lateral lobes and two to four basal lateral lobes, or occasionally entire; bluish green above; pale or glaucous beneath. Flowers 3.5 - 5 cm. long; erect; greenish yellow with orange-colored base within.

Petals obovate, obtuse; about 5 cm. or equalling the reflexed sepals. Fruiting cone dry, oblong, acute, 7.5 cm. (Plate 2)

May - June in rich soil. Worcester County, Massachusetts to Ontario and Wisconsin and southward to Florida and Mississippi.

A line from the southeastern corner of Worcester County to the southwestern corner of the state of Vermont seems to be the northern limit of this tree. (1) Within the area thus left to it in Massachusetts there are only a few stations where it is found, the chief ones being Granville, Russell, Douglas, Stockbridge and Great Barrington. (2)

In descriptions of the tulip tree one always finds the words "magnificent", "beautiful", "handsome", or "noble". It is one of the finest trees of the American forests, a valuable timber tree of the western and southern states, and is much admired in the East as an ornamental. It is a hardy tree, "well adapted for park-planting and for avenues, with handsome, clean foliage of unusual shape ("fiddle-shaped leaves") and rather light bluish-green color, rarely attacked by insects or fungi, assuming in fall a brilliant yellow color". (3) Loudon says that it was common (1829) in Europe, particularly in the south of France and in Italy where it is frequent on public avenues, flowering when twenty to thirty feet high and six to seven years old. It blossoms in Britain when older, and he speaks of the many fine old trees around London, at Kew and "as far north as Pitcaithly-wells in Fifeshire". (4)

(1) Rhod. 15: 217

(2) As indicated by specimens at Amherst College, in Gray Herb. and N.E.Bot. Club Herbarium. The Westfield River Station in Russell is mentioned by Emerson.

(3) Bailey, L.H. - *Encyclopedia* - pg. 1890

(4) Loudon's *Encyclopedia* - pg. 478
Berry speaks of an immense old tulip tree at Annapolis named for General Lafayette, and of an old colonial manor in southern Maryland which has a long entrance drive bordered with old giants of this species.

The tulip tree grows best in deep, rich and somewhat moist soil. Transplanting is not easy, but it is best done in the early spring before the tree starts into new growth. Propagation is by seeds sown in the fall or stratified and sown in the spring; or varieties are usually grafted or budded on seedling stock. Rarely is it propagated by layers. (1)

There are several varieties of horticultural interest. The variety pyramidal has upright branches forming a narrow cone; variety integrifolium has leaves rounded at base and not lobed; variety obtusifolium has rounded lobes at each side of the base; variety aurec-marginatum has leaves edged with yellow; and there are several other variegated types. (1)

The tulip tree is also of importance economically because of its lumber called "white-wood" in the West, and "poplar" or "tulip-poplar" in the East. The soft, fine grained, light yellow or white wood takes a fine polish and is much used in carpentry for furniture, boat and canoe building and the manufacture of many small articles. It does not split easily but is readily worked and bent to any required shape. It cannot be used for boards or planks (? – See Baillon's quotation below) since it contracts and expands more than almost any other wood.

Pammel includes it in his list of poisonous plants of the world, and states that it contains hydrocyanic acid and saponin, while Balfour mentions that the bark is bitter and tonic. (2)

Baillon sums up many of the uses of this tree in the following manner: (3)

"The tulip tree is, like the Magnolia, a very beautiful tree for ornament, often planted in our gardens and our parks. Its wood has a certain usefulness. White, very light, it is easily disposed to the work of turning; it is pliable without being soft, woody without being filamentous; it has a rather agreeable color and takes a beautiful polish. In America, it is made into thin planks of white wood, into boards, into joists, into tables, into

(1) Bailey, L.H. - Encyclopedia pg. 1890

(2) Pammel, L.H. - Poisonous Plants of the World, pg. 837;
Balfour, J.H. - Class Book of Botany, pg. 751

Venetian blinds and many other objects for domestic use. The savages excavate the trunk for piroques and canoes of a single piece. This tree is still sought out for naval construction because the wood is incorruptible and the ship worm and marine plants do not attach themselves to it. The bark of the trunk is fibrous, little compacted, bitter and aromatic. It is considered in the United States as a tonic, antiseptic, febrifuge; to it has been attributed all the properties of Peruvian bark, in the treatment of fever attacks. Gout, rheumatism, dysentery, consumption, hysteria and certain disorders of the head, have been, it is said, treated with success by its bark. The root, commonly called yellow wood, possesses almost the same properties. It is used to prepare an agreeable liquor; and the Canadians employ it to correct the bitterness of the beer "de Sapinette" and to give to it a taste of citron. It is asserted that the perfume, especially of the table liquor "de Martinique" is due to the presence of a distilled liquid extracted from the bark of the tulip tree. The leaves, ground and applied to the forehead, excel in curing the headache. The seeds constitute an aperient medicine. The tulip tree is, besides, one of the most beautiful trees that is known."

**ANONACEAE, MYRISTICACEAE, CALYCANTHACEAE, MONIMIACEAE**

The Anonaceae (also spelled Annonaceae), Myristicaceae, Calycanthaceae and Monimiaceae are all woody families of the order Ranales. They are mostly tropical or semi-tropical shrubs or trees which are not native in Massachusetts, and hence are known here only through cultivation, or for their commercial products. However, a few notes on the systematic position of the families and the economic value of the most prominent members of each family will be of interest.

**ANONACEAE**

(The Custard-Apple Family)

The family Anonaceae is widely spread in the tropics of both the Old and the New World. It contains about seventy genera and some eight hundred species of woody plants which are closely allied to the Magnoliaceae, and some of which are grown for their edible fruits. The only constant character which sets apart the family Anonaceae from the Magnoliaceae is the deeply ruminated endosperm of the seeds in the former family. The Anonaceae have oil cells present in the parenchymatous tissue of their leaves, stems, and even flowers. The leaves are entire, alternate and exstipulate. The flowers are bisexual, with spiral arrangement of parts. The perianth usually consists of three sets of three members each, but it may be entirely lacking. The numerous stamens, and the carpels possessing many ovules are quite similar to those of the Magnoliaceae. The fruits are fleshy and form separate berries, or the ovaries become united with the floral axis. The seeds are generally arillate, which links the family with the Myristicaceae and Calycanthaceae.
All members of the family are entirely tropical except *Asimina triloba*, the North American Papaw, which grows along streams from southwestern Ontario and western New York, Pennsylvania and New Jersey to Michigan, Florida, Kansas and Texas. It is a tree some ten to forty feet in height with large leaves giving off an unpleasant odor when crushed. The carpels are few, ripening into one to four large, thick, stubby fruits which are dark brown and shaped like short bananas. The flesh of these fruits, "though thin, is sweet and edible"; but reports differ as to its desirability. Don says: "the fruit is relished by few except negroes", while Vasey says "the fruit, when ripe, has a rich luscious taste." Flint remarks that "the pulp resembles egg custard in consistence and appearance. It has the same creamy feeling in the mouth and unites the taste of eggs, cream, sugar and spice. It is a natural custard, too luscious for the relish of most people. The fruit is nutritious and a great resource to the savages." (1)

*Anona* is the most important genus of the family, commercially, and is the custard-apple of the American tropics with more than fifty species of shrubs and trees. (2) The fruit is a large and fleshy syncarp formed by the fusion of carpels and the receptacle. *A. muricata* L. (Soursop, Guanabana) is a small branching tree of tropical America which is "now wide spread and frequently planted". It is about the size of a peach tree and bears large (often up to five pounds), ovoid-cordate, dark-green fruits with white, juicy, sub-acid pulp which has a mango-like flavor. It is used in making beverages and in flavoring jelly and conserves.

*A. flabra* L., the pond apple, alligator apple or monkey apple, is native of the Everglades of Florida and southward in tropical America. It has cream colored fruit pulp of no economic value but is "eaten by iguanas, and alligators are also fond of it."

*A. Cherimola* Mill., the Cherimoya, is a native of Andes and Peru and adjacent regions but early grown in Mexico and now widely spread in cultivation. (India, Hawaii, California etc.). The fruit pulp is white, pleasantly acid and the seeds are readily separated from it.

*A. reticulata* L., is the common custard apple, bullock's heart or Guanhtzapoti of tropical America. It is much planted though the fruit is inferior to Cherimoya or the following species, *A. squamosa*.

*A. squamosa* L., the sugar apple or sweetsop, has fruit the size of an orange with loosely coherent carpels and creamy or custard-like, "sweet and pleasant" pulp. It is widely dispersed in cultivation and the fruit is much used in making delicious sherbets, jellies and preserves.

(1) Sturtevant's *Notes on Edible Plants*, pg. 71

(2) For *Anonas* in cultivation etc. see Bailey's *Encyclopedia*, pg. 291-295; Also Bull. 323, Univ. of Flor. Agr. Ex. Station.
Bagaerea cauliflora is of interest on account of its "curious habit of flowering on the trunk. The base of the tree at flowering time is covered with many close pressed, sessile, grey-brown fruits as large as a fist with some of them almost or quite subterranean. Above the fruits on the naked trunk are clusters of male flowers. Hence the foliage bearing twigs are flowerless." (1)

Canangium is a genus of two or three species prized for fragrant extracts. Its most important species is C. odoratum Baill., the Ylang-Ylang of the Pacific Islands. The flowers are used by the natives for garlands and celebrated in songs. The flowers are also the source of the famous perfume called Ylang-Ylang which is obtained commercially by distillation with steam while the natives obtain it by putting the flowers in coconut oil and heating gently, sometimes adding olive oil, castor oil and flowers of Michelia Champaca. The oil thus obtained is called macassar oil (after a tribe of Malayas) and is used by the natives for anointing their heads and bodies. "The 'antimacassars' of the Victorian household protected the upholstery of chairs from this hair-dressing".

Artabotrys is a genus of about forty woody climbers with very fragrant flowers. A. odoratissimus R. Br. is the best known species and is called the climbing Ylang-Ylang. It comes from India, China and the Phillipines and is sometimes planted in Florida.

Rollinia is a genus of about fifty species from Mexico and south to Argentina and Peru. "In some species the fruits are prized for the table and rival the cherimoya, for which they have sometimes been mistaken. Several have been introduced into cultivation through the Miami (Florida) Station by the Office of Foreign Seed and Plant Introduction, U.S.D.A." (2) R. delicosa Safford is described by Baker as the finest annonaceous fruit of tropical America. It grows wild near Rio de Janeiro and is called Fruta de Condessa. The flesh is white, sugary-sweet and of good flavor.

**MYRISTICACEAE**

This is a small tropical family of woody, aromatic plants which are generally regarded as reduced Anonaceae. They have the same or similar spicy ethereal oils in the wood and leaves and the same seed structure. The perianth is reduced to a single whorl of three members while the Anonaceae usually have three whorls. The flowers are dioecious with staminate flowers possessing three to eighteen stamens united in a column and the pistillate flowers with

(1) Torrey, R.E. - Unpublished Notes on Systematic Botany of Higher Plants, pg. 57

(2) Bailey, L.H. - Encyclopedia, pg. 2974.
a single carpel and one ovule provided with an aril which arises zonally as a third seed coat and later splits into filaments. There are some eleven genera and about two hundred and fifty species (Warburg 1897) "spread through the tropics of both Worlds but most numerous in tropical Asia."

**Myristica fragrans** Houtt., the nutmeg, is a native of the Moluccas. It is now widely cultivated and is the most important member of the family. Sturtevant gives the following notes of interest: (1) "Nutmegs and mace are now brought into the market almost entirely from the Banda Islands, and the entire group occupying no more than 17.6 geographical miles. The earliest accounts of the nutmeg are in the writings of the Arabian physicians. They are known to have been at first imported overland into Europe and are mentioned under the name of *karma aromatiku* --"

The ovary of *Myristica fragrans* ripens into a parenchymatous berry which splits into two valves to form the yellow shell of the nutmeg. The seed itself is covered with a beautiful, slitted, red aril and it is this aril which yields the mace of commerce. At maturity the seed coat is removed and the endosperm comes into the market as the nutmeg. From this the ground spice is obtained. The oil of the nutmeg endosperm is poisonous in any but small amounts and in India excessive use has resulted sometimes in dangerous consequences. The Dutch once held a monopoly on nutmegs and imposed the death penalty if anyone took the plant from the country. In order to prevent the germination of the seeds they were soaked in lime water which left a white deposit when dry. This white deposit came to be recognized as a sign of good nutmegs and even today it is necessary to powder the "nuts" to please the public. (2)

The following material from Loudon is of interest: (3) "The nutmeg-tree yields three crops annually; the first in April, which is the best; the second in August, and the third in December; yet the fruit requires nine months to ripen it. When it is gathered the outer coriaceous covering is first stripped off, and then the mace carefully separated and dried in the sun. The nutmegs in the shell are next exposed to heat and smoke for three months, then broken, and the kernels thrown into a strong mixture of lime and water; after which they are cleaned and packed up. This process is necessary for their preservation, and with the same intention the mace is sprinkled with salt water. There are several varieties of the tree; but that denominated the queen nutmeg, which bears a small round nut, is the best. They are imported in chests, which contain each from 100-140 lbs. weight; the mace comes in chests also of different sizes. The essential oil which is obtained in Banda by the distillation of the nut is brought in

(1) Sturtevant's *Notes on Edible Plants*, pg. 379

(2) Torrey, R.E. - *Unpublished Notes on Systematic Botany of Higher Plants*, pg. 58-59

(3) Loudon's *Encyclopedia*, pg. 850,851.
bottles, and the expressed oil in stone jars. Nutmegs are frequently punctured and boiled in order to obtain the essential oil, and the orifices afterwards closed with powdered sassafras. The fraud is detected by the lightness of the nutmeg. The nutmeg has a fragrant, agreeable, spicy odor, and a warm aromatic taste."

"As the medical properties of nutmeg and mace depend on the essential oil they contain, they agree in these circumstances; and both are stimulant, carminative, and, in large doses, narcotic. Mace is more generally used as a culinary spice; but the nutmeg and its volatile oil are in frequent use to cover the disagreeable taste of other medicines, and are sometimes ordered in cases of languor, vomiting, and diarrhoea, and in flatulent colic. On account of the narcotic property of the oil, nutmeg should be cautiously employed in apoplectic and paralytic habits. In India its dangerous effects have been frequently felt; and in this country instances have occurred in which the nutmeg, taken in large quantity, produced drowsiness, great stupor, and insensibility, and on awakening delirium, which alternated with sleep for several hours."

**CALYCANTHACEAE**

This is a small family of shrubby plants containing the single genus Calycanthus. The family is related to the Magnoliaceae and the Annonaceae but differs in a large embryo with spirally wound cotyledons and possession of almost no endosperm. Also the leaves are opposite instead of alternate and the flowers perigynous. The twenty or so carrels sunken in the receptacle, ally the family to the Monimiaceae and the flower may be thought of as a perigynous magnolia. The distribution of the Calycanthaceae is notable. There are two or three species in China, three in the southern part of the United States, one in California and one in Queensland. *C. floridana* L., the Carolina allspice, is the best known species. It comes from the South but is quite commonly cultivated here in the North. It has fragrant, spicy leaves and flowers, as well as bark and wood. The flowers are a peculiar deep red or brownish purple, due to two pigments, anthophaein and anthocyanin. This combination of pigments occurs only in three other unrelated families: in Delphinium triste and *D. glutinum* of the Rhamnaceae; in Coccidum pseudacanha of the Orchidaceae and in *Vicia Faba* of the Leguminosae. The bark of the Carolina allspice is sometimes used as a substitute for cinnamon.

*C. fertilis* Walt. grows from Pennsylvania south along the Alleghenies, but is almost never seen in cultivation.

The two or three Chinese species are sometimes put into a separate genus *Meratia*. *M. praecox* Rehd. and Wils. (*Calycanthus praecox*) is sometimes cultivated but requires winter
Protection in the North. (1)

**MONIMIACEAE**

This is a tropical or sub-tropical family containing some thirty-two genera of trees or shrubs with evergreen, leathery leaves, and aromatic oil cells in the tissues. The family is most clearly related to the Magnoliaceae and effects the transition to the Lauraceae. The outstanding characters are the presence of staminodia, flower perigyny, appendaged stamen filaments, valvate dehiscence of the anthers, embryo without spirally arranged cotyledons and the presence of much endosperm.

Hedycarya, Laurelia and Peumus may be cultivated in warm climates. *Hedycarya arborea* is a tree from New Zealand and it is sometimes planted in California. (2) *Laurelia novae-zealandica* A. Cunn. is also from New Zealand and is a tall, aromatic tree frequently planted in California. (3) *Peumus Boldus* Molina, is an evergreen, twenty-foot tree native of Chile, sometimes grown in California. The wood of the latter has many economic uses since it is very hard and the charcoal is prized by smiths above all other. The bark is used in tanning and dyeing while the leaves are used in medicine and the fruits are edible. (4)

**LAURACEAE**

(The Laurel Family)

Trees or shrubs with aromatic leaves and bark, (except the tropical, herbaceous, parasitic vine, Cassytha). Leaves coriaceous and evergreen in tropical species, or thin and deciduous in temperate forms; mostly punctate; generally smooth, simple and entire; exstipulate; alternate or sometimes apparently opposite or whorled due to a shortening of the internodes. Flowers small, yellow or greenish; in many-flowered terminal or axillary panicles, racemes, corymbs or umbels; perfect, polygamous, bisexual, or sometimes unisexual.

(1) Bailey, L. H. - *Encyclopedia*, pg. 638
(2) Bailey, L. H. - *Hortus*, pg. 298
(3) Ibid pg. 381
(4) Bailey, L. H. - *Encyclopedia*, pg. 2565
by reduction; actinomorphic, with parts generally arranged in trimerous whorls, rarely dimerous; perigynous; apetalous. Haplochlamydeous perianth usually with six similar members in two whorls; more or less united at base; imbricate in two rows in bud. Androecium typically with three to four whorls of three stamens each; rarely all fertile; generally with innermost whorl reduced to staminodia, or absent. Anthers extrorse or introrse; pollen sacs two to four; dehiscence by uplifted valves. Gynoecium with superior, one-celled ovary free from calyx and containing single, pendulous, anatropous ovule; style single, filiform, or short; stigma often three cleft, suggesting a syncarpous, tricarpellary condition. Fruit a one-seeded berry, or more rarely a drupe, more or less enveloped by fleshy cup-shaped receptacle. Single seed with a large embryo containing two large straight cotyledons, a small plumule, and short, superior radicle; no endosperm.

The family Lauraceae derives its name from the genus Laurus, though this genus is not typical of the family since its floral parts are arranged in fours. Laurus is derived from the Celtic blaur, meaning green, and referring to the evergreen character of the leaves.

The variations in the androecium are of interest since they supply the botanist with useful generic characters. For example, the typical flower exhibits four whorls of stamens which are rarely all fertile. In Persea and Cinnamomum the innermost is reduced to a whorl of staminodes. Not only may the innermost whorl of stamens be reduced or absent, but further reduction in the outer whorls occurs in many genera so that only two whorls or even a single whorl remains functional. There may be two or four pollen sacs. The anther dehiscence may be introrse or extrorse, but usually the third whorl has extrorse dehiscence while the others are introrse. A constant
character for all members of the family is the opening of the anthers by valves from below upwards. This character we find occurring in two other families of the Ranales, namely the Monimiaceae and the Berberidaceae.

The three-cleft stigma which characterizes many species of the Lauraceae probably indicates the presence of three carpels in the pistil, according to Eichler, Payer and Baillon, on the other hand, deny that such a syncarpous tricarpellary condition is indicated by the stigma and regard the pistil as monocarpellary. Mirande seems to have proved that at least in the case of the Genus Cassytha we are dealing with a pistil which is ontogenetically composed of several, but usually three carpels, the posterior one of which is prolonged into a style and stigma while the two latero-anterior members abort. (1)

The aromatic wood and leaves, the carpel reduction, the opening of anthers by uplifted valves and the frequent occurrence of staminodia all seem to link the Lauraceae with the Monimiaceae and the Magnoliaceae.

There are about forty genera and one thousand species in the family Lauraceae and they are almost exclusively tropical in their distribution, though a few are known in sub-tropical and temperate climates. They are common forest trees in tropical Asia and America. It is interesting to note that "there seem to be two main centers of distribution; one is in tropical south-eastern Asia whence the family ranges northwards to southern China and Japan and southwards to Australia; a second is in Brazil from which it extends southwards to the Island of Chiloe and is represented northwards by a few genera in the United States." (2) Emerson remarks that Massachusetts is nearly the northern limit of the family and only Sassafras and Benzoin occur in this State. (3) Africa is poor in species and the only European representative at the present day is the sweet bay or true laurel, Laurus nobilis, found in the Mediterranean region, and probably originally a native of Western Asia. (2)

The first laurels appear in the Cretaceous. In the Tertiary times they ran far north in Europe but were then driven south by the ice. Fossil leaves, fruits and flowers of several genera have been found in Miocene strata in Europe, northern Asia, Greenland and elsewhere. Recently they seem to be returning north though they are still mostly tropical. (2)

(1) Rendle, A.B. - Classification of Flowering Plants, footnote pg. 135
(2) Ibid, pg. 136-137
(3) Emerson, G.B. - Trees and Shrubs of Massachusetts, pg. 358
Many species of this family are of economic or medicinal value on account of the volatile oil which they contain in the leaves, wood and bark.

*Cinnamomum* gives us three species of importance. *C. zeylanicum* Nees. is an Asiatic species which yields the cinnamon of commerce. It is largely cultivated in Ceylon where its cultivation began as early as 1770 under Falck, one of the Dutch Governors. (1) Our cinnamon bark and ground cinnamon is obtained from the inner bark of the tree which can be "barked" when the trees are about four years old. The trees are of no value after having reached the age of eighteen years. They grow best in nearly pure quartz sand where there is only a trace of vegetable matter. The ancients knew the plant in the wild state, especially the Israelites who used it as an incense in their altars. (2) Heroditus called the plant *kinnamomom*, a name which he states the Greeks learned from the Phoenicians. . . . "The bark was the lining taken from birds' nests built with clay against the face of precipitous mountains in those countries where Bacchus was nurtured." (3) Cinnamon is referred to by Hippocrates, Dioscorides, Pliny and others. In *Exodus* we find an interesting reference to this as well as to another species of the genus, *C. Cassia* for both cinnamon and cassia were ingredients in the "Holy anointing oil" which Moses is directed to make. (4)

*C. Cassia* (Nees) Blume produces cassia bark, a thicker, coarser, and poorer-flavored cinnamon bark. It thrives in moist, rich land and the plants make fine specimens near residences. It is not quite as hardy as the following species, *C. camphora*, but withstands temperature of twenty degrees Fahrenheit. It is planted in Florida for oil, gum, buds and bark. (5) *C. camphora* (L.) Nees and Eberm., also from Asia (China, Japan and planted in India) yields camphor which is used in medicine as a sedative, antispasmodic, and a constituent of liniments. Most natural camphor has been supplied by Japan, though the material is now being manufactured to some extent in America. It is a "common roadside planting in southern California, hardy in the lower Gulf States, now extensively planted for shade and extract of gum". (5) The oil of all three of the species of *Cinnamomum* mentioned are excellent antiseptics. (6)

*Dicypellium caryophyllatun* (Mart.) gives the clove bark of Brazil. (6)

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(1) Loudon's Encyclopedia, pg. 322
(2) Pammel, L. H. - Manual of Poisonous Plants, pg. 478
(3) Sturtevant's Notes on Edible Plants, pg. 168-168.
(4) Exodus 30:23-25
(5) Bailey, L. H. - Encyclopedia, pg. 773
Nectandra Rodioei Hook. yields the famous timber called "Greenheart wood of Demerara" which comes from Guiana. It is used in shipbuilding. Also of interest is the fact that it contains berberin. (1) The bark is sometimes used in medicine, and called bibiru or bebeeru bark. The "seeds yield a starch which Indians mix with rotten wood and make into a bitter, disagreeable kind of bread." (2)

One of the most interesting genera of the Lauraceae is Persea with fifty species native to tropical America (Mexico and Central America). P. gratissima Gaertn. is now widely cultivated in Florida and California for its pear-shaped drupe known as the avocado or alligator pear. These fruits are considered one of the best semi-tropical dessert and salad fruits, though the taste for them has to be acquired. (3) They are said to be worth a trip from Europe to the West Indies just to taste. (4) Loudon says: "This fruit seems equally agreeable to the horse, the cow, the dog and the cat, as well as to all sorts of birds; when plentiful, it makes a great part of the delicacies of the negroes". (5) Berry says: "I have had but slight experience with the alligator pears usually to be seen on sale in our better fruit stores, but I can testify to the extreme daintiness and appetizing taste that they have when personally collected and properly seasoned with sugar and lime juice." (6) The oil from this plant and allied species has been used in soap manufacture. (7) A single tree which stands in a dooryard in Rio Frío, near Santa Marta, Columbia, "yields annually more than 500 fruits, each weighing about a pound and a half. The principal crop ripens in April, May and June. Usually a second and smaller crop matures in December." There are many horticultural varieties and forms which are sometimes given species rank.

The geological history of Persea is of interest, there being about as many fossil species known as there are still existing ones. Of about fifty known species, six are from the Upper Cretaceous of Kansas, Martha's Vineyard, Long Island, Alabama and Moravia; nine from the Eocene of France, Germany, British Columbia and the United States (of these in the United States, one from California and two "northward from equatorial America during that period of mild climate that characterized the later Eocene and which contained so many

Smith's Dictionary of Economic Plants, pg. 200
(2) Sturtevant's Notes on Edible Plants, pg. 561
(3) Ibid, pg. 414
(4) Emerson, G. B. - Trees and Shrubs of Massachusetts, pg. 358
(5) Loudon's Encyclopedia, pg. 334
(6) Berry, E. W. - Tree Ancestors, pg. 253
(7) Pammel, L. H. Manual of Poisonous Plants, pg. 478
representatives of this family, including even the cinnamon and camphor trees which in existing floras are confined to the Old World"; six from the Oligocene of Italy and southern Germany; twenty-seven Miocene species from the four continents Asia, South America, Europe and North America; eleven Pliocene species from Spain, France, Italy, Asia Minor and Brazil; one from Pleistocene in North Carolina and Alabama. (1)

Cassysltha is chiefly of interest because it deviates so far from the habit of other members of the family. It is an herb resembling dodder in its habit and it has suckers with which it fastens itself to its host. The leaves are either scale-like or lacking, and the flowers are in spikes or heads and possess three petals much larger than the three sepals.

The sweet bay tree of the florists is Laurus nobilis L. It is the laurier of the French; the Lorbeerbaum of the Germans; the Alloro of the Greeks. It is probably the "green bay tree" of Psalms (37:35). "It was designated nobilis by Linnaeus because it was consecrated to priests, sacrifices and heroes in the ages of antiquity and it has since been celebrated accordingly." (2) It was the emblem of victory sacred to Apollo and hence victorious generals were crowned with a wreath of laurel as a mark of distinction and honor. Later this ceremony was transferred to poets, hence they were called "poet-laureates". Still later a crown of laurel indicated academic honors and poets and sculptors still use it as an emblem of victory or honor. The name of baccalaureate degree - that of bachelor of arts - comes from bacca laurea, the laurel berry. (3) The foliage lasts three or four years and the plant has been popular as an ornamental, both because of its evergreen character and because of the ease with which it adapts itself to forms such as pyramids, cones, globes and the like. It is called "the most universal of evergreen tub-plants", and Bailey gives the following: (4) "The sweet bay bush in the farmer's or cottage garden comes with its story from the central streams of Greece, where it seeks moisture in a thirsty land along with the wild olive and arbutus. And this sweet bay is the laurel of the poets - the laurel sacred to Apollo, and used in many ways in his worship, as we may see on coins, and in many other things that remain to us of the great peoples of the past". Although so universally used, there are few important horticultural varieties, though there are variegated-leaved, crisp-leaved and willow-leaved types. Because of the volatile oil in

(1) Berry, E. W. - Tree Ancestors - pg. 253-254
(2) Loudon's Encyclopedia - pg. 234
(3) Emerson, C. B. - Trees and Shrubs of Massachusetts - pg. 359
(4) Bailey, L. H. - Encyclopedia - pg. 1827-1829
the leaves they are often used in pickles and "for flavoring custards, puddings and a few are often packed in fig boxes to give the figs a flavor". (1) The fruit produces Olium Lauri used for rheumatism, for colic and gastric pains, and also said to keep flies and gnats from humans and animals". (2) The medicinal properties may depend in part on the traces of prussic acid found in the leaves, berries and oil. (3) The wood is valuable for fine cabinet work, as is true of other members of the Lauraceae. For example Emerson says: "The wood of many of the species found in southeastern Asia retains the pleasant, camphorated odor many years and is sought for as the material for the finishing and furniture of oriental dwellings; as in beauty, hardness and durability it sometimes vies with mahogany." (4)

Aside from Persea, the two best known members of the family in the United States are Sassafras of the East and Umbellularia californica (Hook. and Arn.) Nutt., a spicy, evergreen, ornamental shrub of the West. This latter yields a strong local anaesthetic said to be irritant and acrid. Its leaves, according to certain tribes of western Indians, will drive away flies. (5)

In Massachusetts we have but two representatives of the family - Sassafras officinale and Benzoin aestivale.

KEY TO GENERA OF LAURACEAE OF MASSACHUSETTS

Leaves all entire; flowers appearing before leaves; anthers two-celled, two-valved; drupe red with stalk unthickened - - - - - - - - - - - - - - - - - - - - - - BENZOIN

Leaves not all entire; some lobed; flowers appearing with leaves; anthers four-celled, four-valved; drupe blue, on club-shaped, fleshy, reddish pedicel - - - - - - SASSAFRAS

(1) Smith's Dictionary of Economic Plants - pg. 240
(2) Merck's Index - pg. 365
(3) Loudon's Encyclopedia - pg. 384
(4) Emerson, G. B. - Trees and Shrubs of Massachusetts - pg. 358
(5) Parmeau, L. H. - Manual of Poisonous Plants - pg. 478
Trees with spicy, aromatic bark and very mucilaginous twigs and foliage. Leaves deciduous; alternate; entire, or often three-lobed. Flowers greenish-yellow; dioecious; in clustered and peduncled corymb- or umbel-like, involucrate racemes; appearing with the leaves; involucre of persistent bud-scales. Perianth a six-parted, spreading calyx. Staminate flowers with nine stamens inserted on base of calyx in three rows, the three inner with a pair of stalked orange-colored glands at base of each. Anthers four-celled, four-valved. Pistillate flowers with six short rudiments of stamens and an ovoid ovary. Fruit an ovoid, blue drupe, supported on a club-shaped and rather fleshy, reddish pedicel, surrounded at base by thickened scarlet calyx.

There are two species - one *S. officinale* of eastern America, and the other *S. Tzumu* of central China.

**SASSAFRAS OFFICINALE** Nees and Eberm.

(Sassafras)

*Sassafras* - the popular name applied by early French settlers in Florida, probably an alteration of the Spanish word *Salasfras*, which signifies *Saxifraga*, the medicinal virtues of which are attributed by

*Sassafras* Nees and Eberm.

Spanish-Americans to this plant.

*Sassafras officinale* — officinal, referring to the use of the plant in the arts and medicine. The specific name of this plant has undergone many changes, and *Sassafras officinale* as the correct name was not decided when the last edition of Gray's Manual was prepared.

A tree sometimes one hundred and twenty-five feet high; trunk seven feet in diameter — maximum (Britton and Brown's measurements — Gray's Manual is more conservative, giving four to thirty meters.). Bark rough in irregular ridges; young shoots and twigs yellowish-green, mucilaginous; pubescent when young, becoming glabrous with age. Leaves ovate and entire, or mitten-shaped or three-lobed to about the middle; often as broad as long; pinnately veined; petioled (about 2.5 cm.); pubescent when young. Flowers about 6 mm. broad and stamens about equaling the calyx segments. Drupe 1 cm. (Plate 29)

Rich woods or sandy soil; flowering April-May; fruiting July-August; southern Maine to southern Ontario, Michigan, eastern Iowa and Kansas southward to the Gulf States; in Massachusetts, stations frequent below Bellows Falls southward in the immediate vicinity of the Connecticut River Valley. Emerson gives the following quotation from Michaux (2): "From Boston to the banks of the Mississippi, and from the shores of the ocean in Virginia to the remotest wilds of Upper Louisiana beyond the Missouri, comprising an extent in each direction of more than one thousand eight hundred miles, the sassafras is sufficiently multiplied to be ranked among the most common trees." Emerson goes on to add: "It is found in almost every part of Massachusetts, and seems to flourish in almost every kind of soil." Specimens in the herbaria of the New England Botanical Club, Gray Herbarium, Amherst College and Massachusetts State College reveal that it has been collected in every county in the State. I have found it most abundant in the Connecticut Valley, as mentioned by Mr. Blake, and again along the coast, particularly around Gloucester and Magnolia, and on the Cape, though seldom in larger than "bush form".

(2) Rhod. 4:132
(3) Emerson, G. B. — Trees and Shrubs of Massachusetts — pg. 364
The fossil history of sassafras is quite remarkable in several respects, as has been pointed out by Berry (1). In the first place "the most ancient known forms are quite like some of those still existing as regards their leaves, showing both the two-lobed mitten-like and three-lobed leaves with which we are familiar, but apparently without entire leaves . . . It seems incredible that in those far off days of the age of dinosaurs trees so like their modern descendants should already have been in existence." In the second place, sassafras fossils "are found in somewhat older rocks than most flowering plants" . . . One species from Portugal and three species from Maryland and Virginia have been found in deposits of the Albian stage at the close of the Lower Cretaceous. "That these fossils occur on both shores of the Atlantic indicates a still more ancient ancestry, and an origin in a third region accessible to both Portugal and Maryland."

In the Sassafras and Liquidambar relics of the southern Appalachian region, Guppy saw reason to congratulate the American students for their fortune in being able to study in one spot the ancient plant types still living as well as fossilized. The following is his picture of the student who thus stands where the past and present meet (2):

"In the woods around him were growing the Liquidambar, the Sassafras, and other shrubs and trees that had flourished in the Mesozoic ages in the spot where he was standing. Their remains crowded the Cretaceous deposits exhibited in the cliffs nearby. Specimens of the past and present were in his hands. Though the difference in kind was very slight -- the difference in time, measured in human lives, amounted to eternity. It is a story of perpetuity rather than of change . . . He begins with the cosmopolitan of such types in the Cretaceous age and he ends with their more restricted distribution and somewhat greater specialization now . . . Those old genera become the genera of today, though the genera of a thousand ages, are

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(1) Berry, E. W. - Tree Ancestors - pg. 248-251
(2) Guppy's Fossil Botany in the Western World: an Appreciation - Amer. Jour. Sci. Sect. 4; 49; 372
but as yesterday! in the history of flowering plants." (1)

Berry says: "Leaves like those of the sassafras are often exceedingly abundant and varied in certain rocks of the Upper Cretaceous age. Over a dozen species have been described - from Dakota sandstone, and "three kinds were present at that time in western Greenland and along our western coast from New York to Alabama" and in Europe from Bohemia to Moravia.

From the Eocene of France, Germany, Greenland, and British Columbia four or five forms are known; from the Oligocene of Europe, two; from the Miocene of Spain, France, Italy, Bohemia etc., six or seven. One of these latter species survived in the Pliocene and is figured by Berry to show its close resemblance to the modern sassafras. The presence of a leaf of this species in the deposits of the third interglacial stage of the Pleistocene indicates that Sassafras survived three glacial periods in Europe and "only succumbed finally during the fourth or final glaciation that came to a close only a few years ago, and after the men of the Old Stone Age had already been a long time in western Europe."

(1) To some people the fossil history of our flowering plants may seem "dead and dry" and of little import but Guppy's testimonial along with the following quotation from Berry's Tree Ancestors should dispel any such notion.

"St. Bernard said: "Trees and rocks will teach what thou canst not hear from a master', and Tennyson has expressed the same thought, of the mystery and romance of biology wedded to geology, more sonorously in the following lines:

There rolls the deep where grew the tree,
O earth what changes hast thou seen!
There where the long street roars, hath been
The stillness of the central sea.

The hills are shadows, and they flow
From form to form and nothing stands;
They melt like mists, the solid lands,
Like clouds they shape themselves and go.

"These two verses compress into cinema-like rapidity what went on at a slow rate over a period of millions of years, and it is these glimpses into the long ago that stimulate the student of geology like new wine, and make him wonder why all the world does not forsake the trivial affairs of life and spend their time in making bricks for the temple of science and the master builder.

"The sketches which follow are an attempt to interest the general public in the marvellous history of some of our trees." - - - (Underscoring ours!)"
In New England forty to fifty foot trees with a
diameter of two feet used to be common a few years ago but most
of them have been destroyed. Emerson mentions a tree growing
in West Cambridge in 1842 which was three feet through at the
base and sixty feet high (1). It was cut down "to allow a
stone wall to run in a right line. Such pieces of barbarism are
still but too common. A tree so beautiful and lofty, and of
such rare dimensions, such an ornament to a bare hillside, sac-
rificed to the straightness of a wall!" In Canada it is even a
smaller tree than with us, seldom getting beyond the shrub
state. Mention is made by Smith of a tree at Kew which is over
one hundred years old and forty feet high (3). Berry speaks of
a tree at his place in east Connecticut which is ninety feet
high and one foot in diameter (3). Emerson says: "In the vicinity
of Boston, in soil resting upon crumbled granite, it at-
tains larger dimensions of diameter and height than I have else-
where observed it. It is nowhere found very abundantly; but is
usually allowed to remain, out of regard for its medicinal prop-
erties, and the beauty of its foliage and fruit, about fences,
and on the borders of fields, where it is most frequently seen.
The tree has the credit of having aided in the discovery of Amer-
ica, as it is said to have been its strong fragrance, smelt by
Columbus, which encouraged him to persevere, and enabled him to
convince his mutinous crew that land was near." (1) A particular-
ly large tree on the hillside back of the old Durfee Plant House
on this campus was growing well until killed by the severe winter
of 1933-1934.

"Sassafras is a desirable tree for ornamental planting
on account of its handsome light green foliage which is interest-
ing with its varying shapes and its orange-yellow or bright red
color in autumn, and on account of its decorative bright colored
fruit." (4) Berry says that this tree "always calls up memories
of the tropics, . . . its whole appearance seems exotic, and
suggestive of the Spanish Main rather than staid old New Eng-
land." (5) "The tree prefers, at least in the North, a warm and sunny
position. Propagation is by seeds sown as soon as ripe; also by
suckers, which are often freely produced, and by root cuttings." (4)

In Colonial days sassafras attracted much attention
and all sorts of virtues were attributed to it. Its roots were
the part generally utilized, an infusion of their bark being

(1) Emerson, G. B. - Trees and Shrubs of Massachusetts - pg. 364
(2) Smith's Dictionary of Economic Plants - pg. 363
(3) Berry, E. W. - Tree Ancestors - pg. 248
(4) Bailey, L. H. - Encyclopedia - pg. 5088
(5) Berry, E. W. - Tree Ancestors - pg. 247
very aromatic and stimulating (1). The qualities and virtues depend on an essential oil which is stimulating diaphoretic and diuretic and has been employed in cases of scurvy, chronic rheumatism, gout and cutaneous affections as well as in perfumery, and soap making (2). "In lieu of gold or precious stones Captain John Smith sent the first ship back to Old England loaded with sassafras." (3) and the much valued roots of the plant "formed part of the first cargo ever exported from Massachusetts (4). At that time it 'commanded an extravagant price, and treatises were written to celebrate its virtues'.

During the Civil War sassafras tea became a common substitute for the Chinese article, and as late as 1875 it was still being sold on the streets of London. It is a good tonic and creates an appetite. Saunders says: "as a spring drink for purifying the system it still has hold on the popular affection." (1) In Pennsylvania the flowers were frequently gathered for making this tea (5) though in other parts of the country the roots or leaves were the parts usually employed. Sassafras tea mixed with milk and sugar forms the beverage known as saloon "still (1875) sold to working classes in early mornings at corners of London streets" (6).

In Virginia a sort of beer was made from the young shoots by boiling them in water and then adding molasses and allowing the whole to ferment (7).

Particularly in the southwest, the dried leaves are used in soups because the abundant mucilage contained in them lends a ropy consistency and peculiar flavor much relished by those accustomed to it. For this purpose the mature green leaves are dried and powdered, the stringy portions being separated from the rest. These soups are known variously as gombo file, gombo zab or gombo sassafras (8).

The drupes of S. officinale contain a strongly-scented oil which is sometimes distilled from them and used in medicine.

(1) Saunders, C. F. - Useful Plants of the United States and Canada - pg. 144
(2) Loudon's Encyclopedia - pg. 384
(3) Berry, E. W. - Tree Ancestors - pg. 247
(4) Emerson, G. B. - Trees and Shrubs of Massachusetts - pg. 362
(5) Sturtevant's Notes on Economic Plants - pg. 523
(6) Ibid; also Smith's Dictionary of Economic Plants - pg. 369
(7) Sturtevant; also Emerson.
(8) Ibid.
Because of this oil the fruit is "not palatable to man but it is greedily eaten by birds." (1)

The bark of the tree yields a decoction which dyes wool a deep orange color (2).

The wood is soft, brittle and weak, but durable like that of most members of this large family. It is sometimes used for posts and rails where the tree is abundant, and some of its tropical relatives yield a very hard wood which is almost indestructible (3). "Its odor is supposed to be disagreeable to insects and worms, to whose attacks it is said not to be liable; for which reason it is sometimes used as the material for bedsteads, and for trunks and drawers for clothes. It is also used for rafters and joists. As fuel, it is little esteemed, as it snaps in the fire, like the wood of the chestnut." (2)

**SASSAFRAS OFFICINALE** Nees and Eberm., var. ALBIDUM (Nutt.)
(Nuttall's White Sassafras) (4)

This variety differs from *S. officinale* in having glabrous leaves and the bark and new shoots glabrous or even glaucous. It is a tree of more upland regions from western New England to the Carolina mountains, while the pubescent species is more widely distributed over the country and in New England is the only form found in the sandy coastal region of Cape Cod.

**BENZOIN** Fabric. Enum. Pl. Hort. Helmst. 1763
(Wild Allspice, Fever Bush, Spice Bush, Benjamin Bush)

Aromatic shrubs or trees. Leaves deciduous with us (persistent in some Asian species), alternate, entire, pinnately veined; leaf buds scaly. Flowers dioecious or polygamous; small; in lateral, sessile, involucrate, umbel-like clusters of from four to five flowers, appearing before the leaves; involucre of four deciduous scales, apetalous. Calyx six-parted, open, deciduous. Staminate flowers with nine stamens in three rows; filaments of inner series one to two lobed and gland-bearing at the base;

(1) Smith's *Dictionary of Economic Plants* - pg. 369
(2) Emerson, G. B. - *Trees and Shrubs of Massachusetts* - pg. 362
(3) Berry, E. W. - *Tree Ancestors* - pg. 248
(4) Fernald, M. L. - *Nuttall's White Sassafras*; Rhod. 15:14
those of the two outer series glandless; anthers all introrse, two-celled, two-valved. Pistillate flowers with twelve to eighteen staminodia in two forms; ovary globose. Fruit an ovoid or oblong drupe with unthickened stalk.

There are about sixty species of Benzoin if one includes the two sub-genera, Daponidium and Aperula, as does Engler and Prantl. However, most botanists include in the genus only seven species. The plants are natives of Temperate and Tropical eastern and central Asia, and eastern North America.

Some Asiatic species yield a fragrant oil used in perfumery, and other species are cultivated as shrubs, though few are hardy north of Massachusetts. Bailey lists the following species of horticultural merit (1): B. gracilis Kuntz, called the stone plant; B. hypoglaucum Reid, a Japanese species; B. melissifolium Nees, a southern species closely allied to our more northern B. aestivale, and a species which grows in much the same habitat as our representative; B. obtusilobum Kuntz, a large shrub with very handsome foliage; B. praecox Sieb. and Zucc.; B. sericeum Sieb. and Zucc.; (the last three species all from Japan).

BENZOIN AESTIVALE (L.) Nees

(Spice Bush, Spice Wood, Benjamin Bush, Pepper Plant (g), Wild Allspice)

Laurus aestivalis L., Sp. Pl. 370. 1753
Laurus Benzoin L., Sp. Pl. 370. 1753
Benzoin aestivale Nees, Syst. Laur. 495. 1836

Benzoin - from the Arabic or Semetic benzoin, an oriental gum or perfume.

aestivale - of, or belonging to summer.

Nearly glabrous shrub, six to fifteen feet; bark smooth;

(1) Bailey, L. H. - Encyclopedia - pg. 487
(2) The French Canadians called it "poivrier", which means "pepper plant", because of the spicy taste. - (Saunders, L. F. - Useful Plants of the United States and Canada - pg. 145)
twigs slender. Leaves oblong-obovate; 7.5-12.5 cm. long; bright green above, pale beneath; finely ciliate; rounded at apex and narrowed at base; petiole about 1 cm. Flowers small, 3 mm. broad; bright yellow; fragrant; pedicels about equalling the calyx segments; anthers oval, minutely emarginate at the summit; ovary about as long as the style. Drupe red, about 1-1.3 cm. long and .6 cm. in diameter; spicy. (Plate 30)

Moist woods and along streams; flowering March-May; fruiting August-September; Maine to Ontario, Michigan, South Carolina, Tennessee and Kansas.

The spice bush, like sassafras, "illustrates a past general distribution and a post-Pleistocene restriction to southeastern parts of Asia and North America", and the eight different fossil species described resemble the existing Asiatic species rather than the American ones. The oldest are two varieties found in the Upper Cretaceous of Kansas and Texas, followed by an Eocene form from western Greenland, and three Oligocene species from France, Spain, Switzerland, Italy, Baden, Russia, Silesia and Croatia. Three of these lived on into the Pliocene in Europe but were finally wiped out from the area between Spain and China by the Pleistocene glaciation, so that now they occur only in eastern Asia and southeastern North America (1).

Today this shrub grows in moist woods and thickets and along streams from Maine and New Hampshire to Ontario, Michigan, eastern Kansas and south to North Carolina and Tennessee, often ascending as high as twenty-five hundred feet in the mountains. It is very attractive in spring with its small but numerous yellow flowers, and is even more attractive in autumn. Speaking of the flowers which come in advance of the leaves Nash says (2): "- - - in their multitude they give a glimmer of gold to the landscape and assume a prominence which would not be theirs did they come later when the foliage and flowers of more decorative main would dwarf them by comparison. It is one of the harbingers of spring and tells us of the near demise of winter". He goes on to speak of the place of this plant in landscape gardening thus: "The natural habitat, a wet situation, well indicates the chief

(1) Berry, E. W. - Tree Ancestors - pg. 252
(2) Nash, George V. - Addisonia 5:15
 usefulness of this plant in cultivation. It is very effective in low woodlands and along streams and is of special adaptation to the water garden. A piece of low swamp ground may be much beautified by this shrub and its natural associates, the skunk cabbage and marsh marigold. These three give beauty and brightness to a landscape otherwise bleak and bare."

Benzoin aestivale is usually propagated by seeds which must be sown soon after maturity since they soon lose their vitality. It may also be propagated by layers, which root best in peaty soil; or by wood cuttings under glass (though according to Bailey only about one-half of these can be expected to root).

The bark of Benzoin is aromatic, stimulant, tonic and astringent, as is also the fruit. Both are used medicinally. An aromatic stimulant oil is often distilled from the fruit and the dried and powdered berries have been used as a substitute for allspice. A decoction made from the twigs gives a pleasant substitute for tea which used to be particularly in vogue in the South. During the Civil War soldiers from the upper country in South Carolina came into camp fully supplied with spice wood for making this fragrant aromatic beverage (1). Andre Michaux, a French botanist "who traveled afoot and horse-back through much of the eastern United States when it was still a wilderness, half starving by day and sleeping on deer skin at night", says of it (Journal - Feb. 9, 1796): "I had supped the previous evening on tea made from the shrub called spicewood. A handful of young twigs or branches is set to boil and after it has boiled at least a quarter of an hour, sugar is added to it and drunk like tea - I was told milk makes it much more agreeable to the taste. This beverage restores strength and it had that effect, for I was tired when I arrived."

Pammel, on the authority of Smith and Lyon, includes it in his list of "Poisonous Plants of the World" belonging to the Lauraceae and says that it has the property of an anthelmin tic (2).

There is a yellow-fruited form of Benzoin aestivale called xanthocarpum (3). This differs from the common species in having orange-yellow drupes instead of red ones. It has been collected in Shrewsbury, Massachusetts, where it grew among plants of the common type, and also by itself.

(1) Saunders, C. F. - *Useful Plants of the United States and Canada* - pg. 145
(3) Torrey, G. S. - *Two Yellow Fruited Shrubs* - Rhod. 16:91
Family **RANUNCULACEAE**

(The Crowfoot or Buttercup Family)

Annual or perennial herbs, rarely woody plants, persisting by means of a rhizome or tuberous roots and characterized by a colorless and usually acrid, more or less narcotic, or poisonous juice. Leaves usually alternate and more or less divided. Stalks dilated at the base, sometimes with stipule-like appendages. Flowers solitary or cymose; bisexual; spiral or spirocyclic, rarely cyclic; actinomorphic, or more rarely medianly zygomorphic; hypogynous. Perianth simple and petaloid, or differentiated into a distinct calyx and corolla. Sepals three to fifteen; petals two to fifteen, or wanting. Nectar-secreting structures of various forms present. Stamens numerous, rarely few, and free. Carpels many to few or solitary, rarely united, with numerous to few anatropous ovules possessing one or two integuments. Fruit a cluster of follicles or achenes, rarely a berry. Seeds with copious oily endosperm and minute embryo. Cotyledons generally epigeal, in the form of stalked or sessile; small, ovate, green leaves; cotyledonary petioles sometimes united either partially or completely, forming a tube through which the epicotyl breaks laterally as it does in the monocotyledons. Pollination usually by insects.

The family takes its name from the chief genus, *Ranunculus*, derived from *rana*, a frog, because most members are found in marshy places frequented by that amphibian.

As we have seen already, when considering the whole order Ranales, the family Ranunculaceae in itself exhibits numerous "evolutionary lines". For example, actinomorphy is predominant, but zygomorphy appears with the higher types; yellow
is the prevailing color but this gives way to white, reds, and even to blue, the highest floral color (1); bracts are becoming petal-like sepals; and stamens are transforming into petals; every step in the evolution of long-spurred nectarial petals from ordinary ones appears; a state with several, many-seeded follicles yields to a condition with many, single-seeded achenes, and it is notable that all these lines are complete within one single family.

The crowfoot family is the herbaceous family of the order, for, with the exception of climbing species of Clematis and of Xanthorrhiza, there are no woody stems. It is a family of particular significance in the phylogenetic systems of Hallier, Hutchinson and others, for it is from the woody Magnoliales and herbaceous Ranales as parallel basic stock that they derive all the dicotyledons; and from the herbaceous Ranales, the Ranunculaceae in particular, they derive the Heloblae and "the whole division of

(1) Allen, Grant - The Colors of Flowers. Allen accepts or sets forth the following points regarding flower color and its significance in the phylogeny of plants:

1. Petals were derived from leaf modification or sterilization of stamens, hence the primitive color is yellow.
2. Yellow is followed by white, then reds and blues.
3. A single flower may go through this whole series in its ontogeny.
4. New colors appear on the outside and tips of petals first.
5. Variegation is a characteristic of highly evolved flowers or parts of flowers.
6. Primitive flowers revert to green, white flowers to yellow, pink and red to white, blue and purple to reds or pinks; advanced colors seldom revert to yellow.
7. Retrogression does occur but color is not primitive - a secondary color.
8. Certain insects are attracted by certain colors and there is definite correlation between primitive insects and primitive flowers they pollinate; and between highly evolved insect and flower types. (Church, A. H. - in Types of Floral Mechanism stresses this also.)

The Ranunculaceae well illustrate these points. Caltha and Ranunculus are most primitive in color, with R. Picaria, R. aquatilis and R. hederaceous fading to white with yellow centers (sometimes reddish outside and white color appearing at tips first). Clematis and Anemone are higher types, with white the normal color and no true yellows. Aquilegia and Delphinium, and other high types are blue, often reverting to reds, and sometimes white.
monocotyledons" (1).

Of morphological significance are certain anomalous members of the family Ranunculaceae in which the cotyledonary stalks (Anemone, Delphinium) or even the blades (Eranthis and Ranunculus Ficaria) unite, forming a tube through which the epicotyl breaks laterally as in the monocotyledons. The course of the vascular bundles in Actaea, Cimicifuga and Thalictrum is, also, suggestive of the monocotyledons.

Mottier and some others link this anomalous character of the embryos with the wholly or partly geophilous habit of the plants (2). That is, the plants in this condition have stems either in the form of a rhizome, tuber, or a short, squat axis, and hence "hypogaean habit". Likewise it is pointed out that this is not a primitive character but a "derived condition".

The leaves of various members are of interest. They may be entire and narrow as in Asarum and some species of Ranunculus, or cordate-reniform in R. Ficaria and Caltha. Generally they are palmately lobed, divided or compound, though rarely pinnately compound as in Xanthorrhiza and some species of Clematis. There are special forms of leaves included in the family as the much-dissected submerged ones of aquatic species of Ranunculus, and climbing ones of Clematis; the latter with petiole, rachis, and sometimes even the blade sensitive to contact. In C. aphylla the leaves have taken over the climbing function so completely that they have become tendrils and photosynthesis is carried on by the cortex of the stem.

Ecologically the family (and the order Ranales as a whole) has received attention. For instance, Blankinship gives the following members of the order as characteristic and typical of certain plant formations in eastern Massachusetts (2): Ranunculus fascicularis and Aquilegia canadensis - hilltop-barren; Sassafras officinale, Anemone virginiana, A. quinquefolia - hilly upland-forest; Ranunculus Cymbalaria - sand-pond margin; R. sen- tentrionalis - low-woodland; R. abrotsicus, Actaea alba - low-woodland; Caltha palustris - swamp; Nuphar (Nymphaezanthus) microphyllum, Brasenia peltata - sand-pond; Nuphar advena (Nymphaezanthus variegatus, probably), Nymphaea odorata, R. aquatilis var. capillaceus, R. multifidus (not native, probably) - mud-pond; and Ranun-

culus bulbosus and R. acris - waste-land.

Early in botanical history (1789), Jussieu gave a place
to the Ranunculaceae in his development of a natural system of
classification. He saw that the free, hypogynous, perianth
leaves, numerous stamens, free carpels, superior ovary and seeds
with abundant endosperm and minute embryo, are features which
place in a single family many members with wide differences in
form and structure of floral envelopes.

The Ranunculaceae are usually divided into three tribes:
the Helleboraeae, the Anemoneae and the Paeonieae. The Helleboraeae
bear their ovules in two rows along the ventral suture of the car-
pels and the fruit is a follicle or rarely a berry. Honey leaves
derived from the outermost stamens are present. The perianth
members appear to have quite recently evolved from leaves. The
two groups Isopyroideae and Trollioideae may be distinguished,
the former including Helleborus, Isopyrum, Aquilegia, etc., with
spiral to cyclic, actinomorphic flowers, and the latter including
Aconitum and Delphinium with markedly zygomorphic flowers.

The Anemoneae in contradistinction to the Helleboraeae,
have solitary ovules arising at the base of the ventral suture of
the carpels and the fruit is an achene. The flowers are actino-
morphic and suggest a more primitive structural type than do the
Helleboraeae. Several groups have been distinguished, as, the
Anemone-Thalictrum group, the Clematis group (sometimes put in a
separate tribe on account of the valvate aestivation, opposite
leaves and climbing habit), and the Myosurus-Adonis-Ranunculus
group.

The third tribe, the Paeonieae, are distinguished by
the greater development of their outer ovule integument (the
character considered to link Paeonia with the Berberidaceae with
which it is classified by Hallier), and the fruit is a follicle
with fleshy walls.

Many members of the crowfoot family are cultivated for
ornamental purposes. Loudon says (1): "The greater part of the
plants of this order are objects of interest with gardeners, con-
taining as it does, many of the most elegant and showy of the
tribes of hardy plants. It is here that the graceful Clematis,
the lowly Anemone, the glittering Ranunculus and the gaudy Peony
are found -- --."

(1) Loudon's *Encyclopedia* pg. 1054
Davis gives the following figures of interest (1):

Species native of the U. S. and Canada - - - - - - - - - 222
Species in Mexico only - - - - - - - - - - - - - - - - - - - 31
Old World species in our gardens - - - - - - - - - - - - - - - 118
American species in gardens - - - - - - - - - - - - - - - - - 75
Total in North America - - - - - - - - - - - - - - - - - - - - 335
Wild and cultivated varieties in North America - - - 353
Species not found in America - - - - - - - - - - - - - - - - - 530

It is remarkable that most members of the family contain one or more poisonous or narcotic principles - alkaloids or glu-
cosides - and because of their acid and venomous properties they are sometimes considered "nearly as powerful as their beauty is great". They are all caustic or acid and in many of them the deleterious principle occurs in dangerous abundance. N. de Candolle remarks that its nature is extremely singular, it is so volatile, that, in most cases, simply drying in the air or infusion in the water is sufficient to destroy it; it is neither acid nor alkaline but its activity is increased by acids, honey, sugar, wine or alcohol; and it is in reality, destructible only by water (2).

In a recent book on the Properties and Uses of Drugs we find the following: "The drugs of the Ranunculaceae are almost without exception cardiac sedatives and circulatory depressants. They are Aconite, Cimicifuga, Pulsatilla, Delphinium, Staphisagria, Helleborus, Hepatica, Actaea and Clematis, several of them being no longer in general medicine." (3)

This is the largest family of the order with thirty genera and about twelve hundred species of plants widely distributed in the temperate and colder parts of both the Old World and the New (4). They are often found in the Arctic region and at high altitudes in the mountains, but are not so common in the tropics or even in the southern hemisphere. The Hellebores are almost exclusively north temperate or subarctic, while the Anemones are much more widely distributed and found in the tropics and beyond to the South temperate region. Some species of the latter have a very wide range while certain others are much restricted. The Peonies are confined to temperate regions of Europe and Asia with one species in California. It is interesting to note, in

(1) Davis, K. C. - A Taxonomic Study of the North American Ranun-
culaceae - pg. 7
(2) Loudon's Encyclopedia - pg. 1054
(3) Rusby, H. H., Bliss, R. ehard, A., and Ballard, C. W. - Properties and Uses of Drugs - 1930; pg. 345
(4) Rendle, A. E. - Classification of Flowering Plants - Vol II, 1888; pg. 168
connection with their distribution, that in some cases almost identical species are found in the eastern and western hemispheres, as, for example, our *Anemone quinquefolia*, and the European *A. nemorosa* (1); or our *Coptis greenlandica* and the Asiatic *C. trifolia* (3).

In Massachusetts we have thirty-eight species of the family representing eleven genera and each of these will be treated in detail later. Here, however, some mention should be made of the other members familiar to us and of importance either because of their poisonous nature or because of their ornamental value. The following genera are all within the range covered by Gray's Manual, with the exception of *Paeonia*.

**ACONITUM** (Tourn.) L. *Sp. Pl.* 532. 1753

(*Aconite, Monkshood, Wolfsbane*)

*Aconitum* is a genus of from eighteen to eighty species of plants (varying with different botanists), native of the mountainous north temperate regions of Europe, Asia and North America. In the Himalayas it is found from ten thousand feet up to the limit of vegetation. The genus is so-called because it was plentiful around Aconae, in Italy, or possibly the name is derived from the Greek akonais, referring to the habitat of the plant on steep, rocky places (3). It is a genus of very tall "hardy perennial herbs much used in borders and masses for their showy flowers and effective foliage... The plants form a pleasing contrast to the yellow *Helianthus* and *Rudbeckia*, the white of *Philox paniculata*, to *Chrysanthemum maximum* and *Anemone japonica* (4). Many species are planted in European gardens but only a few have been introduced and cultivated in this country. They will survive northern winters if covered with leaves, and after once being established they should be left undisturbed as long as possible for best results. The plants do best in rich soil and grow in open sun or in shade. Propagation is by division of the roots in late fall or early spring, or by seeds, the seedlings being transplanted when about two inches high (4).

The following species are particularly well-adapted to cultivation: *A. Fischeri* Reichb., a pale blue, autumn-blooming

3. Lindsay, T. S. - *Plant Names* - pg. 44
species native of North America and Asia and A. Lycoctonum L., a yellow or whitish, early summer-blooming species of Europe and Siberia, both of which are used as arrow poisons, though the latter is not as poisonous as most aconites and Sturtevant reports that its roots are collected and baked for food in Lapland (1); A. Cammarum L., a purple or blue species in blossom from July to September, and a native of Hungary; A. uncinitum L., with blue flowers, from June to September, a species which tends to become a climber and so is a particularly desirable type and one occurring in eastern North America as well as Japan; A. variegatum L. with many blue to white varieties and a native of Europe; A. japonicum Decne, the Japanese aconite, with deep blue or violet flowers from July to September; A. autumnale Reichb., a late fall, blue or lilac-flowered species, of northern China; A. Anthera L., an especially large, yellow-flowered species, blooming in mid-summer and a native of southern Europe; A. Napolius L., a blue species with many varieties, found in England and Continental Europe.

A Napolius is the chief source of the official aconite, a narcotic poison used (externally for the most part) in medicine as a sedative and diuretic, in cases of acute and chronic rheumatism, gout, neuralgia, pleurisy, pneumonia, erysipelas, etc., though the results are temporary and varying (2). Also the plant is sometimes grown in Europe for the leaves, which are used for destroying insects. Aconite acts on the heart and blood and reduces temperature, hence was widely used to allay fevers. The minimum fatal dose is one-tenth of a grain for man. There is no specific antidote, though atropin, digitalis and nitrite of amyl have been used. This and closely related species are among the most poisonous of plants known, all parts of the plant sharing in the possession of the active principle, though the root "possesses all the virulent properties of the plant in a tenfold degree" (3). The poison is most active in winter or early spring. Loudon reports that some persons "only by taking in the effluvia of the herb in full flower by the nostrils, have been seized with swooning fits and lost their sight for two or three days" (4). Elyth, who has collected records of aconite poisoning in Europe, says that it has been responsible for two cases of murder, seven suicides, and seventy-seven more or less accidental deaths; of these deaths, six were from the action of the alkaloid, ten from eating of the root, two from children eating the flower, one from eating of leaves, seven from the tincture mistaken for brandy, sherry or liquor, and, in the remainder of cases the tincture,

(1) Sturtevant's Notes on Edible Plants - pg. 23
(2) Bentley and Trimen - Med. Plants - Vol. I, No. 6
(3) Smith, John - Dictionary of Popular Names of Economic Plants - pg. 4
(4) Loudon's Encyclopedia - pg. 474
liniment or extract was taken (1). It is interesting to note that there are some cases of the plant being used without harmful results. Linnaeus speaks of the plant as fatal to kine and goats but causing no injury to horses who eat the dried plant (2). Sturtevant mentions on the authority of Fluckiger and Hanbury that the tubers are eaten as a tonic in Kuna (3).

The active principles in the aconites are alkaloids which are diacyl esters of a series of polyhydric bases containing four methoxyl groups, the aconines. Aconitin, \(C_{26}H_{34}NO_{12} \) is the type and the most frequent alkaloid, while others are acocin, \(C_{26}H_{34}NO_{10} \), pseudo-acocin, \(C_{26}H_{34}NO_{12} \), etc. (4). A. Napeius also contains anemonin \(C_{10}H_{16}O_{4} \) found in other members of the Ranunculaceae (5).

A. ferox Wall. and A. heterophyllum Wall. should be mentioned. The former is a native of Nepal and the Himalayas and is even more poisonous than A. Napeius. It is the Bish or Bikh of the natives, used to poison arrows and as a stock poison. It is considered the most formidable poison in India and a tiger, if even scratched by an arrow dipped in the poison, will die within a few minutes (6). The latter, A. heterophyllum, is also a native of the Himalayas and Kashmir and is sold in the bazaars of India as Atis or Atees and is used as a tonic and an antiperiodic (7).

Besides A. uncinatum L., already mentioned, Gray's Manual gives two other species of the genus as natives of eastern North America, namely A. noveboracense Gray, of New York, Ohio and Iowa, and A. reclinatum Gray, of Virginia and southern Alleghenies.

A. columbiaeum is the western Aconite of Montana, California, etc. It grows near springs and streams and is responsible for many cases of cattle poisoning.

(1) Pammel, L. H. - Manual of Poisonous Plants - pg. 450
(2) Loudon's Encyclopedia - pg. 474
(3) Sturtevant's Notes on Edible Plants - pg. 23
(5) Pammel, L. H. - Manual of Poisonous Plants - pg. 446
(6) Sargent, F. L. - Plants and Their Uses - pg. 189-190; see also Smith, J. - Dictionary of Popular Names of Economic Plants - pg. 4
ADONIS (Dill.) L. Sp. Pl. 547. 1753

Adonis is supposedly the plant which sprang from the blood of the Greek youth of the same name, or the youth himself changed into a flower. According to Greek mythology, Adonis was a beautiful youth and bold hunter loved by Venus. One day he was attacked by a wild boar.

"The white tusk of a boar has transpierced his white thigh

"The youth lieth dead while his dogs howl around,
And the nymphs weep aloud from the mists of the hill."

(Bion - Mrs. Browning’s translation)

Venus could not be consoled after his tragic death and even after he was led into the Infernal Region she shed countless tears -

"As many drops from Adonis bled,
So many tears the sorrowing Venus shed;
For every drop on earth a flower there grows:
Anemones for tears; for blood the rose."

(Bion - Alton’s translation)

Loudon, in his derivation of the genus name, would identify the plant Adonis with the roses which sprang from Adonis’ blood (1).

Shakespeare’s picture of the flower and plant is somewhat different and is of particular interest because of the curse bestowed on it by Venus:

" 'It shall be fickle, false and full of fraud,
Bud and be blasted in a breathing-while;
The bottom poison, and the top o’er straw’d
With sweets that shall the truest sight beguile:
The strongest body shall it make most weak,
Strike the wise dumb and teach the fool to speak.

'Sith in his prime Death doth my love destroy,
They that love best their loves shall not enjoy.'

By this, the boy that by her side lay kill’d
Was melted like a vapour from her sight,

(1) Loudon’s Encyclopedia - pg. 484
And in his blood that on the ground lay spill'd,
A purple flower sprung up, chequer'd with white,
Resembling well his pale cheeks and the blood
Which in round drops upon their whiteness stood."

- Venus and Adonis, 1.1141 on.

The Greek myth goes on to relate how Venus' grief did not abate and finally she pleaded with Jupiter to release Adonis. Jupiter agreed, but Pluto, ruler of the Under World, would not consent to set the youth free. Finally a compromise was effected and Adonis was allowed to return to earth for one half of the year. Therefore, "in early spring, Adonis leaves the Under World and so he becomes the symbol of vegetation rising from the ground to deck the earth with foliage and flowers, returning to Hades when winter, the cruel boar, slays him again with his white tusk, and makes nature again droop and mourn".

"But even in death, so strong is love,
I could not wholly die; and year by year,
When the bright springtime comes, and the earth lives,
Love opens these dread gates, and calls me forth
Across the gulf."

(Lewis Morris)

Adonis is a genus of hardy annual and perennial plants with showy red and yellow flowers, easy to cultivate in any good soil and in full sun, or in partial shade. They are particularly suited for rockwork or borders. There are only a few well-known species - perhaps twenty - native of temperate regions of Europe and Asia. The annuals are propagated by seed, and the perennials by seeds, or division of the roots in early spring. The chief species of horticultural merit are (1): Adonis aestivalis L., a crimson species with yellow eye, blooming in June or July; A. autumnalis L., also a crimson species, but with dark center, blooming from June to September, and occasionally found in fields within the range of Gray's Manual; A. vernalis L., a yellow, very early spring species; A. apennina L., very similar to the last but a trifle later in blooming; A. pyrenaica DC., also yellow, and blooming in July; A. amuriensis Regel and Radde, a Japanese species much cultivated there, and one which has many varieties. This last species has been reported as possessing the glucoside adonidin, C_{10}H_{40}O_{3}, and both A. aestivalis and A. vernalis are

(1) Bailey, L. H. - Encyclopedia - pg. 220-221
recorded as poisonous by Pammel (1).

**DELPHINIUM** (Tourn.) L. *Sp. Pl.* 520. 1753

(Larkspur)

Delphinium derives its name from the Greek, a dolphin, referring to the resemblance between the unopened flowers and the classical figures of a dolphin head formerly a favorite subject among artists.

This genus gives us about sixty species of annual and perennial, single- and double-flowered larkspurs, native of the North Temperate zone. They are much-prized hardy plants with "handsome spikes of flowers and stately stems of foliage" and they are well-adapted to the border garden. Probably the four most popular species are *Delphinium Ajacis*, *D. grandiflora*, *D. hybridum* and *D. formosum*, the last three of which are very prolific in named garden varieties. Perfect double-flowered species or varieties are shy seeders, and but a small percentage come true to color or variety. Also they are not as popular as the single species. The annual species are propagated by seeds, which are slow to germinate; the perennial species by seeds, division of the roots, or by cuttings. As to the culture of Delphiniums, they do best in deep, rich, sandy loam, exposed to the sun and transplanted every two or three years. In winter they should be covered with a bedding of barnyard manure and in mid-summer treated with top-dressing of the same (2).

*Delphinium Ajacis* L. is an annual species of the "rocket" type of inflorescence (long, single spikes). Its species name has an interesting derivation. According to Loudon (3) "So called because some traces may be perceived in the flower of what may be likened to the letters A J A." This species occasionally escapes from gardens though it does not become thoroughly naturalized. According to Bayard Long (4) it is doubtful if it is eligible to a place in our Manuals. Normally the species is blue-flowered, though they usually fade to white. However in 1924 two localities in New England were found where pure white growths were abundant, one of them was in Forest Hills,

(2) Bailey, L. H. - *Encyclopedia* - pg. 975-978
(3) Loudon's *Encyclopedia* - pg. 473-474
(4) *Delphinium Consolida in America, with a Consideration of the Status of D. Ajacis* - *Rhod.* 18:169-177
Massachusetts (1). The species is not particularly poisonous as are most of the delphiniums, although Pammel lists it as an irritant poison (2).

Delphinium Consolida L., the field larkspur, is the second most popular annual species and is of the candelabrum type with short spike-like heads of different heights. It differs from D. Ajacis in having smooth capsules instead of pubescent ones. Its specific name refers to the supposed power of the flowers to heal or consolidate wounds. This species should probably not be included in our Manuals. It has blue, pink, purple and white, and either semi-double or double-flowered varieties. Along with "Stavesacre" (D. Staphisagria) it is used in treatment of dropsy and spasmodic asthma, and its diuretic and other properties which cause vomiting and purging are due to delphinin, C_{28}H_{35}NO_{6}, a very poisonous and bitter alkaloid (3). Pammel lists it as an aethenic (2). A tincture of the seed mixed with that of Lobelia inflata is sold as a parasiticide. The seeds used to be considered officinal in the United States Pharmacopeia of this country, but are no longer included (4).

Of the red-flowered delphiniums, probably those most in cultivation are Delphinium nudicaule Torr. and Gray, and D. cardinalis Hook. Both are native of California, the former being an early blooming species and the latter a much later blooming one.

Delphinium Zahl Aitch. and Hensl. is a very beautiful yellow species from Persia introduced in 1892 and well worth cultivating, though hard to handle (5).

Delphinium tricorne Michx, the dwarf larkspur, is best adapted to rockwork and is very beautiful. Its range is from western Pennsylvania to Iowa and Georgia. It is listed as a cardiac poison (2).

Delphinium Menziesii DC., an early blooming perennial from California to Alaska, is a cardiac poison, while D. bicolor Nutt., with the same range, is the purple larkspur troublesome to stockmen. The extract from one ounce of dried leaves proved fatal to a yearling lamb in but a few hours. It is chiefly troublesome with sheep and calves. D. Geyeri, D. Nelsoni, D. elongatum,

(1) Cheney, R. H. - A White Form of Delphinium Ajacis - Rhod. 27:139–142
(2) Pammel, L. H. - Manual of Poisonous Plants - pg. 844
(3) Ibid., pg. 480–487
(4) Bentley and Trimen - Medicinal Plants - Vol I, No. 4
(5) Bailey, L. H. - Encyclopedia - pg. 975
D. glaucum, and D. Barbeyi are the worst species for stock poisoning on the western ranches. They are said to be second only to loco weed and cause a greater loss to stockmen than all other weeds (lococ excepted) combined. Forty thousand dollars annually is a conservative estimate of the damage due to them. The poisonous properties of the plants are due to delphinin (C_{20}H_{35}NO_{6}), delphinoidin (C_{42}H_{53}N_{6}O_{9}), and delphesin (C_{37}H_{46}N_{6}O_{4}). The plants are generally considered to be most poisonous early in the spring and to become less active as the flowering period approaches. The first symptoms of poisoning are dizziness, trembling, extreme weakness and loss of muscle coordination, followed by violent spasms and finally death, all within a few hours if much of the plant has been eaten (1).

Returning to the horticultural species (2), we may note Delphinium grandiflorum L. It is a mid-summer bloomer from Siberia and the species includes the most beautiful varieties of cultivated delphiniums. It is one of the most stately types, with striking, much-divided foliage which is beautiful throughout the growing season. It is very tall and so is best adapted to the background where it may be massed as close as two feet. D. formosum Boiss and Huet., probably originated in Asia Minor and is the most permanent species for naturalizing. If given rich soil and good cultivation it is one of the most effective plants in the perennial flower border. D. hybricum steph., comes from the mountains of Asia and has yielded many double and semi-double varieties. It is the tallest and most robust of the popular species. D. cultivorum Vass, is a general assemblage of mixed and more or less undefinable hybrids of horticultural origin and contains some choice garden and border plants of many colors with single and double forms. D. altissimum Wall. is a fall-blooming species of the Himalayas and worthy of notice.

Delphinium Staphisagria L. is the "Stavesacre" of southern Europe, held in high repute by the ancients as a cure for many diseases (3). The specific name is the old Greek name for the plant and "Stavesacre" is the English corruption of the same. The active principle comes from the seeds. They have a disagreeable smell and a nauseous, bitter, burning taste. It was once used as a cathartic but is so virulent that it was "laid

(1) Pammel - Manual of Poisonous Plants - pg. 460-467
(2) Bailey, L. H. - Encyclopedia - pg. 975-979
(3) Pammel, L. H. - Manual of Poisonous Plants - pg. 460;
Smith, J. - Dictionary of Economic Plants - pg. 382;
Bentley and Trimen - Medicinal Plants - Vol I, No.4
aside and is now chiefly used for skin eruptions, to destroy lice, and as a cure for various itching diseases. It is employed thus in the form of an ointment. Because of its use for the destruction of "pediculi" (a use first mentioned by Pliny), the Germans gave it the name "lausus amen", signifying "louse seeds", while to the Romans it was "herba pediccularis". A strong tincture of the seeds was also used as a liniment in cases of rheumatism and neuralgia, though aconite was generally regarded as more useful. Because the seeds are narcotic they have also been used in some parts of the world to intoxicate fish (1).

The species Delphinium glaciale of the Himalayas is interesting because it grows in altitudes of sixteen thousand feet (2).

ERANTHIS Salisb. Trans. Linn. Soc. 8:303. 1803

(Winter Aconite)

Eranthis, from Greek er, spring, and anthos, flower, referring to the early opening of the flowers (or from Greek earth and flower, because the flowers seem to lie upon the earth (3)), is the winter aconite. It is a genus of about seven species of plants native of Europe and Asia. They are low growing, hardy, perennial herbs "at home in half shady places, among shrubs or in the border", and they are particularly desirable because of the very early show of bright yellow flowers. Their propagation is by the division of the roots. The chief species of horticultural interest are (4): Eranthis hyemalis Salisb., a native of Europe growing five to eight inches high and blooming from January to March or as soon as the frost is out of the ground; the variety cilicica Ruth., with red-brown anthers, sent from its native home in Smyrna in 1892 and often cultivated in England but rare in America; and E. siberica DC., a much dwarfer species, a native of Siberia. A wild cut of Eranthis appeared in Dodoens' Pemptades of 1565 as Aconitum luteum minus (5).

(1) Pammel, L. H. - Manual of Poisonous Plants - pg. 460-467;
Bentley and Trimen - Medicinal Plants - Vol I, No. 2
(2) Balfour - Class Book of Botany - pg. 749
(3) Loudon's Encyclopedia - pg. 486
(4) Bailey, L. H. - Encyclopedia - pg. 1127
(5) Arber, Agnes - Herbals - pg. 139
HELLEBORUS (Tourn.) L. Sp. Pl. 557. 1753

(Hellebore)

Helleborus is the ancient name given originally to Helleborus orientalis, the meaning of which is obscure. Some authors say "unknown" (1); while Bentley and Trimen say (2) it is derived from the Greek word and to accomplish, referring to the alleged effects of the plants on mucous membranes; and Loudon says (3) it is derived from the Greek food and to cause death, referring to the poisonous properties of the genus.

Helleborus is a genus of about eight to fifteen species of plants native to Europe and western Asia, and has been cultivated for centuries. The plants are adapted to use in shrubbery borders and rockeries or may be grown in beds for cut flowers. All the species blossom in the spring or a few mild days in December or January will bring out the buds of H. niger, hence its name, Christmas Rose. In cultivation, best results are obtained by growing in rich loam, mixed with sand and with a top dressing of rotten manure. Moisture and good drainage are necessary and partial shade desirable. Plants should not be disturbed after they are once established, since they are very sensitive to change. Propagation is by division of the roots, preferably in the fall, or if the seeds mature, they will germinate if planted immediately in rich open ground. The seedlings take three seasons before they will bear flowers (4).

The chief species of Helleborus which are of horticultural value are (4): H. viridis L., the Green Hellebore, native of Europe but naturalized in the eastern States and found growing wild on Long Island, in New Jersey, Pennsylvania and West Virginia; (This is the least ornamental of the species.); H. niger L., the Black Hellebore or Christmas Rose of the ancients, with very large white or purplish-tinted flowers and several varieties native of Europe and growing in rocky places; H. orientalis Lam. of Asia Minor with numerous varieties of beautiful, white, purple or greenish flowers. The variety colchicus-punctatus Moore is probably the handsomest of all hellebores and the variety atrorubens Waldst. and Kit. is the connecting link between H. viridis and H. orientalis. H. foetidus L. of western Europe also deserves mention.

The two species most used in popular medicine as vermicidal, cathartic and purgative remedies were H. foetidus and H. niger. Both were at one time admitted in the London Materia

(1) Lindsay, Bailey, Gray
(2) Bentley and Trimen - Medicinal Plants - Vol I, No. 2
(3) Loudon's Encyclopedia - pg. 469
(4) Bailey, L. H. - Encyclopedia - pg. 1454
Medica (1) but now the root is official only in the United States Pharmacopoeia according to Bentley and Trimen (2) while Youngken lists it as unofficinal (3). These two plants were much esteemed by the ancients but they have been little used recently because the poisonous principles are so violent that they require great caution in application (4). The drug hellebore obtained from the roots of both species and sometimes adulterated with the roots of Actaea spicata has been employed in cases of mania, melancholia, epilepsy, dropsy, chronic skin affections, worms, etc. The drug is used both internally and externally as medicine for domestic animals (2). The poisonous and narcotic principles are the glucosides helleborin (C$_{3}$$\text{H}_{10}$$\text{O}$), helleborin ($\text{C}_{15}$$\text{H}_{36}$$\text{O}_{13}$) and galeborcin ($\text{C}_{15}$$\text{H}_{36}$$\text{O}_{5}$) (5).

Culpepper's description and notes on the government and virtues of Black Hellebore are worth noting:

"It is called setter-wort, setter-grass, bear's foot, Christmas herb and Christmas flower. It hath sundry, fair, green leaves rising from the root, each of them standing about an handful high from the earth; each leaf is divided into seven, eight, or nine parts, dented from the middle of the leaf to the point on both sides, abiding green all winter; about Christmas time, if the weather be anything temperate, the flowers appear upon foot-stalks, also consisting of five large, round, white leaves apiece, which sometimes are purple toward the edges, with many pale yellow thumbs in the middle; the seeds are divided into several cells, like those of columbines, save only they are greater; the seeds are in colour black, and in form long and round. The root consisteth of numberless blackish strings all united into one head. There is another black hellebore (probably H. viridis) which grows up and down in the woods very like this, but only that the leaves are smaller and narrower, and perish in winter, which this doth not. - The first

(1) Loudon's Encyclopedia - pg. 499
(2) Bentley and Trimen - Medicinal Plants - Vol I, No. 3
(3) Youngken, H. W. - Pharmaceutical Botany - (1918)
(4) Mrs. Arber points out (Herbals, pg. 44) that from the 16th century point of view the Grete Herball contains much that is curious, especially in relation to medicinal matters, for under the heading of "whyte elebor" we read: "In olde tyme it was commonly used in medycyns as we use squamoyn. For the body of man was stronger than it is now, and myght better endure the yvoilece of elebor, for man is weyker at this time of nature." Mrs. Arber goes on to say that, so to us, they of the 16th century were stronger than we, if they could stand some of their medicines. 'There were giants in the earth in those days!' All this is equally applicable to the use of black hellebore.

(5) Pummill, L. H. - Manual of Poisonous Plants - pg. 449
is maintained in gardens. The second is commonly found in the woods. The first flowereth in December or January; the second in February or March. It is an herb of Saturn, and therefore no marvel if it hath some sullen condition with it, and would be far safer being purified by the art of the alchemist than given raw. If any have taken any harm by taking it, the common cure is to take goat's milk: if you cannot get goat's milk, you must make shift with such as you can get. The roots are very effectual against all melancholy diseases, especially such as are of long standing, as quartan agues and madness; it helps the falling sickness, the leprosy, both the yellow and the black jaundice, the gout, sciatica and convulsions. And this was found out by experience, that the root of that which groweth wild in our country, works not so churlishly as those do which are brought from beyond the sea, as being maintained by a more temperate air. The root used as in pessary, provokes the terms exceedingly; also being beaten into powder, and strewed upon foul ulcers, it consumes the dead flesh, and instantly heals them; nay; it will help gangrenes in the beginning. Twenty grains taken inwardly is a sufficient dose for one time, and let that be corrected with half as much cinnamon; country people used to rowel their cattle with it. If a beast be troubled with a cough, or have taken any poison, they bore a hole through his ear, and put a piece of the root in it; this will help him in twenty-four hours. Many other uses farriers put it to which I shall forbear." (1)

It was an old superstition that if an eagle came near while Hellebore was being collected, anyone engaged in the work was fated to die within the year, but this Theophrastus considered folly (2). From this legend and from the fact that the first good wood-cut of the plant appeared as far back as the Herbarum vivae eicones of Brunfels in 1530, we get some idea of the length of time that the plant has been known to man (3).

(1) Culpepper, N. - British Herbal and Family Physician - pg. 173
(2) Arber, Agnes - Herbals - pg. 8
(3) Arber, Agnes - Herbals - pg. 49
**HYDRASTIS** Ellis L. Syst. Ed. 10, 1088. 1759

*(Orange Root, Yellow Puccoon)*

Hydrastis is another genus with a name of doubtful origin, though possibly it was derived from the Greek *water*, referring to the humid habitat of the plant (1). We know only that the name was applied to some unknown "Golden Seal" plant celebrated in antiquity.

There are two species in the genus: *Hydrastis canadensis* L. from North America and *H. japonensis* Sieb. from Japan. The latter is not in cultivation, but *H. canadensis* is a hardy, herbaceous, perennial plant, grown in a few gardens for the showy leaves and beautiful red fruit. It does best in moist, rich loam with plenty of leaf mold. It may be propagated by seeds or by the division of the roots in the fall.

Bentley and Trimen speak of the introduction of the plant into England in 1759 by P. Miller who figured it in 1760 as *Warneria*. More recently it has been grown in the botanical gardens at Kew, Edinburgh, and Lublin (2).

Though once frequently found in western New England, it has now been nearly exterminated in most regions. The plant does not occur in Massachusetts, but since there are stations for it in Vermont and Connecticut, it would seem there was a possibility of other stations in western New England and perhaps even in Massachusetts (3).

Hydrastis was so much in demand for medicinal purposes at one time that the United States Department of Agriculture saw fit to issue a bulletin concerning its commercial cultivation (4). The root is the part of value, and, as the common name of the plant suggests, it is bright orange or yellow in color. This root has been used, and still is used by Indians of the West as a source of a yellow dye which "imparts to linen a rich and durable light yellow color of great brilliancy, which might probably by proper mordants give all the shades of that color, from the pale yellow to the orange." The lake produced by it with the bichloride of tin might also prove a useful pigment in oil and water color painting (2).

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1. Loudon's *Encyclopedia* - pg. 491
Both the rhizome and root are included in a list of primary officinal drugs of the United States Pharmacopoeia (1). Its chief value medicinally is as a tonic, though it is also said to be an ope rent, chologogue (of use in jaundice and liver diseases), diuretic, laxative etc. It produces ulcers and catarrhal inflammation of mucous surfaces when applied directly. It is used locally as an injection, or internally.

The medicinal properties of the plant are due to the alkaloids hydrastin \((C_{21}H_{21}NO_7)\), canadin \((C_{20}H_{13}NO_4)\), berberin \((C_{20}H_{17}NO_4)\) — almost four per cent, and anemonin \((C_{10}H_{5}O_4)\) (2).

**ISOPYRUM** L. Sp. Pl. 557. 1753

*(False Rue Anemone)*

*Isopyrum* is the ancient name given this genus by the Greeks and meaning like and wheat, in reference to the seeds which resemble those of wheat.

It is a genus of some fifteen to twenty species native of the temperate regions of the northern hemisphere. They are dwarf, stemless, annual or perennial herbs, sometimes used in wild gardens. *Isopyrum thalictroides* L. of the western Himalayas is the species most frequently cultivated in alpine gardens. It is very ornamental and good in masses with its panicles of white, anemone-like flowers and foliage resembling the maiden-hair fern. It grows only about six to twelve inches tall and flowers in April or May. Any good garden soil will do for it and propagation is by seeds, or by the division of the roots in autumn. *I. grandiflorum* Fisch. has large, white, solitary flowers (3). *I. biternum* (Raf.) T. and G. is within the range of Gray's Manual, though it never occurs in New England.

**NIGELLA** (Tourn.) L. Sp. Pl. 534. 1753

*(Fennel Flower)*

The genus name *Nigella* is derived from the diminutive of the Latin *niger*, meaning black, and referring to the color of

(1) Youngken, H. W. - Pharmaceutical Botany
(2) Lloyd, J. V. and C. G. - Drugs and Medicines of North America - I. Ranunculaceae, 1884-1885
(3) Bailey, L. H. - *Encyclopedia* - pg. 1707
the seeds. The common names of the flower, "Love-in-the-mist" and "Devil-in-a-bush" refer to the flowers and fruits which are often surrounded by a much divided involucre. Other common names are black cummin (thus known to the ancients), nutmeg flower, and Roman-coriander.

**Nigella** is a genus of about twelve species mostly native of the Mediterranean region. They are hardy annuals grown horticulturally for the interesting flowers and seed-pods. For propagation the seed should be sown early in the spring in the open ground where the plants are to be grown and later thinned out to stand eight inches apart. They do not stand transplanting. The following three species are the only ones now used in America: N. damascena L. of southern Europe, a white or blue species; N. hispanica L. from Spain and northern Africa, a deep blue species with several varieties of white and purple flowers; and N. integrifolia Regel of central Asia (1).

**Nigella sativa** L. is native of eastern Mediterranean, and Taurus-Caspian countries, and is cultivated in various parts of the world for the aromatic seeds. In India these seeds are used to put away with woolen clothing to keep away insects (2). In some parts of Germany, in southern France, in Italy, and in most Eastern countries the seeds are used as condiments for seasoning curries or other dishes, being less expensive than most spices (3). In Egypt and Palestine they are spread on bread or cakes like comfits, and Egyptian ladies use them to produce stoutness, considered by them to be a point of beauty (2). These seeds are supposed to be the fitches of the Scriptures (2): "When he hath made plain the face thereof doth he not cast abroad the fitches, and scatter the cummin, and cast in the principle wheat, and the appointed barley, and the rice, in their place?" (Isa. 28:25) The plant is thought to be the gith of Columella and Pliny in the first century, of Palladion in the third, and of Charlemagne in the ninth. The melanthion of Columella seems to be the descriptive name for his gith. As "Black Cummin" the plant finds mention in most botanies of the sixteenth and seventeenth centuries (3).

**Nigella arvensis** L., also a native of Europe, the Mediterranean region and the Orient, has seeds used as those of *N. sativa*, and they are said to be used extensively in the adulteration of pepper. The leaves of the former species are also used in seasoning various dishes (4).

**Nigella damascena** L. is grown in Turkey for seeds (3).

(1) Bailey, L. H. - *Encyclopedia* - pg. 2145
(2) Smith - *Dictionary of Economic Plants* - pg. 169
(3) Sturtevant - *Notes on Edible Plants* - pg. 387-388
(4) Loudon's *Encyclopedia* - pg. 476
PAEONIA L. Sp. P. 580. 1753

(Peony)

The genus Paeonia was named after the mythical physician, Paeon. He was not only the physician of the gods, but was supposed to have cured Plato of a wound inflicted by Hercules through the use of this plant.

Paeonia is a genus of hardy "specially attractive and important flower-garden perennials, prized for their showy spring and early summer bloom. In delicacy of tint and fragrance the peony more nearly approaches the rose than any other flower." (1)

There are about twenty species of peonies, all native of Europe and Asia with the exception of one small-flowered species, Paeonia Brownii Dougl. (P. californica Torr. and Gray), of California. The species are difficult to distinguish, even when they are "unmodified", while the garden forms which have risen through variation or hybridization are doubly puzzling to the systematic botanist. In fact, no two systematists agree on the limits or nomenclature of the species of this genus.

From the horticultural point of view, there are two types of peonies: the shrubby or "tree" type, and the herbaceous type (2). The former are the products of Paeonia Moutan Sims. (Bailey calls it P. suffruiticosa Andr.) and extended lately by the addition of P. Delavayi and P. lutea. They are low shrubs branching near the ground and bearing many large flowers varying in color from red to white and even yellowish. The group is eclipsed by the popularity of the herbaceous kinds, which bloom each year on shoots arising from the crown and dying to the ground each fall. This herbaceous group is the product of P. albiflora Pall. of Siberia, the Himalayas and Japan, and P. officinalis L. of southern Europe.

The old fashioned red "piny" has been cultivated since the time of Pliny and is still a favorite, while the double varieties have come in more recently, mostly since about 1850. Loudon mentions that a double red variety of P. officinalis, when introduced in Antwerp about the end of the sixteenth century, sold for twelve crowns a root (3). The single species and varieties have never been as popular as the double ones, though very recently some of the former type have been coming into favor.

(1) Bailey, L. H. - Encyclopedia - pg. 2431
(2) Ibid. pg. 2431-2436
(3) Loudon's Encyclopedia - pg. 473
The chief factor against them is that they do not keep long as cut flowers and they fade rapidly on the plant. Around 1900 there was a "craze" for peonies in this country. The American Peony Society was founded in 1903, and this society proceeded to publish many bulletins on the culture of the plants.

The peony is propagated largely by the division of the large thick roots at any time from August until spring, but preferably in autumn as then the cut surfaces will callous over and new rootlets will form before frost. Grafting is resorted to when new or rare varieties are to be rapidly increased. An eye of the sort desired is inserted into the tuber of some strong growing variety, from which all other eyes have been removed. Propagation by seed is tedious and resorted to only for distinct species and new varieties. It takes the seeds two years to germinate and it is three more years before the plants develop well formed blossoms.

Peonies do best in deep, rich, rather moist loam. The ground should be kept well tilled and an annual top-dressing applied in November and then forked-in in the spring. A liberal supply of water is desirable at all seasons and especially so during the blossoming season. If well cared for the plants will bloom for twenty years or more. They do well in partial shade, which prolongs and intensifies the color of the blooms, and therefore they can be used to advantage to "brighten up somber nooks". Since they grow from one to several feet high, they are suited for planting in front of shrubbery, along driveways, and "are especially pleasing when entering into a distant vista". The flowers should be cut off when faded, and the old foliage removed in the fall.

Besides outdoor ornamentals, they are of value as cut flowers, and they are now much used for June weddings. When cut in tight buds and closely wrapped in paraffin-paper, some varieties will hold in cold storage for over a month and then open satisfactorily.

Peonies are subject of Botrytis disease on stems, buds and leaves, and about the only method of prevention is the use of sanitary methods of culture. This means good soil, and the removal of all wilted stems and rotted buds as soon as they are discovered. Also it is well to burn up all the stalks and foliage in the fall.

The following species and varieties are perhaps the most popular (1):

*Paeonia lutea* Franch has yellow flowers two to four inches across, and it has a variety *superba* Lemoine which

(1) Bailey, L. H. - *Encyclopedia* - pg. 2431
has larger flowers with a carmine base. These belong to the "tree" group.

P. Mlokosiewitschii Lomak. is an herbaceous species recently discovered and introduced from the Caucasus region, and said to be the most handsome yellow-flowered species. The flowers are four to five inches across and single.

P. Wittmanniana Stev. is another herbaceous type, and the first yellow species introduced to the garden of the Royal Horticultural Society in England - in 1842. The yellow is very light and not pronounced, and apparently not of great promise. This also came from southern Europe.

P. Brownii Doug. is of little use horticulturally, but is of interest since it is the only native American species. It grows about one foot high and has dull reddish-brown flowers.

P. Moutan Sims. is the "tree" peony of China with many varieties. It grows three to six feet high and bears large flowers of various colors. It has long been cultivated in the Orient where hundreds of varieties are known. The Chinese, especially, have worked with this for centuries. A plant of it mentioned by Fortunen near Shanghai bears three to four hundred blossoms annually (1).

P. albiflora Pall. of Siberia has many varieties and colors from pink to white. The variety sinensis Stev. is a tall Chinese variety with large double crimson flowers and is one of our commonest garden varieties.

P. tenuifolia L. is a species with interesting leaves. They are much dissected and cover the whole stem up to the flower. The flowers are dark crimson and double.

P. officinalis L. is the old form of our gardens with single red flowers. The Mongols and Daurians used to boil the root in their broth, and grind the seeds and put into their tea. This, as its name attests, is the peony of medicine (2). The roots and fruit were supposed to be collected at night by the old herb doctors, for if they were collected in the daytime and a woodpecker happened to witness the act, the eyes of the herbalist would be endangered (3).

P. paradoxica G. Anders. is one of the dullest species with leaves in dense tufts and flowers of a purple-red color. The variety fimbriata Hort. has double purple flowers with projecting purple stamens. This is considered to be a very pretty species but it is not much cultivated in America.

P. Veitchii Lynch has several blossoms to a stem, each four inches or so across. They are often nodding, and of a

(1) Balfour, J. H. - Class Book of Botany - pg. 749
(2) Loudon's Encyclopedia - pg. 472
(3) Arber, Agnes - Herbae - pg. 7
purplish-crimson color. It comes to us from China and has been recently described as a particularly worth-while and attractive plant.

**TRAUTVETTERIA** Fisch. and Mey. Ind. Sem. Petr. 1:82. 1834

(False Bugbane)

**Trautvetteria** is a genus named after the Russian botanist E. R. Trautvetter. The plants included in the genus are tall, erect, very hardy, perennial herbs sometimes grown for the ornamental broad leaves and small white flowers borne in clusters. They are easily propagated by the division of roots in late fall or early spring, and the plants are frequently offered by dealers in native plants.

The genus is variously interpreted, many authors regarding it as monotypic, while others have described six or more species. However, *Trautvetteria carolinensis* Vail, a native of Pennsylvania and the southern States, and *T. grandis* Nutt., closely resembling it, but a native of the West, are the two generally recognized species (1).

**TROLLIUS** L. Sp. Pl. 556. 1753

(Globeflower)

**Trollius** was named by Conrad Gesner and the name is derived from the Old German *trol* or *trollen*, signifying something round; or *trollblume*, in allusion to the shape of the flowers.

The plants of the genus are very like *Ranunculus* in general appearance, but they may be distinguished easily by the fact that the fruits are follicles instead of achenes. The genus gives us a "group of neat, hardy, herbaceous perennials, of a dozen or more species mostly found in moist or marshy places of the North Temperate zone", blooming in spring or early summer. They are "cultivated for the beauty of their globular flowers and show of dark green leaves, being suited to wet sunken gardens, wild borders and edges of water gardens" though they do well in any moist garden soil. They are propagated by seed (but then do not flower until the second season), or by the division of the old plants (2).

(1) Bailey, L. H. - *Encyclopedia* - pg. 3372
(2) Ibid., pg. 3387
Trollius europaeus L., with several varieties and forms, is the usual globe flower of the horticulturist, and differs from most species in having incurved sepals instead of nearly horizontal ones. It is a native of western Europe and has lemon-yellow flowers. T. asiaticus L. is much like T. europaeus, but taller and with orange-colored flowers with spreading sepals. It is a native of Siberia and its blossoms are well suited for cut flowers. T. dachungaricus Regel. from Turkestan is mentioned in foreign horticultural lists and resembles T. europaeus except that the flowers are golden yellow within and reddish outside with open or spreading sepals. In English gardens T. chinensis Bunge thrives well and seeds freely when grown in bog-gardens or beside water. T. numilus Franch. variety yunnanensis is described as horticulturally not unlike Caltha palustris, but superior. T. laxus Salisb. is a native of bogs and swamps from western Connecticut and Delaware south to Pennsylvania and west to Michigan.

XANTHORRHIZA L'Her. Stirp. Nov. 79. 1784

(Shrub Yellow-Root)

Xanthorrhiza derives its name from the Greek yellow and root, referring to the bright yellow color of the roots.

It is a genus of shrubby plants cultivated mostly for the handsome Actaea-like foliage which turns a bright golden yellow in autumn.

There is but one species, Xanthorrhiza apiifolia L'Her, a native of the eastern United States from New York to Georgia. The plants prefer moist shady places. They are propagated by seed or by root division in autumn or early spring. Bailey mentions that they are frequently not hardy in Massachusetts or other northern States.

Smith mentions that the roots are bitter and have some reputation with American doctors as a tonic. Originally they were used as the source of a yellow dye.

Generally this plant is not considered native in Massachusetts, yet in a report of the flora of Boston district

(1) Bailey, L. H. - Encyclopedia - pg. 3387
(2) Ibid., pg. 3537
(3) Smith - Dictionary of Economic Plants - pg. 446
it is mentioned as found in Salem, Danvers and Concord (1). A sheet in the herbarium of the New England Botanical Club collected by L. A. Wentworth in Lynn, June 6, 1919 bears the statement: "Colony of several hundred plants along wooded brookside".

KEY TO GENERA OF RANUNCULACEAE OF MASSACHUSETTS

Tribe I - Anemoneae - Sepals three to twenty, petal-like; petals often lacking, seldom nectariferous (Ranunculus the exception); stamens numerous; achenial fruits usually numerous with solitary ascending or suspended seed.

A. Petals five or more, with nectariferous pit at base of blade; sepals usually five; achenes many; seed ascending - - - - - - - - - - - - Ranunculus

A. Petals none (or rarely staminodial); sepals several; achenes many to few, seed suspended.

1. Sepals usually four.

a. Climbing plant; leaves opposite; sepals valvate; achenes tailed - - - - Clematis

a. Plant not climbing; leaves alternate and compound; sepals imbricate; achenes not tailed - - - - - - - - - - Thalictrum

1. Sepals not usually four; all but lower leaves whorled or opposite.

b. Leaves simple and lobed; involucre of bracts calyx-like - - - - - - - - Heraclea

b. Leaves compound or dissected.

(1) Leaflets of radical and involucral leaves long petiolate; achenes terete and strongly ribbed - - Anemonella

(1) Leaflets of radical, cauline and involucral leaves sessile; achenes flattened, not ribbed - - - - - - Anemone

(1) Rhod. 18:165-168. 1916
Tribe II - *Helleboraeae* - Sepals petal-like; petals usually nectariferous, or reduced to staminodia, or none; stamens numerous; fruits few, and few to many-seeded follicles or berries.

B. Flowers regular, racemose.

2. Flowers in long racemes; petals two-horned at apex; fruit a single, thinwalled, many-seeded pod - - - - - - - - - - - - *Cimicifuga*

3. Flowers in a simple, short raceme; petals entire, not two-horned at apex; fruit a fleshy, many-seeded berry - - - - - - - - - - *Actaea*

B. Flowers regular, not racemose.

3. Petals present.

   c. Petals small, hollowed at apex; leaves trifoliolate; follicles separate and stalked - - - - - - - - - - - - *Coptis*

   c. Petals large, spurred; leaves ternately compound; follicles slightly connate - - - - - - - - - - *Aquilegia*

3. Petals absent.

   d. Sepals three to eight, broad, yellow; leaves reniform, undivided; follicles separate - - - - - - - - - - - - *Caltha*

**ACTAEA** L. Sp. Pl. 504. 1753

Erect, perennial herbs with large two- to three-ternately compound leaves; the ovate leaflets sharply cleft and toothed. Flowers small, white, in short thick terminal raceme. Sepals three to five, petaloid, fugacious. Petals four to ten, small, flat, spatulate or narrow-clawed. Stamens numerous with slender white filaments. Pistil one; stigma broad, sessile, depressed, two-lobed; ovary one, many-ovuled. Fruit a large, sometimes poisonous berry. Seeds in two horizontal rows, smooth, flattened.
The name *Actaea* is one of the ancient Greek names for the elder, which these plants resemble somewhat in foliage and fruit, and from which this genus was transferred by Linnaeus (1).

There are about six known species of *Actaea* native of the North Temperate zone, with three species in the United States, two in the East and one (*A. arguta Nutt.*) in the West. The western species resembles our eastern species, *A. rubra*, but the red berries are smaller and more globose.

The *actaea* are sometimes offered in collections of hardy border plants and grown chiefly for the showy spikes of small, white flowers in spring, and handsome clusters of berries in autumn. Useful for rockery and wild gardens, or for clumps and borders. They thrive in rich woods and shade. Propagation is by seeds sown in late fall to germinate next spring, or sown in spring. A more satisfactory means of propagation is by root division in spring."

The berries of the European *Actaea spicata* are purplish-black instead of red, but otherwise the plant closely resembles our *A. rubra*. With alum they yield a black dye (1). These berries are very poisonous and we have reports of sheep being poisoned by eating the leaves. The poisonous property is "due to a resinous body neither acrid nor bitter (?) but violently purgative, irritant and emetic." (3)

**KEY TO SPECIES OF ACTAEA OF N. AMERICA**

Flowering raceme ovoid; pedicels slender; fruit red - *A. rubra*

Flowering raceme oblong-ellipsoid; pedicels thick; fruit white - - - - - - - - - - - - - - - - - - - - - - - - - - - *A. alba*

**ACTAEA RUBRA** (Ait.) Willd.
(Red Baneberry, Black Cohosh, Snake-Berry, Red-Berry)

*Actaea spicata* variety rubra Ait., Hort. Kew 2:331. 1789
*Actaea rubra* Willd., Enum. 361. 1809
*Actaea rubra* dissecta Britton, Britt. and Brown Ill. Fl. 3:55. 1897

(1) Loudon's *Encyclopedia* - pg. 313
(2) Bailey, L. H. - *Encyclopedia* - pg. 212
Agtaea - from the Greek word for the elder, a plant which this resembles.

rubra - from the Latin word meaning red, referring to the red fruits.

Erect, bushy, three to six decimeters high, pubescent or glabrous. Leaves petioled, or the upper sessile, ternate; the divisions pinnate with the lower ultimate leaflets sometimes again compound; leaflets ovate, or the terminal one obovate, toothed or somewhat cleft, or all deeply incised, the teeth mainly rounded or mucronate, or acutish. Racemes ovoid. Petals rhombic-spatulate, shorter than stamens; pedicels slender, 1-1.7 cm. long. Berries cherry-red; oval or ellipsoid; 1-1.3 cm. long and poisonous. (Plate 24, A-F)

Rich woods from Nova Scotia to New Jersey and Pennsylvania, west to South Dakota and Nebraska; April to May; especially common northward.

Miss Bacon tells of an experiment made with the fruit of the red baneberry to test its poisonous qualities, which were not then fully known (1). She discovered that a small dose produced a slight burning of the stomach; double that, a severe burning; double that and she says: "Half an hour afterward all curiosity on the subject of red baneberry was abundantly satisfied, for this one experimenter at least. At first there was a most extraordinary pyrotechnic display of blue objects of all sizes and tints, circular with irregular edges; as one became interested in the spots a heavy weight was lowered on the top of the head and remained there, while sharp pains shot through the temples.

"Then suddenly the mind became confused and there was a total disability to recollect anything distinctly or arrange any ideas with any coherency. On an attempt to talk, wrong names were given to objects, and although at the same time the mind knew mistakes were made in speech, the words seemed to utter themselves independently.

"For a few minutes there was great dizziness, the body seeming to swing off into space, while the blue spots changed

(1) Bacon, Alice E. - *PhD*, 5:77-78
to dancing sparks of fire. The lips and throat became parched and the latter somewhat constricted; swallowing was rather difficult; there was intense burning in the stomach with gaseous eruptions, followed by sharp colicky pains in the abdomen and also pain across the back over the kidneys. The pulse rose to one hundred and twenty-five, was irregular, wiry, tense; the heart fluttered most unpleasantly. These symptoms lasted an hour and were followed by a feeling of great weariness, but in three hours from the time of taking the dose all seemed to be again normal. The experiment was carried no further, as the effects in heart and brain were danger signals not to be ignored.

"The conclusion reached is, that while the very unpleasant taste will prevent it from being dangerous in general (as no child, youth, sane adult, not even a hungry school boy would ever devour it from deliberate choice, the taste is most nauseous, bitter, puckery; indeed several even more drastic adjectives might be applied with perfect truth), the fruit of the red baneberry evidently contains a poison having a powerful effect on circulation and brain; a dozen berries would probably be enough for a fatal dose, half that amount sufficing for the above experience."

This is of special interest since we find the following in "Drugs and Medicines of North America (1): "The English plant, Actaea spicata, has acquired a reputation as a poisonous plant that it seems to us must be in most part unmerited. By old writers the plant was said to grow in dark recesses and to emit a fetid smell, which attracted toads, hence it is called toad-plant. The berries were supposed to be poisonous, and the entire plant to poison cattle. Our native plants, which could hardly be distinguished from the foreign, seem to be entirely innocent of poisonous properties, and certainly do not emit any disagreeable odor." Further, Morrell says that under the name of "cohosh" this is used as a remedy for heart troubles (2).

**ACTAEA ALBA (L.) Mill.**

(White Baneberry, White Cohosh, White-Heads, Necklace Weed)

*Actaea spicata* variety alba L., Sp. Pl. 504. 1753
*Actaea alba* Mill., Gard. Dict. Ed. 6, No. 2. 1768

*Actaea* - from the Greek word for the elder, a plant which this resembles.

*Alba* - from the Latin meaning white, referring to the color of the fruits.

(2) Morrell, Jennie M. H. - *Plants and Their Uses* - Eud. 5:135
Closely resembles *Actaea rubra* in habit. Leaflets generally more incised, teeth and lobes sharper, acute or acuminate. Raceme oblong or ellipsoid. Petals slender, truncate at apex. Fruiting pedicels as thick as peduncles and often red; berries globular-ovoid, white, often purplish at the end. (Plate 24, G-H)

Rich woods. Flowering a week or two later than *Actaea rubra*. More common southward and westward. Nova Scotia to Georgia west to Minnesota and Missouri. Ascends five thousand feet in Virginia.

Mottier reports a slight monocotyledonous tendency in this species. In the embryo the cotyledons have a common base and are of unequal length, yet he does not believe it to be a case of one cotyledon which has bifurcated, since later development is typically dicotyledonous (1).

**ANEMONE** L. Sp. Pl. 538. 1753

*(Anemone, Anemony, Windflower)*

Erect, perennial herbs. Basal leaves lobed, divided or dissected; those of stem two to three together, opposite or whorled and forming an involucre near to, or remote from the one-flowered, solitary peduncle or umbellate peduncles. Sepals four to twenty, petaloid. Petals none, or resembling abortive stamens. Stamens many, shorter than sepals. Carpels numerous with single suspended seed. Fruit a one-seeded achene; achenes pointed or tailed, flattened, not ribbed.

The usual derivation for *Anemone* is from the Greek *anemos*, meaning wind, therefore the common name windflower. The name is very old, having been used by Dioscorides, Pliny, Theocritus and Theophrastus, although they differed in their

(1) Mottier, D. M. - *Embryology of Some Anomalous Dicotyledons*
explanation of the term saying that the plant loses its flowers in the wind, flourishes, or does not flourish in the wind, etc. (1). Culpepper says: "Called also wind flower because they say the flowers never open but when the wind bloweth; Pliny is my author, if it be not so, blame him. The seed also (if it bear any at all) flies away with the wind." (2). Lindsay gives the following of interest: from the Greek anemos, wind, "comes the Latin anima which signified air in motion, then a breath, and in the masculine form animus, the rational soul, then the spiritual life in man." (3). It is most remarkable that in Hebrew, Greek and Latin the same word stands for wind and spirit. Carrying on this idea of the spiritual life symbolism in Anemone we find a recently published volume on the spiritual life called Crusade for the Anemones (4).

Another meaning given to Anemone by Hesychesa and some modern writers is "vain" or "fruitless" (5). In connection with this it is an interesting point that in a list of flowers with symbolic meanings Anemone is said to mean "fading hope" (6).

Still a third derivation accepted by some prominent authors is that Anemone is from the Semetic Na'man (5). Na'man (Naaman or Nu'man) was a Semetic Dity identical with Adonis or Tammuz. The Arabic name for the red anemone is shawara an-numan, meaning "the wounds of Nu'man". In Isaiah (7) are mentioned "shoots for Naaman" and these are supposed to be the "gardens of Adonis". According to Greek and Latin writers it was the blood of Adonis from which the Anemone sprang.

Whatever the true derivation may be, all have come to have an interesting poetic and artistic as well as historical significance.

As early as 1530 we find in Brunfels' "Herbarium vivae eicones" Vol. 1, a beautifully realistic figure of Anemone Pulsatilla, the Pasque flower, probably drawn and engraved by Hans Weiditz, or perhaps Albrecht Durer. Then in 1583 appeared a figure of Anemone trilolia in Dodoens' Pemptades, while in 1586 another figure of Anemone Pulsatilla appeared in Camerarius' De Plantis Epitome - Matthioli. This last, though later than either of the formentioned, is not as realistic or natural, though it is excellent for the times. Perhaps the most interest-

(1) Toy, C. H. - The Etymology of Anemone - Rhod. 1899 - pg. 41
(2) Culpepper, N. - British Herbal and Family Physician - pg. 17
(3) Lindsay, T. S. - Plant Names - pg. 57
(4) Bebesco, Princess Marthe - Crusade for the Anemones - Macmillan Co., 1932
(5) Rhod. 1:41
(6) Funk and Wagnall's Standard Dictionary
(7) Isaiah 17:10
ing figure of an **Anemone** is found in the background of Leonardo da Vinci's study of *Ornithogalum umbellatum*. The species seems to be *A. trifolia*. (1)

We find that the anemone has figured not only in drawings and paintings but also in poetry. Sometimes it is referred to symbolically as a flower of the spirit, a flower of the wind, or a flower of nature. The following are two examples:

"--- Growth of Jasmine turn'd
Their humid arms festooning tree to tree,
And at the root thro' lush green grasses burn'd
The red anemone."

- Tennyson - "Dream of Fair Women"

"And the untaught Spring is wise. In cowslips and anemones."

- Emerson - "Nature"

**Anemone** is a genus of about eighty-five species widely distributed through the temperate or subarctic regions of both hemispheres, with about twenty species native of North America. Besides these numerous species there are many handsome garden varieties and forms, often seen in cultivation. Yet in 1852 we find Culpepper saying (3): "They are sown usually in the garden of the curious, and flower in the springtime." The anemones may have been curiosities then, but they certainly are no longer; and some of the most highly valued varieties are fall-flowering. They are cultivated now "for their beautiful show of flowers and in a few cases for their striking foliage" (3). They are all hardy or semi-hardy perennials, which thrive best in a fresh, rather rich, sandy loam which is well-drained, though most species will do well in any good garden soil. The tuberous-rooted species are suitable for hardy borders, while most of the others prefer a place in the rockery, and some are partial to shady places. **Anemone hortensis**, *A. coronaria* and *A. fulgens* and others will well repay the little indoor or greenhouse care they require for producing winter blossoms. They need essentially the same handling as tulips and hyacinths and are usually classed with bulbous plants. Tubers placed in pots in September or October bring forth a beautiful show of bloom by January or March." -- "Nearly all species can be readily propagated by both root division and by seed. The seeds are sown very shallow in a clean bed in either warm fall or early spring. The division of the

(1) Arber, Agnes - *Herbals* - pg. 75, 152, 170, 171
(2) Culpepper, N. - *British Herbal and Family Physician* - pg. 17
(3) This and the following material on the culture of Anemones and the species in cultivation from Bailey, L. H. - *Encyclopedia* - pg. 384-287
roots is best made in early spring before growth starts. The season for both outdoor and indoor planting will directly influence the flowering season."

The chief species of importance are the following:

**Anemone patens L.** variety Nuttaliana Gray, the American Pasque flower (Pasque, or Pague, means Easter, at about which time these anemones blossom), native of the northern Central States and Siberia, has bluish-purple or whitish flowers appearing in April before the leaves.

*A. Pulsatilla* L. is the Pasque flower of Europe which has flowers that are blue to reddish-purple.

*A. coronaria* L., the poppy-flowered anemone, bears flowers one and one-half to two and one-half inches across, poppy-like, and of many colors or mixtures of colors—red, blue, white, etc. The stamens are blue. It blooms in the spring until about June and comes to us from the meadows of the Mediterranean region. There are numerous named forms in both single and double types as well as semi-double. St. Bridgid is one of the most popular single-flowered varieties, while *flore-pleno* is perhaps the most commonly cultivated double variety.

*A. hortensis* L. is the broad-leaved garden anemone which is very similar to *A. coronaria* but differs in its coarse broad leaves and elongated narrow pointed sepals.

*A. palmata* L. comes from the Mediterranean region and bears yellow flowers. There are horticultural varieties of this species with both single and double flowers ranging in color from yellow to pure white.

*A. apennina* L. is a species with sky blue flowers which comes from the woods of Italy. Both it and its varieties are suited to shady nooks in clumps of shrubbery. Professor Patterson spoke of this as one of the most beautiful flowers of Italy.

*A. japonica* Sieb. and Zucc. is one of the best of all fall-blooming plants. It grows two to three feet high (or some of its varieties as high as four to five feet), and bears rosy purple or Carmine colored flowers which are two to three inches in diameter and borne on long peduncles. It is native of China and Japan, and the species has numerous varieties with flowers ranging in color from various shades of rose or Carmine to white. The variety *rubra* Hort. is one of the most attractive Carmine colored ones in which the flowers and leaves have a peculiar waxy gloss which enhances their beauty. *A. hupehensis* is a dwarf early flowering form of *A. japonica* with pink and pale mauve flowers shaded with deeper pink on the back. It is a more hardy plant here in Massachusetts than is the species.

*A. nemorosa* L. of Europe is very similar to our *A. quinquefolia* and both are attractive spring flowering plants often used and particularly well-suited to partially shaded places of perennial borders. The only wild specimens of *A. nemorosa* in America came from Massachusetts. For a time the plants were persistent and spreading about an old garden at Danvers but now the colony is reported destroyed (Rhod. 30: 196-198)
Various species of anemones have been reported as poisonous. They contain anemonin, a poisonous crystalline compound (C_{12}H_{20}O_{4}) found in the leaves and flowers. It is sometimes used for asthma, bronchitis and whooping cough (3).

Culpepper says of the "Governments and Virtues" of Anemone (5): "It is under the dominion of Mars, being supposed to be a kind of crowfoot. The leaves provoke the terms mightily, being boiled, and the decoction drunk. The body being bathed with the decoction of them, cures the leprosy. The leaves being stamped and the juice snuffed up in the nose, purgeth the head mightily; so with the root, being chewed in the mouth, for it procureth much spitting, and bringeth away many watrey and phlegmatic humours, and is therefore excellent for the legarth; and when all is done, let physicians prate what they please, all the pills in the dispensary purge not the head like to hot things held in the mouth. Being made into an ointment, and the eye-lids anointed with it, it helps inflammation of the eyes, whereby it is palpable, that every stronger draweth its weaker like. The same ointment is excellent good to cleanse malignant and corroding ulcers."

KEY TO SPECIES OF ANEMONE OF MASSACHUSETTS

Achenes densely woolly.

Head of fruit narrowly cylindric; involucre of 6 or more leaves; involucral petioles 2.5 cm. long; leaf segments narrow

A. cylindrica

Head of fruit thick-cylindric; involucre of 3 leaves; involucral petioles 1-2 cm.; leaf segments broad.

Fruiting head 1.5-2 cm.; plant comparatively slender; only slightly pubescent; anthers .7-1.2 mm.

A. riparia

Fruiting head 2-2.5 cm.; plant rather stout; quite hairy; anthers thicker than previous species

A. virginiana

Achenes merely pubescent or nearly glabrous.

Stout, 3-6 dm., branching; leaves of involucre sessile; achenes flat, nearly orbicular, with beak their own length

A. canadensis

Slender, 1-2.2 cm., unbranched; leaves of involucre petiolate; achenes oblong, not flattened, with short beak

A. quinquefolia

(1) Fernald, M. L. - Rhod. 30:183-188
(2) Merck's Index - pg. 80
(3) Culpepper, N. - British Herbal and Family Physician - pg. 17
ANEMONE CYLINDRICA A. Gray Ann. Lyc. N.Y. 3:221. 1836

(Long-Fruited Anemone)

Tall, three to six decimeters; slender; silky-hairy throughout; branched at the involucre. Basal leaves tufted; long petiolated; broader than long; three to five parted; the divisions cuneate-ovate or cuneate-oblanceolate, the lateral divisions two parted, the middle three cleft with lobes toothed and cut at apex; those of the involucre similar, 6 or more, their petioles about 2.5 cm. long. Flowers two to six, on very long, upright, naked peduncles; about 2 cm. broad. Sepals five, greenish-white, oblong, generally obtuse. Head of fruit cylindrical, 2-3.5 cm. long; achenes compressed; woolly; tipped with minute styles. (Plate 20, A)

Rocky woods and dry open places from western Maine to Saskatchewan, south to New Jersey and Pennsylvania, Illinois, Missouri, Kansas, and Rocky Mountains south to New Mexico. May-July.

This species is of very little importance, though it is sometimes used in gardens "for beauty of foliage and fruits" (1).

ANEMONE VIRGINIANA L. Sp. Pl. 540. 1753

(Tall Anemone)

virginiana - meaning of, or from Virginia

Tall, 6-9 dm.; stout; hairy; branching at the involucre. Lateral peduncles bearing secondary involucres. Basal leaves long petiolated; broader than long; three-parted, the divisions broadly cuneate-oblong, pointed, cut-serrate, the lateral two-parted, the middle three-cleft. Those of primary and secondary

(1) Bailey, L. H. - Encyclopedia - pg. 287
involucres similar, on petioles 1-3 cm. long. Peduncles elongate; earliest naked, the others with two-leaved involucels at middle, flowers 2-4 cm. broad. Sepals generally five, white or greenish, acute or obtuse. Head of fruit ovoid or thick cylindric, 2-2.5 cm. long; achenes compressed, woolly, tipped by short, divergent or ascending, subulate styles. (Plate 19)

Roadsides, woods, and meadows, Nova Scotia and central Maine to Alberta and Minnesota and southward to Carolina and Arkansas, June to August. Mentioned in Bailey as of horticultural value (1).

This is our commonest thimbleweed, found along almost any moist and shaded roadside in this part of the state, though reported merely as "occasional" in southeastern Massachusetts (2). There is a form called leucospala Fernald which is sometimes found in Massachusetts. It has been collected in Worcester, Franklin, Hampshire, Hampden and Berkshire Counties. (New England Botanical Club herbarium)

ANEMONE RIPARIA Fernald
Anemone riparia Fernald, Phod. 1:51. 1889

*riparia* - meaning of river banks

Similar to *Anemone virginiana* and *A. cylindrica* but less conspicuously pubescent; comparatively slender; leaves thinner, greener and less strongly veined. Plant 2-3 dm. high, glabrous or loosely pubescent, especially below on the petioles and at the base of the involucre. Leaves thin, three-divided, the cuneate-lanceolate or cuneate-ovate divisions unequally cleft into coarsely and sharply-toothed segments, the lateral divisions very deeply cleft. Involucre three-leaved subtending the one to

(1) Bailey, L. H. - *Encyclopedia* - pg. 286
(2) *Rhod.* 38:108-110
Five slender, elongated naked or involucellate, sometimes proliferous, appressed-silky peduncles. Sepals five, unequal, oval or obovate, obtuse or acutish, large (1.5–2 cm. long and 0.9–1.5 cm. broad), thin, petaloid, white or rarely reddish, canescent-tomentose or glabrate without. Anthers 0.7–1.2 mm. thick (those of other species thicker). Head of fruit subcylindric, 1.5–2 cm. long; scarcely 1 cm. thick; achenes with suberect, pale, subulate persistent beaks (1).

Calcereous river banks, etc., Cassie Company, Quebec to Alberta, south to Maine, western Connecticut, eastern Pennsylvania and western New York. Late May to July.

This species of *Anemone* is typically more northern in range than *A. virginiana* and is much earlier flowering. I have collected it in Lee, North Adams and Leverett, Massachusetts, and each time thought it merely a variant of *A. virginiana*. In all three cases it was found on calcereous ledges, in rather dry situations. In talking with Mr. Weatherby I mentioned my difficulty in always distinguishing *A. riparia* from *A. virginiana* and he admitted that while the difference is often obvious, yet at other times specimens seem to be intermediate between the two. It would be of interest to see if this plant retains its distinct specific characters when it is transplanted to the normal habitat of *A. virginiana*.

Amherst College, Gray Herbarium and the New England Botanical Club have specimens from Buckland, Colrain, Charlemont, Mt. Toby, Royalston and Uxbridge, so the species is well represented in western Massachusetts.

**Anemone canadensis** L.

*(Canada or Round-leaved Anemone)*


*Anemone pennsylvanica* L., Mant. 2:447. 1771

*canadensis* - from Canada

(1) Fernald, M. L. - Rhod. - 1:48–52
Stout; rather low, 3-5 dm.; hairy, especially on lower surfaces of leaves; branching at, or above involucre. Basal leaves long petioled; broader than long; five to seven parted, the divisions broad, oblong, acute, variously cleft and toothed. Primary involucre three-leaved, three-cleft; sessile and very similar to basal leaves; from this arises naked peduncle bearing two-leaved secondary involucre with pair of peduncles. Flowers white, 2.5-5 cm. across. Sepals oblong, obtuse, 1.2-1.8 cm. long. Head of fruit spherical. Achenes flat, nearly orbicular, pubescent; wing-margined and tipped with stout persistent style which is about their own length. (Plate 30, B-C)


This is probably the rarest species of Anemone in Massachusetts. For example, the New England Botanical Club has but 7 sheets collected in only 3 counties: Essex, Middlesex and Berkshire.

ANEMONE QUINQUEFOLIA L.

(Wind-Flower, Snow-Drops)

Anemone quinquefolia L., Sp. Pl. 541. 1753
Anemone nemorosa variety quinquefolia A. Gray, Man. Fl. 5:38. 1867

quinquefolia - from Latin, meaning five-leaved

Low, 1-2.3 dm.; simple; nearly glabrous from thick, filiform, whitish or brown horizontal rootstock. Basal leaves long-petioled; five-parted, the divisions oblong, cuneate, dentate; appearing after the flowering stem. Involucre of three long-petioled trifoliolate leaves, their leaflets similar to those of basal
leaves. Flower solitary on peduncle not much longer than involucre. Sepals four to seven; oval-oblanceolate; white or tinged with purple or crimson without. Head of fruit globose, inclined; achenes fifteen to twenty; oblong; pubescent; tipped with hooked beaks. (Plate 18)


The flowers of this species closely resemble those of Anemonella but aside from the difference in involucre (involucral leaves of Anemone are pectiled, those of Anemonella sessile), the two plants could be told apart by their achenes. The achenes of Anemone are very distinctly smooth (though pubescent), while those of Anemonella are very distinctly ribbed.

Also of interest is the tendency to a red tinge on the outside of the sepalas, and at the tip on the inside. This well illustrates Grant Allen's theory of flower color and suggests accordingly that Anemone stands midway as regards its phylogenetic position among the Ranunculaceae.

Anemone quinquefolia is very close to the European A. nemorosa but differs in more slender habit and slender petioles, fewer lobed divisions of the involucral leaves, paler green foliage, more slender rootstocks and smaller flowers (1).

As previously mentioned it is sometimes used in the perennial border in shady places or in wild flower gardens.

Sargent reports that the flowers are poisonous and "dangerously attractive to children". Pammel speaks of irritating properties in the plant and of its use in homeopathic medicine with "results doubtful". (2)

ANEMONELLA Spach., Hist. Veg. 7:239. 1829

(Lyndesmson Hoffmg., Flora, 15: Part 2, Intell. El. 1,54. 1832)

Low, glabrous, perennial herb arising from a cluster of tuberous-thickened roots with two to three ternately compound

(1) Britton and Brown's Manual - pg. 100
(2) Sargent, F. L. - Useful Plants - pg. 209; Pammel, L. H. - Manual of Poisonous Plants - pg. 455
radicle leaves; those of the involucre similar, but sessile at base of an umbel of slender-pedicelled flowers. Sepals five to ten, thin, petaloid and conspicuous. Petals none. Stamens all anther-bearing. Stigma terminal, broad and depressed, sessile. Achenes four to fifteen; ovoid; terete, strongly eight to ten ribbed, sessile.

A monotypic genus of eastern North America.

*Syndesmon* was the name used earlier for *Anemonella* (1832 vs. 1839) and comes from the Greek meaning bound together, in reference to the characteristics of *Anemone* and *Thalictrum*, which are united in this plant. The flower closely resembles that of *Anemone quinquefolia*, as well as the habit, while the leaves resemble those of the thalictrums. As a consequence of these resemblances, *Anemonella* has been placed in both genera at one time or another. According to the *International Rules* (1), *Syndesmon* was not properly published though it appeared before *Anemonella*, so it is not tenable under these rules. It is maintained, however, under the American Code (2).

**ANEMONELLA THALICTROIDES** (L.) Spach

*Anemone thalictroides* L., Sp. Pl. 542. 1753  
*Thalictrum anemonoides* Michx., Fl. Bor. Am. 1:338. 1803  
*Syndesmon thalictroides* Hoffm., Flora 15: Part 2, Intell. Bl. 4, 34. 1832  
*Anemonella thalictroides* Spach., Hist. Veg. 7:240. 1839

*Anemonella* - diminutive of *Anemone*, to which it is similar in some respects

thalictroides - *Thalictrum*-like

Low, 1-2.4 dm.; glabrous; perennial herb. Stem and slender petiole of radicle leaf from cluster of thickened tuberous roots. Basal leaves two to three ternately compound; appearing

(2) Followed by Britton and Brown
later in spring and resembling those of *Thalictrum*; leaflets roundish, somewhat three-lobed at end, cordate at base, long-petiolulate; those of the two- to three-leaved, one- to two-ternate involucre similar, sessile. Flowers perfect; several in an umbel, immediately above the involucre; 1-3 cm. broad. Sepals five to ten, oval, 1.2 cm. long and longer than the stamens, white or sometimes pinkish, not early deciduous. Achenes sessile, pointed, 0.6-0.9 cm. long. (Plate 17)


This plant occasionally bears leaves on the stem below the involucre. The sepals, stamens or involucre are sometimes variously modified. Flowers have been collected (1) with small, green sepals and stamens converted into sessile, elliptic-oblancoolate, green, sepaloid structures but with normal carpels. Other specimens have been reported whose green sepals were edged with white, whose stamens were peculiar, and which possessed short, sessile, leaf-like carpels. These teratological flowers would seem to be significant as showing leaf origin of all members of the flower. There are cases of double flowers on record, both white and roseate; one called variety *flore-pleno* Hort. is considered worthy of cultivation (2).

In growing the plants, partial shade is necessary and the soil should be moist and light or sandy. When undisturbed for some time "they will form a carpet of great beauty". Propagation is by division of roots in the spring or fall, but since this division weakens the plants, it is best to take them from the edges of beds (2).

**AQUILEGIA** (Tourn.) L. Sp. Pl. 533. 1753

(Columbine)

Erect, branching, perennial herbs arising from short, fleshy rhizome. Leaves two- to three-ternately compound with

(1) Robinson, B. L. - *Rhod.* 3:205
(2) Bailey, L. H. - *Encyclopedia* - pg. 3296
petioles dilated at base and possessed of stipule-like appendages; leaflets lobed. Flowers large, showy, terminating the branches.

Sepals five, regular, pctaloid. Petals five, concave with short spreading lip, produced backward between the sepals into hollow spurs much longer than calyx. Stamens many, the inner ones reduced to staminodia. Carpels five, sessile, with slender styles, forming heads of erect, many-seeded follicles in fruit.

The genus name Aquilegia is of doubtful derivation, some authors deriving it from the Latin agilia, eagle, in reference to the prominent, often curving, spurs of petals, like those of beak or claws of an eagle; others maintain it is from the Latin aquilegus, water-drawer, in reference to the nectariferous spurs (4). The common name columbine comes from the Latin columba, a dove, referring to the spurred petals which make the flower comparable to a bird, the sepals forming wings (5).

Aquilegia is a genus of about fifty species distributed throughout the North Temperate zone and extending into the mountains of Mexico. There are about twenty-three species native of North America, with twenty of these appearing in western parts of the United States.

In connection with Aquilegia we find the genus playing a part in one of the most interesting of medieval classifications of flowers. Albertus Magnus (Bishop of Ratisbon, "a famous scholastic philosopher, esteemed one of the most learned men of his age and a follower of Aristotle and Theophrastus") classified flowers under bird forms (Aquilegia), pyramid or bell forms, and star forms (4).

In the field of art we find Aquilegia holds a place. It is "scarcely possible to imagine a more perfect 'habit drawing' of a plant than that of Albrecht Dürer's Aquilegia." This is among the more famous in a series of plant drawings done by Dürer in 1526 (5).

(1) Loudon's Encyclopedia - pg. 479; also Britton and Brown's Manual - pg. 32
(2) Bailey, L. H. - Encyclopedia - pg. 339
(3) Funk and Wagnalls Standard Dictionary; also Lindsay, T. S. - Plant Names - pg. 4
(4) Arber, Agnes - Herbs - pg. 123
(5) Ibid., pg. 168
In cultivation, aquilegias are "hardy perennial herbs
grown for their profusion of showy flowers in early summer, and
the delicate foliage later on in the year". Bailey says of them
(1):

"The columbines are among the most beautiful and
popular of all hardy plants. The tall and strong-growing species
can be used to advantage in half shady positions. The attractive
forms and rich variations in hue of aquilegias come out well
when associated with Hemerocallis, Siberian irises, thalictrums,
Polygonatum, Spiraea Filifolia and wild ferns. In the North,
a similar effect is produced by grouping columbines together with
white and blue Lupinus polyphyllus, Campanula persicifolia, Iris
germanica and Iris pallida variety dalmatica, Iceland poppies and
Trollius. For rockeries, the low growing early alpine species
such as Aquilegia alpina, A. Stuartii and A. flabellata are well
adapted. Throughout the middle and northern States, columbines
need winter protection, dry leaves being preferable for covering."

"Seeds sown in pans in coldframes in March, or open air
in April, occasionally bloom the first season, but generally the
second. The different species should be some distance apart, if
possible, if pure seed is desired, as the most diverse species
hybridize directly. They may be propagated by division of roots
in late fall, or early spring, but the better way is by seeds.

- - A. caerulea, A. glandulosa and A. vulgaris are likely to
flower only two or three years, and should be treated as biennials;
but A. vulgaris may be kept active for a longer period by
moving."

"A light sandy soil, moist, with good drainage, shelled,
but exposed to the sun, is what aquilegias prefer" though
stronger species will succeed in heavy garden soil.

Many of the common garden columbines are not true
species, but either mutants or hybrids of Aquilegia glandulosa,
A. vulgaris, A. siberica, A. caerulea, A. chrysanta and A. Skin-
meri, all of which are mentioned more in detail below. The old
world species usually have hooked spurs while those from America
have straight or merely knobbled ones.

A. oxysepala Traut. and Mey. blooms in June and comes
from Siberia. It is "said to be one of the first to bloom, and
one of the most attractive in the list. It is one of the most
dwarfed. The flowers are large, blue, yellow and white; it comes
so much before the others that its pistils, as a rule, are all
fertilized before any other species comes into flower." It has
only recently been introduced.

(1) This and the following material on species of Aquilegia in
cultivation is from Bailey's Encyclopedia - pg. 343-348.
Aquilegia lactiflora Kar. and Kir., of the Altai Mountains of Siberia, also blooms in June, but later than A. oxysepal. The flowers are white or tinged with blue, about one-half inch long with slender sepals and spurs one-third inch longer. It is said to be a desirable species, but not much planted.

A. canadensis L. is the columbine native of Massachusetts and is found practically everywhere east of the Rockies. There are some beautiful hybrids of this species and the blue variety nana Hort. The pale yellow-flowered variety flavescens Hook. is also very pretty.

A. vulgaris L. is one of the most common species in cultivation. It is native of Europe and Siberia, but has become widely naturalized in America, and is by many botanists included among plants growing wild in Massachusetts. For example, specimens collected in woods or by road-sides are included among local floras of Needham, Ashburnham, and Mt. Washington (New England Botanical Club). The variety flore-pleno Hort. has very double flowers and occurs in many horticultural forms. The variety Vervaeneana Hort. has leaves with yellow variegations. Variety nivea Baumg. bears pure white flowers for several weeks in early spring. Variety olympica Baker bears several, large, light lilac to bright purple flowers much esteemed by gardeners. An interesting teratological specimen of A. vulgaris is a specimen from the herbarium of Margaret B. Simmons (now in the herbarium of the New England Botanical Club) which bears the inscription: "Monstrosity - reversion of flower parts to leaves".

A. siberica Lam. has pale to bright lilac-blue single flowers, while its variety flore-pleno Hort. possesses very double ones. The variety spectabilis has very large flowers.

A. Skinneri Hook. is a very handsome plant with bright red spurs over an inch long. The sepals are green and petal limb greenish-orange. Its variety flore-pleno Hort. is a very fine double-flowered form.

A. chrysantha Gray has pale yellow sepals tinted claret, with deep yellow petal limbs, and spurs about two inches long. There are variants: single and double, white to yellow, and the plants vary in height from one and one-half feet to four feet. It is a long-blooming species with either the species or the varieties in flower from May to August.

A. longissima Gray is one of the longest-spurred species. The flowers are pale yellow with spurs four inches long or more. It is similar to A. chrysantha but the petals are narrower and the season of flowering occurs from late July to October first. "The seeds must be obtained from wild plants (southwestern Texas into Mexico) since those cultivated usually fail to produce seed."
Aquilegia caerulea James is the source of many of the cultivated columbines. The flowers are two inches across, whitish or variously tinged with light blue and yellow. A variety with sepals often blue comes from the mountainous regions of Montana to New Mexico. The variety hybrida Hort. (or sometimes called variety lutea Hort.) has sepals some shade of blue or pink, or mixed, and petals nearly white or yellow. Variety Helenae Hort. is very robust with numerous blue and pure white flowers. Variety flore-pleno Hort. has longer and more showy, more or less double, flowers.

A. alpina L. is one of the handsomest species and it is a native of Switzerland. It grows about one foot high and bears bright blue and rarely pale or white flowers one and one-half to two inches across.

A. glandulosa Fisch. is similar but taller and with shorter spurs and larger flowers. It comes from the Altai Mountains of Siberia. The variety jacunda Fisch. and Lall. has somewhat smaller flowers, but is a fine variety with tendency to become double-flowered.

As an herb of Venus, Aquilegia was recommended for medicinal use by the old herb doctors (1). It is said to be free from alkaloids (2), yet Linnaeus is said to affirm that children have lost their lives from eating it (3). The leaves have been used in lotions for sore mouths and throats, and seeds taken in wine with a little saffron is stated to be good for liver and jaundice troubles (1). The Spaniards used to eat a piece of the root in a morning fasting "to help them when troubled with the stone in the reins or kidneys".

**Aquilegia Canadensis** L.

(Wild Columbine, Rock-Bells, Honeysuckle, Rock-Lily)

Aquilegia canadensis L., Sp. Pl. 533. 1753
Aquilegia flaviflora Tenney, Amer. Nat. 1:389. 1867

Aquilegia - (see under genus name)

canadensis - from Canada

(1) Culpepper, N. - British Herbal and Family Physician - pg. 97
(2) Pammel, L. H. - Manual of Poisonous Plants - pg. 446
(3) Loudon's Encyclopedia - pg. 476
Glabrous or somewhat pubescent; 3-6 dm. high; branching. Lower and basal leaves slender-petioled, bi-ternate; 1-1.5 dm. broad; the ultimate leaflets sessile or on very short stalks, obovate, obtuse, cuneate, obtusely lobed and toothed, pale beneath; leaves of upper part of stem lobed or divided. Flowers nodding, 2.5-5 cm. long; scarlet with yellow inside, or rarely white or yellow; spurs nearly straight, about 1.3 cm. long, thickened at end. Stamens and styles long-exserted, much longer than ovate sepals. Head of fruit erect; follicles slightly spreading, about 1.8-2 cm. long, tipped with filiform beak of about the same length. (Plate 6)

Rocks or open woods, Nova Scotia to "Northwest Territory" south to Florida and Texas. Ascending five thousand feet in Virginia, and also reaching high altitudes in Rocky Mountains. April–June.

It is interesting to note that on sheets with plants collected in Dukes County in 1897 it is recorded as being "scarce" or "not common". If this be true today, it is probably the only part of the state where it is not common.

This species consists of several geographic (?) races differing in size and color of flowers, in length of spurs and in pubescence. The variety Philpenii J. Robinson is salmon pink in color and has been reported occasionally from the eastern part of Massachusetts (Salem and Boylston) (1). It has slightly paler foliage than the species.

The roots (rhizomes!) of this species were eaten for food by some tribes of North American Indians (2).

**Caltha** (Fupp.) L. Sp. Pl. 558. 1753

(Marsh Marigold)

Glabrous, succulent; perennial herb with large, simple,

(1) Rhod. 31:36; Rhod. 18:165-166
(2) Brown, R. - *Gardeners Chronicle* - 1820; 1868
entire or crenate, mostly basal, cordate, auriculate or reniform leaves. Flowers yellow, white or pink. Sepals five to nine, large, petaloid, deciduous. Petals none. Stamens numerous, obovoid. Carpels five to ten, sessile with scarcely any style; maturing into compressed, spreading, many-seeded follicles.

*Caltha* is the ancient Latin name for the common marigold and is a syncope of the Greek word meaning a goblet "in allusion to the form of the corolla (sic!) which may be likened to a golden cup" (1).

*Caltha* is "a genus of beautiful marsh plants comprising about fifteen species distributed through the temperate and arctic regions of both hemispheres". In North America we have seven or eight species, three of them being eastern.

As regards their use in cultivation Bailey says of *Caltha* (2): "Beautiful hardy blooming plants, the largest and best of which are used about water gardens and moist parts of borders. Calthas flourish best in wet places near running water. Though naturally bog-plants, they succeed admirably well in an ordinary border in rather rich soil. They should be introduced more liberally into the flower garden, where they bloom very freely year after year, and usually mature a second quite abundant crop of bloom in the fall. The flowers last a long time in water and sell readily in the cut-flower market."

Propagation is either by the division of roots in late fall or mild winter weather, or by seed sown when fresh in moist, cool, partially shaded place.

The chief species of horticultural importance are: *Caltha palustris* L. and its very beautiful variety *monstrosa-pleno* Hort. (with larger, often much doubled flowers) and variety *Tyermanii* Hort., a dwarf form; *C. polypetala* Hochst., with flowers three inches across and many stolons by which the plant is readily propagated; and *C. elata* Buthrie with golden yellow flowers smaller than those of *C. palustris*, and orange-colored stamen filaments and black anthers.

(1) Loudon's *Encyclopedia* - pg. 490
(2) Bailey, L. H. - *Encyclopedia* - pg. 637
Caltha palustris L., Sp. Pl. 553. 1733

Caltha - (see under genus name)

palustris - from the Latin, meaning marsh-loving, in reference to their habitat

Stout, glabrous, erect or ascending, 2-5 cm. high, branching. Stem hollow, furrowed, with lower internodes very short and leaves crowded together. Basal leaves on long and broad petioles, cordate or reniform, 5-17.5 cm. broad with narrow sinus; entire, crenate or dentate; the upper shorter-petioled or sessile, with nearly truncate bases. Flowers bright golden-yellow, 2.5-4 cm. broad. Sepals broadly oval, obtuse. Follicles three to twelve, or even more; compressed; 0.9-1.3 cm. long; slightly curved outward; with many seeds in two rows along the ventral suture. (Plate 3)

Swamps and wet meadows; New Brunswick to South Carolina west to Saskatchewan and Nebraska. Ascensus to twenty-five hundred feet in Virginia. April-June.

Locally Caltha is called "cowslip", and when coming into flower in the spring is much used for greens and is by many considered superior to any other plant used in this way, sometimes even being cultivated for this purpose. The plant is reputed poisonous in the green state, but boiling dissipates the poisonous principles. In all parts of the plant is found a colorless juice which has a rather sharp, acrid taste. This is probably an alkaloid identical with the acrid substance in Ranuncula. In May, the marsh marigold produces diarrhea and stop age of the flow of milk in cows. Rafinesque reports that cattle ate as a consequence of an inflammation of the stomach produced by eating the plant (1).

(1) Pammel, L. H. - Manual of Poisonous Plants - pg. 448-449; also Sargent, F. L. - Useful Plants - pg. 139
In the southern States, particularly, the flower buds are pickled for use as a substitute for capers (1). The juice of the sepals boiled with alum can be used to dye paper yellow (2).

Caltha is, perhaps, the best "primitive" type for use in teaching students the structure of a flower.

**CIMICIFUGA** L. Syst. Ed. 12:659. 1767

*(Bugbane)*

Tall, erect, perennial herbs with two- to three-ternately divided leaves; the leaflets cut-serrate. Flowers small, white; in elongated wand-like racemes. Sepals two to five, petaloid, soon deciduous. Petals (transformed stamens) one to eight, small, clawed, two-lobed or horned at apex. Stamens numerous, the filaments filiform and white. Carpels one to eight, many-ovuled, sessile or stipitate, with broad stigma, forming follicles at maturity.

Cimicifuga comes from the Latin cimex, bug, and fugere, to flee or drive away, indicating certain virtues the plant is supposed to possess (3).

There are about ten species of Cimicifuga, natives of North America, Asia and eastern Europe. We have six species in North America, with three of them in the eastern states.

In spite of the distinctly bad odor of the flowers, Cimicifuga is a very attractive and ornamental plant for the back of plantings or in the hardy border. Practically all species have been used in gardens and they have been found to thrive best in half shady places in rich, black soil, although they may be successfully grown in open places with any good garden soil (4). Propagation is by seeds sown in cool, moist soil soon after ripening.

(1) Sturtevant's *Notes on Edible Plants* - pg. 187
(2) Loudon's *Encyclopedia* - pg. 490
(3) Ibid., pg. 476
(4) Bailey, L. H. - *Encyclopedia* - pg. 769
ing, or by the division of the large knotted rootstocks in fall or early spring, *C. racemosa* is perhaps the most popular and most often cultivated species and is "very pretty in fruit (as well as blossom) with its two rows of oval follicles always extending upward from the lateral branches". *C. racemosa* variety dissecta differs in having the leaves more compound and in blooming until September, while the species blooms in July and August. The variety has its short-pedicelled flowers in particularly fine, dense racemes.

*G. serpentinaria* (probably *C. racemosa*) is reported as having been "used with success by the native practitioners in North America for curing the dangerous bite of the rattlesnake" (1).

*C. foetida* L. of eastern Europe and Siberia is called the "stinking bugwort" and was used "for destroying insects, particularly the pests from which it takes its name" (bugs!) (2).

All species of *Cimicifuga* have nauseous, astringent and bitter taste to roots and other parts.

**CIMICIFUGA RACEMOSA** (L.) Nutt.

(Black Snakeroot, Black Cohosh, Rattle Snakeroot)

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*Cimicifuga racemosa* L., Sp. Pl. 594. 1753
*Cimicifuga racemosa* Nutt. Gen. 2:15. 1813
*Cimicifuga racemosa* dissecta A. Gray, Man. Ed. 3, 47. 1830

*Cimicifuga* - (see under genus name)

*racemosa* - racemose, referring to the type of inflorescence

Tall, 1-2.6 m. high, slender; from a thick-knotted root-stock; leafy above. Leaves two-to three-ternately, and then often quinately compound. Leaflets few, very broadly ovate, oblong or orbicular; obtuse, acute or acuminate at the apex; sub-cordate or sub-cuneate at base; incisely toothed, cleft,

(1) Loudon's *Encyclopedia* - pg. 476
(2) Smith - *Dictionary of Economic Plants* - pg. 382
divided or occasionally dissected, thickish, nearly glabrous. Racemes compound, terminal, 1.5-4.5 dm. long (in fruit becoming 3-9 dm. long), usually finely pubescent; pedicels bracted. Flowers 1.2-1.5 cm. broad, foetid. Petals four to eight, two-cleft. Stamens very numerous. Carpels one or two, sessile; stigma broad. Follicles ovoid, 0.6-0.8 cm. long, minutely beaked. Seeds in two rows, smooth, flattened. (Plate 23)


At present there are but two known stations for Cimicifuga racemosa in Massachusetts - Sheffield in Berkshire County, and Bernardston in Franklin County. At the time of our visit to the Bernardston locality in 1833, the colony occupied an area of about an acre. In both places it appears to be indigenous. This is of interest, since it brings the range of the plant east almost to the Connecticut River and north to the Vermont line. Although we find reference to its existence in Canada and Newfoundland, it is probably escaped from cultivation there (1).

This plant has been cultivated in most botanic gardens and was first introduced into Europe early in the eighteenth century (2).

Bentley and Trimen give the following notes as to its use (2). It is officinal only in the United States. For medicinal use the bitter, slightly acrid and astringent roots should be collected in autumn because it is most active then. The active principle is cimicifugin or macrotin, a resinoid. By some, the plant is used as a nervous sedative, and by others, as a stimulant. It has been proved valuable for acute rheumatism, and chorea, and has been given with success for lumbago, bronchial diseases, epilepsy, dropsy, hysteria, fevers, etc.

CLEMATIS L.

(Virgin's Bower)

Perennial herbs or vines, mostly a little woody and

(1) Churchill, J. R. - Phcod. 25:201; Phcod. 28:17
(2) Bentley, R. and Trimen, H. - Medicinal Plants - Vol I:No. 8
climbing by means of the bending or clasping of the leafstalks; rarely low or erect. Leaves opposite; slender-petiolated; pinnately compound. Flowers cymose-paniculate or solitary, often dioecious. Sepals four or five, valvate in the bud, erect or spreading, petaloid. Petals none, or small and spatulate. Stamens numerous; filaments mostly glabrous, with the outer ones sometimes broadened; anthers narrow and linear or short and blunt. Carpels numerous, one-seeded, with long, persistent, plumose styles.

*Clematis* is supposedly the name given by Dioscorides "for a climbing plant with long and lithe branches" and comes from the Greek klena, a vine-branch or tenaril, referring to the climbing habit of the plants (1).

Botanically, the genus is usually divided into three subgenera or sections (2): *Flamula* DC. with rather small cymose-paniculate flowers usually dioecious, or the pistillate with some sterile stamens; sepals petaloid, whitish, spreading, thin; petals none, and anthers short and blunt; *Viorna* Reichenb. with large usually nodding, solitary flowers on long peduncles; sepals thick, erect and connivent at base, mostly dull purple; petals none and anthers narrow and linear; and *Atragene* DC. with flowers large, solitary on peduncles, sepals thin and widely spreading, some of the outer filaments enlarged and more or less petaloid.

Some authors raise each of these sections to the rank of a genus. The section *Flamula* then becomes *Clematis*; while *Viorna* and *Atragene* pass from sectional to genus rank (3). Horticulturally, the genus is split up into even more sections and groups. Bailey gives the following (4):

Section **Viorna** - Group Crispae, Group Tubulosae, Group Connatae, Group Atrageneae
Section **Pseudanemone**
Section **Viticella**
Section **Vitalba** - Group Cirrhosae, Group Montanae, Group Rectae, Group Euvitalbae, Group Hexa-petalae, Group Orientales.

(1) Gray's Manual - pg. 402; also Lindsay, T. S. - Plant Names - pg. 62
(2) Gray's Manual, Ed. 7
(3) Britton and Brown's Manual, Ed. 2
(4) Bailey, L. H. - Encyclopedia - pg. 790-798
In all there are about one hundred species of wide distribution in temperate regions. The clematids of the Flammula group have a particularly wide geographic distribution. There are two species in the eastern, and several species in the western and southern part of North America. The viornas are natives of Europe and North America with about ten species occurring in the eastern part of the United States and extending into Mexico but with no representatives in Massachusetts. Atragene is the smallest group with five species native of the north temperate zone and with three species in North America but only one of these occurring in Massachusetts.

Most species of Clematis are recorded as poisonous to some extent due largely to the presence of an alkaloid, to saponin, and to hydrocyanic acid (1).

Many species of Clematis are very ornamental and they are cultivated mostly as climbing shrubs "to cover walls, roof-fences, mounds, trellises, arbors, balconies, small buildings, etc." (2). They grow rapidly and are free-flowering and sometimes sweet-scented. Not only are they prized for their flowers but also for the attractive feathery-tailed fruits. Sometimes the less vigorous species are used for pot culture in greenhouses and for conservatory walls. Some "dwarfier and more bushy species are used in borders or in large rockeries, and the future should see the introduction of more of the bush types".

The clematises require a light and loamy soil, and one that is kept rich and well-drained. A little lime mixture in the soil is advantageous. Considerable moisture is needed, and this is usually secured by the use of cow manure for fertilizer and the spraying of the plants during their growing period. The plants should be trained on solid wooden or metal trellises rather than on strings or pilable supports. Clematis which blossom from one year old wood should have all weak or overcrowded branches trimmed off in February or March, while the species which blossom from new shoots each year need to be vigorously cut back in November.

The propagation of clematises is usually by grafting scions of plants grown under glass before the wood is entirely ripe, onto roots of C. Flammula and C. Viticella, or by taking ripe wood cuttings and rooting in sand. The latter is the more economical commercially and does away with the danger that sprouts from roots may supplant the grafted scions. Layering is sometimes used as a method of propagation when old stools are at hand, and finally the seeds of many species may be sown. The last mentioned method has yielded many new varieties for the plants hybridize readily.

(1) Pammel, L. H. - Manual of Poisonous Plants - pg. 446-447
(2) Bailey, L. H. - Encyclopedia - pg. 487-783 (Culture and Use of Clematis)
In this country the propagation of the large flowering species has not been attempted to any great extent because of many difficulties. Practically all plants sold by nursery-men have been imported from Holland where "moist atmosphere and black soil produces large, vigorous plants". However, their climate and ours are so entirely different that the plants "often failed to adapt themselves to our surroundings".

The plants are subject to the attacks of nematode worms, and there is no cure for them when once affected. However, hard freezing kills the parasite, and so, if only well frozen soil is used in propagation, the danger of infection is diminished.

As previously mentioned, the clematises hybridize readily, and the result has been a great number of varieties and forms, some very beautiful, but few of which have become popular or "secured a permanent place for themselves". This is chiefly because of a "deficiency in a vigorous habit of growth and abundance of bloom".

It is to Clematis lanuginosa Lindl. of China, more than to any other species, "that the beauty and popularity of the garden varieties and hybrids are due". The finest hybrids, including C. Jackmanni Moore and its sections, and C. Lawsoniana Anderson-Henry contain more or less of the blood of C. lanuginosa. The following are the most outstanding garden clematises among the hybrids of this species:

C. lanuginosa variety candida Lem ina bears large, seven-to-eight-inch, white flowers with purplish shading around the margins of the sepals. C. Lawsoniana variety Henryi bears creamy-white flowers and blooms from August to November. C. Jackmanni Moore has very broad velvety purple flowers, usually in threes and forming panicles at the ends of the branches. The stamens are borne in a tuft and are pale green in color. (C. Jackmanni is also the name applied to a series of hybrids of C. lanuginosa and C. Viticella, the first of which bloomed in 1862.) Madame Grandé Mort. is a purple-crimson, double-flowered variety, while the purple flowered Star of India Cripus, and the blackish-purple velutina purpurea Jackman are also double-flowered hybrids. Madame Baron Veillard Baron Veil. bears light rose flowers shaded with lilac, and Madame Édouard Anard is a deep rich crimson.

C. patens Morr. and Decon. is almost as prolific as C. lanuginosa in the production of garden varieties and hybrids and is the species most likely to produce double-flowered forms. The variety Standishii Moore is a fine Japanese variety flowering profusely in the spring. Here, too, come the hybrids Mrs. George Jackman Jackman with bluish white sepals and indistinct wine-red bars, and Duchess of Edinburgh Jackman with white, strongly imbricated double flowers.

Under C. Viticella comes the hybrid C. venosa Krampen
with purple-barred white flowers and purplish stamens. *C. Vitica* is one of the parents of the *Jackmanni* type of hybrids.

Of the small-flowered species of clematis, the white, sweet-scented and very floriferous *C. paniculata* of Japan is very popular and "is by far the most common of the fall-blooming species in American gardens". This species tends to become naturalized. For example, in the herbarium of the New England Botanical Club are two sheets collected by Professor Fernald and Bayard Long. The specimens were collected from a roadside thicket in Barnstable.

The blue *C. crispa* L. and the red *C. texensis* Buckl. have pretty bell-shaped flowers and both are easily grown and do well in almost all situations. There are several hybrids of these two species among the garden forms.

Of the perennial non-climbing clematis, the bright blue and fragrant *C. heracleifolia* DC. variety Davidiana Hemsl. and the white, also sweet-scented *C. recta* L. are about the best known and most desirable varieties. *C. gracilifolia* Rehd. and Wilson from western China is a very graceful and floriferous clematis which has proved hardy at the Arnold Arboretum, as has the very beautiful Chinese species *C. Spatheri* Rehd. and Wilson.

*C. montana* Buch-Ham., is a vigorous climber with sweet-scented flowers resembling anemones; it comes from the Himalayas. There are several varieties and hybrids. *C. Vitalba* L., called in England the Traveler's Joy, is the most vigorous climber of the genus, sometimes ascending twenty to thirty feet. The flowers are "numerous, in axillary panicles and dull white in color with a faint odor of almonds. The styles of the fruit are long-tailed and feathery, hence the name 'old man's beard'." It blooms from July to September.

*C. tangutica* Korshinsky is a "very handsome bright yellow-flowered species which is said to be hardy. It comes from Mongolia and blooms in June and sometimes again in August." *C. serratifolia* Rehd. is also a yellow variety which is quite hardy and comes to us from Korea.

Aside from their use in horticulture, there is little to be said for *Clematis*. Pammel reports that in Cuba one species is used in case of tooth ache to blister the face and also used in the same way for rheumatism; and that *C. recta* produces blisters and often ulcers and causes the eyes to water and become inflamed, while an infusion is used to cure the "itch" and violent inflammation of skin results (1). The young shoots of *C. Flammula* may be eaten when boiled (2).

(1) Pammel, L. H. *Manual of Poisonous Plants* - pg. 456
(2) Sturtevant's *Notes on Edible Plants* - pg. 178
A wood cut of Clematis first appeared in Dodoen's "Pemptades" of 1583 and this reappears either in identical form or more or less accurately copied in works of de l'Obel, de l'Ecluse, Gerard, Parkinson, Jean Bauhin, Chabraeus and Petiver (1).

KEY TO SPECIES OF CLEMATIS NATIVE OF MASSACHUSETTS

Flowers white, small, cymose-paniculate; dioecious; petals none — — — — — — — — — — — — — — — — — — C. virginiana

Flowers pinkish-purple, large, solitary, perfect; petals present, small and spatulate — — — — — C. verticillaris

CLEMATIS VIRGINIANA L.

(Virginia Virgin's Bower, Love Vine, Devil's Hair)

Clematis virginiana L., Amoen. Acad. 4;275. 1759

CLEMATIS — (see under genus name)

virginiana — of, or from Virginia

Long vine twelve to fifteen feet, climbing over shrubs in low woodlands, along fences and water courses. Leaves 5-7.5 cm. long; glabrous, or nearly so in maturity, silky-villous beneath when young; trifoliolate or rarely quinquifoliolate; leaflets broadly ovate, acute at apex, toothed or lobed; cordate at base; dark green above and paler beneath. Flowers white, in leafy panicles, monoecious or polygamous or dioecious; 1.6-2.5 cm. broad when expanded. Sepals silky, valvate in bud. Stamens with glabrous filaments. Styles persistent, plumose; 2.5 cm. or more long. (Plate 22)

(1) Arber, Agnes — Herbals — pg. 191,192

This species is very similar to the western North American C. ligusticifolia Nutt., and both are sometimes cultivated for ornamental purposes in their respective localities. In Massachusetts this species is very common in the western part of the state, but herbarium specimens from the region of Cape Cod are few. Whether this is a case of the plant actually being rare in that region, or a case of lack of collecting in the locality, we are not prepared to say.

**Clematis Verticillaris DC.**

(Purple Virgin's Bower, Whorl-leaved Clematis)

Atragene americana Sims., Bot. Mag. Pl. 837. 1806

Clematis verticillaris DC., Syst. 1:166. 1818

**Clematis** - (see under genus name)

**verticillaris** - from Latin, meaning verticillate, in reference to the arrangement of the flowers and leaves

A trailing or partly climbing, somewhat woody, nearly glabrous vine. Leaves trifoliate with slender petioles and petiolules; leaflets ovate or slightly cordate; thin; acute; toothed or entire. Flowers pinkish-purple or purplish-blue; 5–7.5 cm. across. Sepals four; thin and translucent; strongly veined; silky along the margina and the veins. Petals spatulate; 1.2–1.9 cm. long. Style persistent, plumose throughout; about 5 cm. long. (Plate 21)

Rocky woodlands and thickets chiefly in calcareous regions, eastern Quebec, Hudson Bay to Manitoba and locally to Connecticut, Delaware, Virginia, Michigan and Minnesota. Ascends three thousand feet in the Catskills. May–June.

This is one of our rarer ranalian plants, but one of the most attractive. In the immediate vicinity of Amherst, it
is comparatively common, having been collected in Amherst, Leverett, Sunderland, South Hadley, and on Mt. Toby, Mt. Tom and Mt. Holyoke. It has also been reported from Bardwell's Ferry (Shelburne) and from Berkshire County. In the eastern part of the state, a single specimen from Pine Hill in Middlesex Fells represents the species in the New England Botanical Club Herbarium.

**Coptis** Salisb. Trans. Linn. Soc. 6:305. 1803

(Goldthread)

Low, smooth, perennial herbs with slender yellow rhizomes. Leaves basal, ternately divided. Flowers small, white and scapose. Sepals five to seven, petaloid, deciduous. Petals five to seven, small, club-shaped, hollow at apex. Ste- mens fifteen to twenty-five. Carpels three to seven, slender, stipitate; in fruit forming an umbel of divergent, membranaceous, pointed, four to eight-seeded follicles.

The genus name Coptis comes from the Greek meaning to cut, referring to the divided leaves (1). The common name "goldthread" refers to the slender gold-colored rootstock.

Coptis is a genus of about nine species, native of the cooler portions of the north temperate zone. We have four species in North America, but only one of these occurs in the eastern part of the United States. Our Coptis groenlandica is so nearly similar to the Coptis trifolia of northeastern Asia and Alaska as to have passed for some time as the same species. However, "though closely related they are quite definite in their individual differences. C. trifolia has longer petioles, sessile leaflets, broader, rounder-tipped sepals with definite claw, more rhombic petals, fewer carpels, smaller follicles, shorter beaks and more crowded somewhat quadrate seeds" (2).

Coptis is sometimes planted in bogs and moist places and is considered "neat and pretty with shiny leaves". The

(1) Loudon's *Encyclopedia* - pg. 469
(2) Pernald, M. L. - *Rhod. 31:156-142*
plants require a peaty soil mixed with a little sand, and prefer shade and damp situations. The plants are valued for hardy borders because their leaves are so attractive, and if covered with leaves in the fall, remain fresh and green. Propagation is most easily accomplished by seeds sown when ripe in moist but well-drained soil in partial shade covered slightly, and then kept moist (1).

*C. trifolia* has been cultivated in several botanic gardens and was first introduced into England in 1782. All parts of this plant (as well as other species) are bitter, but the bitterness is most evident in the rhizomes. They contain as high as eight and one-half per cent of berberine and another alkaloid captine, which resembles hygrastine. There is no tannic or gallic acid present, hence the drug may be used as "pure bitters". In commerce the rhizomes and varying proportions of stems and leaves are sold as goldthread, from which a tonic is made resembling quassia, gentian, etc. and "applicable in all cases as quassia but high priced". It is often applied locally for ulcers and canker sores in the mouth (2).

*C. teeta* Wall. is commonly sold in bazaars in India where it is called Mishas Bitter or Mishmi Tita. The Chinese call it Hwang-lion or Honglione and Chuen-lion or Chonlin. Bentley and Trimen speak of its importation into Bengal from Mishmi Country in Assar "in neat little baskets or bags with open meshes, made of narrow strips of rattan, each containing from half an ounce to two ounces of the drug (2). It was once imported in bulk and offered for sale in London and used for debility, atomic dyspepsia, recovery from exhausting diseases, mild forms of intermittent fevers, etc.

**COPRIS GROENLANDICA** (Ceder) Fernald Rhod. 31:156. 1929

(Gold Thread, Canker Root, Mouth Root)

Aneamone groenlandica Ceder
Helleborus trifolius L., Sp. Pl. Pd. 2, 754. 1782
Coptis trifolia Salisb., Trans. Linn. Soc. 3:305. 1805

Coptis - (see under genus name)
Groenlandica - of Greenland

(1) Bailey, L. H. - *Encyclopedia* - pg. 841
(2) Bentley and Trimen - *Medicinal Plants* - Vol 1, No. 5
Tufted; glabrous; 7.5-15 cm. high from slender or filiform, yellow and bitter rootstock. Leaves all basal, evergreen; long- and slender-petioled; the blade reniform, 2.5-5 cm. broad, three-divided; segments broadly obovate, obscurely three-lobed, cuneate, obtuse, prominently veined, sharply toothed, the teeth mucronate; dark green and shining above, paler beneath. Scape one-flowered or rarely two-flowered; naked, slender, 7-13 cm. high. Sepals oblong, obtuse. Petals small, club-shaped. Follicles three to seven; about 6 mm. long; borne on stipes of about their own length; spreading; tipped with beaks about 1 mm. or slightly more in length. (Plate 5)

In damp, mossy woods and bogs, Newfoundland to Maryland, mountains of North Carolina and Tennessee, Michigan, and northeastern Iowa. May-July.

In New England C. groenlandica was formerly used much as C. trifolia was in other parts of the world. In addition the Indians employed the rhizomes for dyeing wools and skins yellow. In medicine, as a bitter tonic, it was sold in large quantities in dry-herb shops of Boston. Today it is rarely seen or used commercially (1).

**HEPATICA** (Kupp.) Hill. Gard. Dict. Abr. Ed. 4. 1754

(Liverleaf, Hepatica)

Perennial, scapose herbs with long-petioled, thick, cordate or reniform, three-lobed, evergreen leaves; new leaves appearing after the large white, pinkish or purple flowers which are solitary on slender scapes. Involucre of three small sessile leaves close under the flowers, simulating a calyx. Sepals mem-

(1) Smith's *Dictionary of Economic Plants* - pg. 186

Hepatica is the ancient name given this plant and comes from the Greek hepatikos meaning liver, and refers to the resemblance in shape between the three-lobed leaves of this plant and the liver (1).

It is a genus of about four or five species native of the north temperate zone, with two North American species, both found in Massachusetts.

Loudon speaks of Hepatica as "a great favorite of the flower border, both as being evergreen in foliage and for its abundant blossoms and great variety of colors and shades". Today it is less popular, perhaps, but it is of considerable value for very early spring blossoms. The plants do best in a shady spot, though they may be grown in open places, and are particularly well suited "to the north or east slope of a rockery". Plants kept in pots in a coldframe until midwinter will quickly bloom at any time desired if removed to a warm room or greenhouse" (2). When used in beds outdoors, the plants should be left undisturbed in rich well-drained loam. Propagation is by the division of roots of old plants or by seeds sown very shallow in a moist shaded soil.

The European H. triloba, and the American H. americana and H. acutiloba, with their various color forms are the species usually cultivated, although the Hungarian H. angulosa DC. is being used to some extent. The latter species has a large, pure white-flowered variety alba Hort., a rose-colored variety rosea Hort., and a very free-flowering lilac form variety lilacina Hort.

KEY TO SPECIES OF HEPATICA NATIVE OF MASSACHUSETTS

Lobes of the leaves rounded or obtuse — — — H. americana

Sepals white — — — — — Forma candida

Sepals rose-pink — — — — Forma rhodantha

Lobes of the leaves acute— — — — — — — H. acutiloba

(1) Loudon's Encyclopedia - pg. 481; also others (Lindsay, T. S. - Plant Names - pg. 68; etc.)
(2) Bailey, L. H. - Encyclopedia - pg. 1458
HEPATICA AMERICANA (DC.) Ker.
(Round-leaved or Kidney Liver-Leaf,
Noble Liverwort, American Liverwort)

Anemone Hepatica L., Sp. Pl. 528. 1753
Hepatica Hepatica Karst., Deutsch Fl. 559. 1888-1693
Hepatica triloba a obtusa Pursh, Fl. Amer. Sept. 391. 1814
Hepatica triloba b americana DC., Syst. 1:316. 1817

Hepatica - (see under genus name)
americana - American, to distinguish from the very similar
European H. triloba

Roots fibrous. Leaves long-petioled; reniform; 5-6.3 cm. broad when mature. Spreading on the ground, three-lobed; lobes sometimes toothed or lobed again, ovate, obtuse or rounded at apex. Scapes 1-1.5 dm. high; villous. Involucre of three sessile, obtuse, oblong leaves, immediately under the flowers. Flowers blue, purplish or nearly white, 1.2-2.2 cm. broad. Sepals oval or oblong, obtuse, longer than the numerous stamens. Achenes several, in a small, loose head; ovate-oblong, 3.5 mm. long, pointed, hairy. (Plate 4, G-H)


Hepatica americana is one of the earliest flowering plants we have and a few warm days in winter, sufficient to melt the snow and warm the soil slightly, will bring it into bloom. Probably the earliest date of flowering recorded for Massachusetts was that reported by Mr. Slade, who found it in full flower on January 29, 1906. Previous to that the earliest date was March 2, 1880 (1).

H. americana differs from the European H. triloba (though it has long passed as the same species) in having smaller flowers;

(1) Slade, Denison - Early Flowering of H. triloba; Rhod. 8:128
more pilose petioles and scapes; more rounded lobes to the leaves; achenes slender-fusiform or lance-subulate terminated by a slender and definite, often curved, beak, instead of plump, conic-ovoid achenes tapering to short, thick beak terminated by sessile stigma (1).

The flowers of this species range from blue or purplish through rose and white in color, though the blue is the most common. Fernald has set off the two less common color forms, calling the white, forma candida, and the rose, forma rhodantha. Mr. Weatherby points out that these color forms are not constant (2). Two clumps of blue-flowered hepaticas, one clump of white-flowered and one clump of pink-flowered were transplanted to the garden, and out of the four, only the white has kept the color of its flowers wholly unchanged. The pink held for one season, then for four years was white and finally turned pink again and has remained thus. One blue-flowered plant remained with little change for five years, then suddenly turned lilac-pink. From these changes Mr. Weatherby concludes there must be a difference in individuals, with the pink forms most subject to variations and the white (pure albino) constant. A test with hydrochloric acid and ammonia gave negative reactions with the white, so no pigment was present. In the others, transplanting or change in soil conditions stimulated physiological changes which affected the color. Goddard remarks that forma candida is "not uncommon" in this vicinity, while forma rhodantha is "comparatively rare" (3).

This plant is supposed to be of use in consumption, and under the doctrine of signatures acquired a reputation for use in liver troubles (4).

**HEPATICA ACUTILOBA DC.**

(Sharp-lobed or Heart Liverleaf or Liverwort)

Hepatica triloba variety acuta Pursh., Fl. Am. Sept. 391. 1814
Hepatica acutiloba DC., Flora 1:22. 1824

Hepatica - (see under genus name)

acutiloba - meaning acutely lobed, in reference to the leaves

(1) Fernald, M. L. - The Specific Character of H. americana; Rhod. 19:45
(2) Weatherby, C. A. - Inconstancy in Color-Forms of H. americana; Rhod. 27:131-132
(3) Amherst Flora, Vol. 15 - In library at Appleton Hall, Amherst College
(4) Morrelli, Jennie H. M. - Plants and Their Uses; Rhod. 3:130
Plant closely resembling H. americana but leaves with three ovate and pointed lobes, or very frequently five-lobed leaves. Those of the involucre acute or acutish. Scapes 1-2.3 dm. high, villous. Flowers usually pale blue or white, never pink. (Plate 4, A-F)

March-April. Woods western Quebec to Georgia, Missouri and Minnesota. Rare or absent near the Atlantic Coast but more abundant than H. americana westward. For instance, in the herbarium of the New England Botanical Club we find 12 sheets from Berkshire County, and 6 from Franklin.

Between this species and H. americana there are "puzzling forms which are referable with about equal certainty to either species". Britton and Brown also report a tendency toward dioecism in this species (1).

RANUNCULUS

(Crowfoot, Buttercup)

Annual or perennial herbs with alternate, simple, entire, lobed or divided or dissected leaves. Flowers solitary or somewhat corymbed; yellow, or more rarely white. Sepals usually five, rarely three; deciduous. Petals of the same number or more; conspicuous or minute, provided with a nectariferous pit and usually a scale at the base of the petal. Stamens usually numerous, occasionally few. Carpels numerous, one-ovuled. Mass of achenes capitate or spicate, each member generally flattened, smooth, papillose or echinate, tipped with a minute or an elongated style.

Ranunculus is a Latin name for a little frog, and was applied by Pliny to these plants in allusion to the marsh habitat

(1) Britton and Brown's Manual - pg. 101
of many species (1). The common name of the genus, crowfoot, refers to the often much-divided leaves.

There are some two hundred and seventy-five species of \textit{Ranunculus} widely distributed in the temperate and cooler regions of both hemispheres, and on mountain tops in the tropics.

The genus is usually divided into sections such as: \textit{Ficaria} Boiss., \textit{Batrachium} DC., \textit{Halodes} Gray, and \textit{Euranaunculus} Gray (1). Britton and Brown raise each section to the rank of a genus and then the section \textit{Halodes} becomes the genus \textit{Haloperutes} Greene, and \textit{Euranaunculus} becomes \textit{Ranunculus} (2).

"The culture of \textit{Ranunculus} (3) in gardens and by florists has been confined chiefly to the Persian and Turban \textit{Ranunculus}, \textit{R. asiaticus}, since the Asiatic species is far more attractive than the European ones. This species has been cultivated for a long time, perhaps the first mention of it being in 1629. Since then "its varieties have been improved both in size of flowers and variety of colors. The flowers are very double, almost globular in outline, and often exceed two inches in diameter, while the colors now embrace almost every shade except blue, and some are striped and variegated. A well grown mass of these charming flowers, when in full blossom, is a sight not soon forgotten. They are not so well known in American gardens as in those of England, or at least not in the eastern States". They blossom about the last week in May and should be placed in herbaceous borders where they get some shade during the middle of the day or in a level place in the rock garden with a northern exposure. The roots are tuberous and are not hardy in the northern states and so should be taken up in the fall, and stored where they will not freeze until spring and then planted when the frost is well out of the ground (about two inches deep and six inches apart). They should have very sandy top soil, plenty of moisture at the roots and shade if possible. For greenhouse flowers the Turban varieties are more desirable than the Persian and should be planted in pans of light soil in January and then placed in the coolest greenhouse where they will blossom in April.

Of native European and American species, \textit{R. aquatilis} and its varieties are interesting aquatic plants, and \textit{R. lingua} L. is sometimes useful for water gardens. \textit{R. repens} L. variety \textit{flore-pleno} Hort. and \textit{R. amplexicaulis} L. are useful subjects for bog-gardens. For herbaceous borders or moist corners in the rock garden, \textit{R. aconitifolius} L. variety \textit{flore-pleno} Hort., \textit{R. cartusaeefolius} Willd., \textit{R. anemonoides} Zahl, \textit{R. pannassifoli}-

(1) Gray's \textit{Manual}, and other authors
(2) Britton and Brown's \textit{Manual}, Ed. 2
(3) Bailey, L. H. - \textit{Encyclopedia} - pg. 2905
ous L. and R. Ficaria L. are the only species worth growing. These are all readily propagated from seeds or by division of the plants in the spring.

Practically all species of Ranunculus possess an acrid colorless juice which is poisonous. The poisonous principle is dissipated to a great extent by drying or by boiling in water. This acrid, poisonous property led to the external use of the juice as a rubefacient and vesicant but prohibited its use internally. It was at one time quite commonly used in Europe for external application in cases of rheumatism and neuralgia, though it never obtained a place in the pharmacopoeias. In this country there was less use made of the plants and their juice (1).

The oil of Ranunculus is a particularly acrid narcotic which in small doses produces stupor and slow respiration in animals. In larger doses it has been proved to cause paralysis and finally convulsions of the whole body before death. Anemonin causes similar symptoms, but is followed neither by convulsions nor corrosion of internal organs, which occurs with oil of Ranunculus (1).

The following quotation from Culpeper on crowfoots is of interest (2):

"Many are the names which this furious biting herb hath obtained, almost enough to make up a Welchman's pedigree, if he fetch no farther than John Gaunt, or William the Conqueror; for it is called frog's foot, from the Greek name Barrakion; crowfoot, gold knobs, gold cups, king's knobs, baffiners, troilflowers, polts, locket goulions and butterflowers.

So abundant are the sorts of this herb, that to describe them all, would tire the patience of Socrates himself, but because I have not yet attained to the spirit of Socrates, I shall but describe the most usual.

Description: The most common crowfoot hath many green leaves, cut into divers parts, in taste biting and blistering the tongue; it bears many flowers, and those of bright resplendent yellow color. I do not remember, that I ever saw anything yellower. Virgins, in ancient times, used to make powder of them to furrow bride beds; after which flowers come small heads, some spiked and rugged like a pineapple.

Place: They grow very common everywhere; unless you turn your head into an hedge, you cannot but see them as you walk.

Time: They flower in May and June, even till September.

(1) Pammel, L. H. - Manual of Poisonous Plants - pg. 457-460
(2) Culpepper, N. - British Herbal and Family Physician - pg. 109
Government and Virtues: This fiery and hot-spirited herb of Mars is no way fit to be given inwardly, but an ointment of the leaves or flowers will draw a blister, and may so be fitly applied to the nape of the neck to draw back rheum from the eyes. The herb being bruised and mixed with a little mustard, draws a blister as well, and as perfectly as cantharides, and with far less danger to the vessels of urine, which cantharides naturally delight to wrong; I knew the herb once applied to pestilential rising that was fallen down, and it saved life even beyond hope; it were good to keep an ointment and plaister of it, if it were but for that."

### KEY TO SPECIES OF RANUNCULUS NATIVE TO MASSACHUSETTS

<table>
<thead>
<tr>
<th>Leaves entire, or merely dentate.</th>
<th>Petals much exceeding the calyx; achenes smooth.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Achenes beakless; roots tuberous-thickened -- R. Ficaria</td>
</tr>
<tr>
<td></td>
<td>Achenes beaked; roots not tuberous-thickened.</td>
</tr>
<tr>
<td></td>
<td>Leaves filiform; flowers small, 1 cm. or less in diameter; achenes with minute beak -- R. reptans</td>
</tr>
<tr>
<td></td>
<td>Leaves lanceolate or lance-oblong; flowers large, 1 cm. or more; achenes subulate - R. laxicaulis</td>
</tr>
<tr>
<td></td>
<td>Petals equaling or but shortly exceeding the calyx; achenes striate - R. Cymbalaria</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leaves not entire; variously lobed or dissected.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic or sub-aquatic; immersed leaves filiformly dissected.</td>
</tr>
<tr>
<td>Flowers yellow; petals with scale over pit; achenes smooth - R. delphinifolius</td>
</tr>
<tr>
<td>Flowers white, or only the claw yellow; petals with naked pit; achenes transversely wrinkled.</td>
</tr>
<tr>
<td>Leaves petioled, 2.5-5 cm. long, flaccid, collapsing when taken from water - R. aquatilis var. capillaceus</td>
</tr>
<tr>
<td>Leaves sessile, 2.5-cm. or less; rigid when taken from water - R. longirostris</td>
</tr>
</tbody>
</table>
Terrestrial or sub-terrestrial; leaves merely cleft or divided.

Some or all of the basal leaves merely crenate.

Plant glabrous or nearly so; basal leaves cordate.

Achenes merely mucronate — — — — — — — — — — — — R. abortivus
Achenes with subulate hooked beak— R. allegheniensis

Plant villous; basal leaves not cordate;
obovate — — — — — — — — — — — — — — — — — — — — — — — — R. micranthus

Leaves all lobed or divided.

Plant glabrous; achenes marginless — — — R. sceleratus

Plant hirsute or pubescent; achenes with evident margin.

Petals shorter than or barely equaling calyx.

Leaves three-cleft; beak of achene
strongly hooked — — — — — — — — — — — — R. recurvatus

Leaves three-divided; divisions stalked
and cleft; beak of achene short,
not hooked — — — — — — — — — — — — R. pennsylvanicus

Petals much exceeding calyx.

Plants creeping or slightly ascending — — R. repens

Plants erect or sub-erect.

Beak of achene short.

Calyx spreading; roots fibrous — — — R. acris
Calyx reflexed; stem bulbous-thickened
at base — — — — — — — — — — — — — — — — — — R. bulbosus

Beak of achene long.

Achenes slightly margined, beak slender.

Leaf segments broad, oblong or obovate — — — — — — — — — — — — R. hispidus
Leaf segments narrow, linear-oblong — — — — — — — — — — — — R. fascicularis

Achenes strongly margined;
beak stout — — — — — — — — — — — — R. septentrionalis
Ranunculus abortivus L. (Small-Flowered Crowfoot, Kidney or Smooth-Leaved Crowfoot)

Ranunculus abortivus L. Sp. Pl. 551. 1753

Ranunculus - (see under genus name)

abortivus - Latin, meaning parts aborted, but to what it refers is unknown. Perhaps to the insignificant flower as a whole

Biennial, slightly succulent plant with short, sparse, and often fugacious pubescence, or glabrous. Stem 1.5-6 dm. high, branched. Basal leaves long-petioled, bright green, thick, broadly ovate, obtuse and cordate or reniform with wide shallow sinus, barely crenate; the succeeding leaves often three-lobed or three-parted; cauline three- to five-parted or divided, sessile or nearly so; segments oblong or linear, somewhat cuneate, mostly toothed. Flowers pale yellow. Petals oblong, shorter than the small reflexed calyx. Receptacle short, villous, 2.5-4.5 mm. broad. Head of fruit globose; achenes minute, tipped with minute curved beak. (Plate 15, A-G)

Shaded woods and along streams, Labrador and Nova Scotia to Manitoba and south to Florida, Arkansas and Colorado. April-June.

This is one of our commoner buttercups and is found on almost every moist shaded wood-bank or swampy woods in the State. The New England Botanical Club has no specimens of this species in its herbarium from either Plymouth or Nantucket Counties, but it is probably a case of lack of collecting in those areas.
RANUNCULUS ABORTIVUS Var. EUCYCLUS Fernald

R. abortivus variety eucyclus Fern., Rhod. 1:52. 1893

Ranunculus - (see under genus name)
abortivus - (see under R. abortivus)
eucyclus - from Greek, meaning cyclic, referring to the arrangement of parts

Stem slender, flexuous, not succulent. Root leaves larger than in the species, often 5-6 cm. broad, orbicular, deeply cordate with a narrow sinus, thin. Flowers, receptacle and achenes smaller than in species. (Plate 15, H)

Rich, low woods or river banks, New Hampshire and Quebec to Connecticut.

This variety is recognized by its glossy green leaves which are orbicular and possess nearly or quite closed sinuses. The plant has been collected in Essex and Suffolk Counties in the eastern part of the State, and from Huntington, South Hadley, Springfield and Williamstown in the western part.

RANUNCULUS ACRIS L.
(Tall or Meadow Buttercup)

Ranunculus acris L., Sp. Pl. 554. 1753

Ranunculus - (see under genus name)
acris - acrid, bitter, referring to the bitter juice

Plants erect; hairy; branched above; 6-9 dm. high. Roots fibrous. Basal leaves tufted; petioled; three- to seven-divided, the divisions sessile and three-cleft or parted and their segments cut into lanceolate or linear to obovate, mainly
acute lobes. Upper leaves short-petioled and merely three-parted, distant. Flowers numerous, bright yellow, but not as deep colored as R. bulbosa, about 2.5 cm. broad, peduncles not furrowed; petals obovate, two or three times the length of the spreading calyx. Head of fruit globose, 1.2-1.4 cm. broad. Achenes compressed, short-beaked. (Plate 7)

Fields and meadows, Newfoundland to Virginia, British Columbia and Missouri. Also Bermuda. Naturalized from Europe. May-September.

The juice of this species blisters readily and hence Linnaeus named it *acris*. Even picking sometimes causes inflammation of the hands. Due to this blistering property, this species, as well as *R. sceleratus*, was used by European beggars to produce sores as a means of exciting compassion (1).

It has long been the popular belief that cows pastured where there is an abundance of buttercups produce a richer colored milk, due to eating these plants. This is not true, for cattle will eat it only in case of necessity. The plants will be found growing luxuriantly, where all grass around is cropped close. When it is eaten, it produces sore mouths, choking, vomiting and, in some cases, death from apoplexy, and when eaten by pregnant cows frequently causes abortion. It grows in rich pastures and hence it is the richness of the grass, and not the buttercups, which is responsible for the richer milk (2).

The double-flowered variety *flore-pleno* DC. is sometimes used in gardens and is called yellow bachelor’s buttons (3).

Plants with very broad leaf-segments instead of linear ones were designated as variety *Steveni* by Fernald (4), and in northern New England the variety is more abundant than the species, and seems to be distinct. In southern New England the two intergrade and are not easily distinguished. Now the species is usually made to cover this variation without setting aside this broader-segmented type as a variety.

(1) Loudon's *Encyclopedia* - pg. 486; Sargent, F. L. - *Useful Plants* - pg. 317
(3) Bailey, L. H. - *Encyclopedia* - pg. 8205
(4) Loudon's *Encyclopedia* - pg. 486
Ranunculus aquatilis L. var. capillaceus DC.
(Common White Water Crowfoot)

1:325. 1786

Batrachium trichophyllum F. Schultz, Arch. Fl. France et All.
1:107. 1848

Ranunculus aquatilis var. trichophyllus A. Gray, Man. Ed. 5:40.
1867

Ranunculus aquatilis var. caespitosus DC., Prodr. 1:86. 1824
Ranunculus aquatilis var. capillaceus DC., Prodr. 1:36. 1824

Ranunculus - (see under genus name)
aquatilis - from Latin for water, referring to the aquatic habitat
capillaceous - from Latin, referring to the hair-like leaf divisions

Leaves 2.5-5 cm. long; all under water and mostly pectioled; their capillary divisions and subdivisions rather long and soft, usually collapsing more or less when withdrawn from the water; petiole rather narrowly dilated. Flowers white, 1.2-3 cm. broad, on stout peduncles 2.5-5 cm. long; blooming at surface of the water. Head of fruit globose, 5 cm. broad; receptacle hairy; achenes apiculate. (Plate 12, A-C)

Ponds and slow streams, Nova Scotia to British Columbia southward to North Carolina and California. Also Europe and Asia.

This is not a commonly collected species, but it has been frequently found around Amherst, and it is quite possible that the difficulty of collecting and making good herbarium specimens may account for the fact that the species is said to be represented in only four counties in the State, namely: Middlesex, Norfolk, Bristol and Berkshire.

Britton and Brown say of this species that it "consists, apparently, of numerous races differing in habit, in size of flowers, number of stamens, and shape of petals; several of these have been recognized as species".
This crowfoot is apparently harmless and is one of the few "wholesome" species of the genus. It has been used as a forage plant in some parts of England and on the Continent, and is very nutritive. On the borders of the river Avon, the cottagers used to support cows and horses almost entirely on it. It was collected from the river by men in boats. Perhaps its aquatic habit reduces its poisonous alkaloids so that they are ineffective (1).

**Ranunculus Allegheniensis** Britton


*Ranunculus* - (see under genus name)

Allegheniensis - from region of the Alleghenies

Similar in habit and foliage to *R. abortivus*. Stem widely branched; glabrous; often glaucous; 309 dm. high.

Basal leaves reniform or suborbicular, long petioled; crenate or some of them lobed, the lobes and teeth subacute; cauline leaves sessile or the lower petioled, divided nearly or quite to the base into linear-acute, entire, toothed or cleft segments. Flowers small, 2.5-4.5 mm. broad, pale yellow. Petals oblong, not exceeding the calyx, glandular. Head of the fruit globose or globose-oblong, 2.5 mm. in diameter; achenes slightly compressed and margined, with subulate, recurved beak about one half its length. (Plate 15, I-K)

Moist rich woods eastern Massachusetts to Vermont, eastern New York and south to North Carolina. April-May.

This species has been collected in several places near Amherst and in the region of the Connecticut River nearby, but it is not abundant.

(1) Loudon's *Encyclopedia*, pg. 436-439; also Pammel, pg. 446.
**RANUNCULUS BULBOSUS L.**

(Bulbous Buttercup, Yellow Weed or Gowan)

*Ranunculus bulbosus* L., Sp. Pl. 554. 1753

*Ranunculus* - (see under genus name)

*bulbosus* - bulbous, referring to the swollen underground portion of stem

Erect, from bulbous thickened base; hairy; 1.5-3 dm. high. Leaves peti- ledd, appearing as if pinnately three-divided, the terminal division stalked, the lateral ones sessile or nearly so, all variously lobed and cleft, cuneate. Flowers bright, deep, and glossy yellow; about 2.5 cm. across; peduncles furrowed. Petals five to seven, much longer than the reflexed sepals, obovate, rounded or wedge-shaped at base. Head of fruit globose, 0.6-0.8 cm. broad; achenes compressed; very short-beaked. (Plate 8, A-D)


*R. bulbosus* is one of the most poisonous species of the genus. The juice is particularly irritating to the skin and when applied locally, causes serious inflammation and blistering. A slice of the bulbous base placed in contact with the finger is reported to have caused pain in two minutes and in ten hours a blister appeared which was followed by a bad ulcer, which proved difficult to heal (1). When held to the nostril, a whiff of the juice causes sneezing. Loudon reports that when kept for some time, the roots lose their stimulating power and may be eaten. "Hogs like them and frequently dig them up. When mixed with grasses, they act as a stimulant to some animals as salt does to others" (2). Lightfoot says that the roots when boiled are mild and eatable (3).

(2) Loudon's *Encyclopedia* - pg. 486-489
(3) Sturtevant's *Notes on Edible Plants* - pg. 483
This species of buttercup is probably the "cuckoo buds of golden hue" of Shakespeare, and is the second flower (after dandelion) to cover our meadows with yellow (1).

**RANUNCULUS CYMBALARIA** Pursh.

*(Sea-Side Crowfoot)*

**Ranunculus Cymbalaria** Pursh., Fl. Am. Sept. 692. 1814
**Oxygraphis Cymbalaria** Prantl, in Engl. & Prantl, Nat. Pfl. Fam. 3: Abt. 2, 63. 1891
**Cyrtorhyncha Cymbalaria** Britton, Mem. Torr. Club 5:161. 1894
**Halerpestes Cymbalaria** Greene, Pittonia 4:308. 1900

**Ranunculus** - (see under genus name)

**Cymbalaria** - from the Greek for boat, referring to the "boat-shaped" leaves

Low, glabrous, somewhat succulent, spreading by runners. Leaves mostly basal, long, and slender-petioled; clustered at the root or on the joints of the long rooting runners; blades cordate-ovate or reniform, crenate; 0.3-1.8 cm. long, rather fleshy. Flowers one to seven; about 0.4-0.6 cm. broad, borne on scapes 2.5-3.5 cm. long, these sometimes bearing one or more leaves toward the base. Heads of fruit oblong, 0.4-1.8 cm. long; achenes compressed, somewhat swollen, distinctly striate, minutely sharp-pointed. (Plate 10, D-F)

Sandy shores; Labrador to New Jersey and west along the St. Lawrence River and the Great Lakes to Minnesota, Kansas, etc. June-August. This species occurs all along the coast of Massa-chusetts, on the Cape, and on Nantucket and Dukes Islands.

(1) Loudon's *Encyclopedia* - pg. 486-489
RANUNCULUS DELPHINIFOLIUS Torr.
(Yellow Water Crowfoot)

Ranunculus multifidus Pursh., Fl. Am. Sept. 736. 1814
Ranunculus missouriensis Greene, Erythea 3:20. 1895

Ranunculus - (see under genus name)

delphinifolius - delphinium-leaved, referring to the manner in which the leaves are cut

Floating or immersed, (or sometimes creeping in mud), perennial herb, rooting at nodes if at all; branching, often several feet long. Immersed leaves repeatedly forked into long filiform divisions, short-petioled, 2.5-7.5 cm. long; emersed leaves glabrous or pubescent, 1.3-5 cm. broad, petioled or the upper nearly sessile, three- to five-divided, the divisions cleft into linear or cuneate segments. Flowers deep, bright yellow, 0.6-3.8 cm. broad. Petals five to eight, much longer than the sepals. Head of fruit globose or oblong, 0.6-1.2 cm. long; achenes less than 2 mm. long, tipped with a straight beak one-half their length or more, slightly roughened and conspicuously callous-marginated toward the base. (Plate 12, F-H)

Ponds and quiet water; Central Maine to Ontario, south to North Carolina, Mississippi and Arkansas. June-August.

Specimens of R. delphinifolius are common, particularly from the eastern part of the State (Essex, Middlesex, Suffolk, Norfolk, Plymouth and Dukes Counties); and in the western part of the State it has been collected in Hampshire, Franklin and Berkshire Counties. Though the plant has been collected around Amherst several times, it seldom appears in the same place a second year.
There is a variety known as *terrestris* (Gray) Farwell which differs "conspicuously in its firmer, less finely cut leaves of roundish outline, pubescent petioles and smaller flowers". This has been reported from Middlesex, Berkshire and Hampden Counties.

**RANUNCULUS FASCICULARIS** Muhl.

*(Early or Tufted Crowfoot)*

*Ranunculus fascicularis* Muhl., Cat. 54. 1812

Ranunculus - (see under genus name)

*fascicularis* - from the Greek meaning bundle, referring to the clustered roots and tufted habit

Low; tufted; ascending one to 2.5 dm. high; depressed pubescent with silky hairs. Root a cluster of thickened, fleshy fibers. Leaves petioled, three- to five-divided, the terminal division stalked and remote, itself three- to five-cleft; lobes oblong or linear. Flowers bright yellow, 2.5 cm. across. Petals six or seven, spatulate-oblong or obovate, rounded, truncate or emarginate, about twice the length of the spreading calyx. Head of fruit globose, about 0.8 cm. in diameter; achenes flat, scarcely margined, tipped with subulate straight or rather curved beak nearly or quite their length. (Plate 8, E-H)

Dry or moist hills, often on ledges, eastern Massachusetts to Ontario, and south to North Carolina, Wisconsin, Kansas and Texas. Reported from Manitoba. Not common near the Atlantic Coast. April-May. This species grows on the hills about Amherst and is one of the earliest-flowering species to appear on the Holyoke Range and on Mount Toby. It also occurs in Middlesex County, but is comparatively rare elsewhere.
RANUNCULUS FICARIA L.
(Lesser Celandine)

Ranunculus Ficaria L., Sp. Pl. 550. 1753
Ficaria verna Huds., Fl. Angl. 214. 1762
Ficaria ranunculoides Moench., Meth. 218. 1794

Ranunculus - (see under genus name)

Ficaria - from the Greek for a fig, referring to the fig-like, thickened roots

Glabrous, somewhat succulent herb arising from large, fleshy, thickened roots. Basal leaves on long, stoutish petioles; ovate; obtuse; deeply cordate; sub-crenate; somewhat fleshy; 2.5-5 cm. long. Flowering stems scapose, erect, 10-12.8 cm. high, bearing one or two leaves, or naked. Flowers yellow, 2-2.5 cm. broad; achenes beakless, truncate. (Plate 10, A-C)

Wet places; Massachusetts to District of Columbia. "Fugitive from Europe where it is common pasture weed." April-May.

This is probably the rarest species of Ranunculus in Massachusetts and we find but 3 specimens in the New England Botanical Club Herbarium, one from Middlesex, one from Norfolk, and one from Worcester County.

The tuberous roots of this species of Ranunculus resemble grains of corn or wheat and are sometimes boiled and eaten. Smith says (1): "After heavy rains, however, its place is often well marked by numerous little tuberous roots lying on the surface like grains of wheat (the leaves having withered after flowering), which have been supposed by some to be corn from heaven. This is particularly the case in Silesia, where they are gathered and used as food, being very mealy and not un-wholesome when boiled." In the spring the young leaves may be

(1) Smith's Dictionary of Economic Plants - pg. 320-321
The uncooked roots or fresh foliage produce blisters much the same as *R. bulbosus*, *R. acris* and *R. sceleratus* (2).

**RANUNCULUS HISPIDUS** Michx. variety **FALSUS** Fernald

(*Hispid Buttercup*)


*Ranunculus* - (see under genus name)

**hispidus** - meaning hispid or bristly, in reference to its pubescence

**falsus** - false, because the variety is not the truly hispid species of the South

Usually densely villous when young, sometimes merely appressed-pubescent or smoothish when old. Stems ascending or spreading, 1.5-4 dm. high; flexuous, not repent nor stoloniferous. Roots a cluster of thickened fibers. Leaves pinnately three- to five-divided or the basal only three-lobed, the divisions ovate, oblong or obovate, narrowed or cuneate at base, sharply cleft or lobed, usually thin. Flowers bright yellow, 1.2-3.5 cm. broad. Petals oblong, about twice as long as the spreading sepals, entire or emarginate. Head of fruit globose-ovoid or globose; achenes broadly oval, green when mature, narrowly margined, 2-2.6 mm. broad, abruptly tipped by a subulate beak of about one-half their length. (Plate 14, E-H)

(1) Sturtevant's *Notes on Edible Plants* - pg. 483
(2) Pammel, L. H. - *Manual of Poisonous Plants* - pg. 446
Dry or moist woods and thickets; Vermont and Ontario to North Dakota, Georgia and Arkansas. The earliest-flowering buttercup in the vicinity of New York. Ascends six thousand feet in North Carolina. March-May.

This variety differs from the typical *R. hispidus* in a more northern range, and a pubescence which is appressed or even almost or quite wanting (1). It has been reported from Amherst, Springfield, Holyoke, Mt. Holyoke, Stockbridge and Sheffield.

**RANUNCULUS LAXICAULIS** (T. & G.) Darby

*(Water Plantain Spearwort)*

*Ranunculus altismaefolius* A. Gray, Man. Ed. 5:41. 1867. Not Geyer, 1848
*Ranunculus ambigens* S. Wats., Bibliog. Index, 1:16. 1878

*Ranunculus* - (see under genus name)

**laxicaulis** - from Latin *loose*, and Greek *stalk*, referring to the creeping habit.

Mostly stout, ascending, 3-6 cm. high, glabrous, often rooting from lower nodes. Stem hollow, sometimes nearly 2.5 cm. thick at the base. Leaves lanceolate or oblong-lanceolate, 7.5-15 cm. long, 1-2.5 cm. broad, denticulate or entire, all but the uppermost on broad petioles which clasp the stem by a broad base. Flowers bright yellow, panicked, 1.2-1.8 cm. broad. Petals five to seven, oblong, much exceeding the sepals. Head of fruit globose or slightly elongated, about 1.2 cm. in diameter; achenes compressed, about 2 mm. long, with long, narrow, subulate beak which is early deciduous. (Plate 11, F-I)

(1) Pammel, L. H. - Manual of Poisonous Plants - pg. 446
Ditches and muddy places; southern Maine and Ontario to Georgia, Tennessee, Minnesota and Arkansas. June-August.

This is one of the least common species of Ranunculus but it is found around Amherst and has been collected in Essex, Bristol, Norfolk and Nantucket Counties.

**RANUNCULUS LONGIROSTRIS** Godr.

*(Stiff White Water Crowfoot)*


*Batrachium circinatum* Reichenb., Spach. Hist. Veg. 7:201. 1839

*Ranunculus aquatilis* variety *divaricatus* A. Gray, Man. Ed. 2, 7, 1856

*Ranunculus longirostris* Godr., Wiegand and Bames, pg. 211

*Ranunculus* - (see under genus name)

*longirostris* - from the Latin *longi*, and *beak*, referring to the achenes

Leaves less than 2.5 cm. long; all under water and sessile with broad, conspicuous stipules; the divisions and subdivisions short, spreading nearly at right angles from stem in one roundish plane; rigid; not collapsing when withdrawn from the water. Flowers white, 1.2-1.8 cm. broad, on stout peduncles 2.5-5 cm. long, blooming at the surface of the water. Petals with naked pit. Head of fruit globose, 0.4 cm. broad; receptacle hairy; achenes marginless, transversely wrinkled, apiculate.

*(Plate 12, D-F)*

Ponds and slow streams; Ontario, New England, northern New Jersey and Pennsylvania, and west to the Pacific Coast, extending south in the Rocky Mountains to Arizona. Also in Europe. Summer.

This species, if not *R. ficaria*, is probably the rarest species in Massachusetts.
RANUNCULUS MICRANTHUS Nutt.
(Rock Crowfoot)

*Ranunculus micranthus* Nutt., *T. & G. Fl. N. Am.* 1:18, 1838

*Ranunculus* - (see under genus name)

*micranthus* - from the Greek, meaning small-flowered, referring to the size of the flowers

Similar to *R. abortivus*, but usually smaller and villous with spreading hairs, flowering when very young; 1.5-4.5 dm. tall, from roots which are often fusiform-thickened. Basal leaves thin, dull green, broadly obovate or suborbicular, scarcely if at all cordate at the base, crenate or some of them three-parted or pedately three-divided with segments narrow-oblong, entire or sharply toothed. Flowers very small, about 0.6 cm. broad, light yellow. Sepals narrowed into short claws. Petals oblong or oval, two or three times as long as broad. Receptacle linear, glabrous or nearly so. Head of fruit longer than broad. (Plate 16, A-E)

Deciduous rich woods, often on rocks; southern Maine to Saskatchewan, south to Georgia and west to Arkansas and Colorado. April-May.

This is not a common species in Massachusetts, though it has been collected in Essex, Middlesex, Norfolk, Hampshire and Hampden Counties.

RANUNCULUS PENNSYLVANICUS L.f.
(Bristly Buttercup)

*Ranunculus pennsylvanicus* L.f., *Suppl.* 272, 1781

*Ranunculus* - (see under genus name)

*pennsylvanicus* - from Pennsylvania
Annual; stout; erect; branching; pilose-hispid with widely spreading bristly hairs; 4-6 dm. high; leafy to top.
Leaves three-divided; divisions stalked, deeply and unequally three-cleft; the lobes lanceolate, cuneate, acute, incised and toothed. Flowers inconspicuous; yellow; 0.6-0.8 cm. broad.
Petals equalling the reflexed sepals, or shorter. Head of fruit oblong or short-cylindric, 0.6 cm. thick, sometimes 1.3 cm. long; achenes smooth, obscurely margined, pointed with sharp beak one-third their length; receptacle cylindro-conical, hairy. (Plate 14, A-D)

Wet, open places; Nova Scotia to Georgia, British Columbia, Kansas and Colorado. June-August.

This species has been reported from Worcester County (Southbridge and Barre) (1), but aside from that, it has been found only in the more western region of the State, near Amherst. It has been collected in Amherst, Belchertown, Granby, Holyoke, Ludlow, Southwick, Greenfield and Sunderland.

**RANUNCULUS RECURVATUS** Poir.

*(Hooked or Rough Crowfoot)*

*Ranunculus recurvatus* Poir., in Lam. Encycl. 6:125. 1804

*Ranunculus* - (see under genus name)

*recurvatus* - from the Latin, recurved, in reference to the hooked beak of the achenes

Erect, 1.5-6 dm., usually hirsute, branching. Leaves all petioled, broadly reniform, 2.5-7.5 cm. wide, deeply three-cleft, the divisions broadly cuneate, acute, two- to three-cleft,

(1) *Rhod.* 2:128
cut and toothed toward apex. Flowers pale yellow, 0.6-1 cm. broad. Petals shorter than or barely equalling the reflexed calyx. Head of fruit globose, 1.2 cm. broad; achenes compressed, margined, tipped with recurved and hooked beak of one-half their own length. (Plate 13)


This species is quite common all over the state, especially here in the western part. It runs into a variety fontinalis Peattie (1) which differs from the species in being perfectly smooth. It was collected by Professor Fernald and E. B. Harger in 1913 at Whately Glen.

RANUNCULUS REPENS L.
(Creeping Buttercup, Gold Balls)

Ranunculus repens L., Sp. Pl. 554. 1754
Ranunculus Clintoni Beck., N. and Mid. States 9. 1833

Ranunculus - (see under genus name)
repens - from the Latin, meaning repent, in reference to the creeping habit

Generally hairy, sometimes only slightly so, spreading by runners and forming large patches. Leaves petioled, three-divided, the terminal divisions, or all, stalked, all ovate, cuneate or truncate, acute cleft and lobed, often white-variegated or spotted. Flowers nearly 2-2.6 cm. broad. Petals obovate, much exceeding the spreading sepals. Head of fruit globose, 0.3 cm. in diameter; achenes margined, tipped with short, stout,

(1) Journ. Elisha Mitchell Soc. 44:305; April 1889. According to Weatherby (Rhod. 31:163) this is forma laevicaulis Harger & Weatherby, but the above name was on sheet in herbarium of New England Botanical Club Nov. 11, 1934.
slightly bent beak. (Plate B, D-F)

Fields and roadsides and low wet grounds generally in ditches and along water courses; Newfoundland to Virginia, Ontario and British Columbia, Bermuda, Jamaica. Mainly introduced from Europe, but regarded as indigenous in its western range. May–July.

This species is less acrid than most species of Ranunculus and is eaten in Europe as a potherb. Loudon says an "obnoxious plant in every description of gardening and agriculture" probably because of procumbent and patch-forming weed character, and slight poisonous qualities when fresh (1).

R. repens is rare in the interior of Massachusetts, (2) though 3 specimens from Berkshire County are known—but is quite common near the coast. Professor Fernald distinguishes several and offers the following key to them (3):

A. Middle leaflet of the basal leaves cuneate to sub-truncate at base; petals five to nine; stamens many.
B. Lobes and teeth of the leaves deltoid or ovate to oblong, obtuse or bluntish.
   Trailing or repent branches or stolons present.
   Stems and petioles distinctly pubescent.
   Pubescence
      appressed—R. repens L. (typical)
      Pubescence wide-
         spreading — var. villosus Lamotte
         Stems and petioles glabrous or nearly so— var. glabratus DC.
         Trailing or repent branches wanting— var. erectus DC.

B. Lobes and teeth of the much-cleft leaves lanceolate to linear, acuminate— var. linearilobus DC.
A. Middle leaflet of the basal leaves rounded or subcordate at base; petals very numerous, forming a "double" flower—var. plenifolius

The varieties glabratus and villosus are commoner than the others, though the latter is the only one collected in this vicinity. It has been collected in Amherst, Charlemont and Springfield.

The variety plenifolius is common in old gardens where it spreads like a weed and is admired for its button-like flowers

(1) Loudon's Encyclopedia - pg. 486-489
(2) Knowlton, C. M. - Rhod. 8:201
(3) Fernald, M. L. - The Variations of R. repens - Rhod. 21:169
whose myriads of petals shine as though varnished. It was found spreading in roadside thickets in Oxford (Worcester County) in 1915 (New England Botanical Club).

**RANUNCULUS REPTANS L.** (1)

*(Creeping Spearwort)*

*Ranunculus reptans* L., Sp. Pl. 549. 1753
*Ranunculus filiformis* Michx., Fl. Bor. Am. 1:320. 1803
*Ranunculus Flammula* var. *reptans* E. Meyer, Pl. Lab. 96. 1830
*Ranunculus Intermedius* Hook., Fl. Bor. Am. 1:11. 1829

*Ranunculus* - (see under genus name)

*reptans* - meaning *creeping*, in reference to the habit of the plant

Small plants, very slender, reclining or trailing, glabrous or pubescent, rooting from the nodes. Flowering stem and peduncles solitary, ascending. Leaves filiform, tapering into petioles. Flowers bright yellow, small, solitary on peduncles, 2.5-7.5 cm. long. Petals four to seven, narrowly obovate to oblong, 2.5-5 mm. broad, with definite claw; 3-9-nerved; much exceeding the calyx. Achenes 15-30, flattish, hemispherical with minute, sharp beak; fruiting head 1.5-3 mm. long. (Plate 11, A-E)

Gravelly or sandy shores; Newfoundland to Pennsylvania, northward and westward. June-September.

This species has been collected only in this part of the State - in Erving, Amherst, Northampton, Springfield, Sunderland and Wendell. There is a broader-leaved variety *ovalis* (Bigel.) T. & G. which is found chiefly in the eastern part of the State, in Essex and Middlesex Counties. (Plate 11, B)

RANUNCULUS SCeleratus L.
(Cursed Crowfoot, Celery-Leaved Crowfoot)

Ranunculus sceleratus L., Sp. Pl. 551. 1753
Ranunculus eremogenes Greene, Erythea 4:121. 1896

Ranunculus - (see under genus name)

sceleratus - cursed, referring to the blistering juice

Annual herb; stout; 1.5-6 dm. high, freely branching; glabrous or nearly so. Stem thick, 3 cm. or so, hollow. Basal leaves thick, three- to five-lobed on long, broad petioles. the blade 2.5-5 cm. broad, reniform or cordate, rounded. Those of the stem petioled or the upper sessile, deeply three-lobed or divided, the lobes obtuse, cuneate oblong or linear, several-toothed or entire. Flowers small, pale yellow, numerous, 0.6-0.9 cm. broad, the petals about equalling the calyx. Head of fruit oblong or cylindric, 0.6-1.5 cm. long; achenes of head very numerous, about 1 mm. long, barely mucronate. (Plate 16, F-J)

Swamps and wet ditches; New Brunswick to Florida and abundant along the coast and locally west to North Dakota, Kansas and Nebraska; usually in saline and alkaline situations. Also Europe and Asia. June-August.

This species is often collected in the eastern part of the State - in Essex, Middlesex, Suffolk, Plymouth, Bristol and Barnstable Counties.

With European beggars the acrid and blistering juice of this species shared its popularity with R. acris in producing sores, though wounds so made often become incurable. When chewed, the tongue becomes inflamed, and the juice in the stomach
produces "violent effects" (1).

Shepherds in Wallachia are supposed to have boiled and eaten it and found it nutritious (2).

**RANUNCULUS SEPTENTRIONALIS** Poir.

(Swamp or Marsh Crowfoot or Buttercup)

*Ranunculus septentrionalis* Poir., in Lam. Encycl. 6:185. 1804

*Ranunculus* - (see under genus name)

*septentrionalis* - from the Latin, meaning northern, referring to the fact that it is distinctly a northern species

Roots simple, fibrous. Plant branching; 3-8 dm. high; usually villous; ascending or in wet ground later branches procumbent and sometimes rooting at the nodes. Leaves large; petioled; three-divided; divisions mostly stalked, usually broadly cuneate or ovate at the base, unequally three-cleft into broad lobes and variously cut. Lower petioles occasionally 5 dm. long. Flowers bright yellow, 2.5 cm. or more across. Petals broadly obovate, twice the length of the spreading sepals. Head of fruit globose or oval, 0.8 cm. in diameter; achenes flat, 3-3.4 mm. broad, strongly margined with stout straight beak nearly as long as body of achene. (Plate 9, A-C)

Swamps and low grounds; New Brunswick to Manitoba, Georgia and Kansas. May-August.

(1) Loudon's *Encyclopedia* - pg. 486-489; Pammel, Smith, and Sargent also mention.
(2) Sturtevant's *Notes on Edible Plants* - pg. 433
This species has been reported only from western Massachusetts - from Franklin, Hampden, Hampshire and Berkshire Counties, and it is not abundant in these localities.

**THALICTRUM** (Tourn.) L. Sp. Pl. 545. 1753

(Meadow Rue)

Erect, perennial herb, with two- to three-ternately compound basal and cauline leaves. The latter alternate; divisions and leaflets stalked; petioles dilated at base. Flowers in corymbbs, loose racemes or panicles; perfect, polygamous or dioecious; generally small, greenish-white or purplish. Sepals four to five, petal-like or greenish, usually caducous. Petals none. Stamens numerous, exerted and showy. Carpels usually few (four to fifteen), with single suspended seed, and unilateral stigma. Achenes ribbed or grooved, or inflated, stipitate or sessile.

The name Thalictrum is of doubtful origin, but was the name used for the same plant (or a different one, according to some writers) (1) by Dioscorides. It is usually considered to be derived from the Greek word thallo, meaning to flourish or grow green, referring to the vivid green of the young shoots (2).

Of morphological significance is the arrangement of the vascular bundles in several distinct circles in the stem; this suggests the stem structure of the monocotyledons. The innermost bundles arise first and pass out into the leaf at the next node above, while the peripheral strands represent leaf traces of higher nodes (3). The leaf base is usually broadened into a sheath which is sometimes elongated into a pair of lateral

(2) Loudon's Encyclopedia - pg. 484; Lindsay, T. S. - Plant Names - pg. 75
(3) Solereder, H. - Systematic Anatomy of Dicotyledons - Vol I, pg. 19
stipular lobes (1). Glandular hairs occur in the form of simple uniseriate trichomes in certain species, but are found in our native species only in Thalictrum revolutum (2).

Some species of Thalictrum contain berberin in their roots.

The stamens are the attractive part of the flower, and serve to attract insects, which are mostly pollen-collecting bees and pollen-eating flies and beetles. The filaments are long and the anthers dangle far out, hence the flowers may be referred to as anemophilous as well as entomophilous.

Thalictrum is a genus of about eighty-five to ninety species most abundant in northern temperate regions, with a few in the Andes, India and South Africa. There are supposed to be about twenty-one North American natives found mostly in the eastern and southern States, the Rocky Mountains and on the Pacific Coast.

The thalictrums are "interesting plants for the herbaceous border and wild garden" and many are very hardy. They have feathery heads of flowers with fern-like foliage often of a purplish cast. They have not been so much planted as they deserve, though they are handsome and do well under any good garden conditions. Some are early spring bloomers, while others blossom much later in the summer and fall. The spring species are usually smaller and more delicate than the fall ones. In the garden they do best in low open ground where the soil is loamy and well-drained. Propagation is by seed or more often by division of the roots in early spring. Such divided plants bloom much earlier and tend to be stronger in growth; the seeds moreover are sometimes scarce (3).

The principle species of note are: Thalictrum aquilige-folium L., feathered Columbine, a good garden plant growing one to three feet high and blooming in early summer; T. diptercarpum L. growing two feet and coming from Yunnan, China, much noted abroad - its flowers are rather large and rose-colored, and are borne in pyramidal panicles; T. chelidonii Franch., from the Himalayas, a dwarf, much-branched plant with blue or purple flowers an inch across and borne in rigid branching panicles; T. minus L. variety adiantifolium Hort., admired for its leaflets, which resemble those of the fern, Adiantum; T. Purdonii J. J. Clark, from northern China, cultivated abroad, though little used here, and resembling T. minus, except that the flowers are larger; T. dasy-

(1) Rendle, A. B. - Classification of Flowering Plants - pg. 139
(2) Solereder, H. - Systematic Anatomy of Dicotyledons - Vol. I, pg. 18
(3) Bailey, L. H. - Encyclopedia - pg. 3386
The following paragraphs from Culpepper are of interest since they sum up the beliefs of the herb-doctors and the like as to the virtues of the meadow-rue, as well as giving a colorful description of a common plant (1):

"(Description) Meadow-rue riseth up with a yellow, stringy root much spreading in the ground, shooting forth new sprouts round about, with many herby green stalks, two feet high, created all the length of them, set with joints here and there, and many large green leaves on them, above as well as below, being divided into smaller leaves, nicked or dented in the forepart of them, of a red green color on the upper side, and pale green underneath; Toward the top of the stalk there shooteth forth divers short branches, on every one whereof stand two, three or four small heads, or buttons, which breaking the skin which encloseth them, shoot forth a tuft of pale greenish yellow threads, which falling away, there come in their places small three cornered pods, wherein is contained small, long and round seed. The whole plant hath a strong unpleasant scent." (Therefore he is probably describing T. revolutum.)

"(Government and Virtues) Dioscorides saith that this herb, bruised and applied perfectly healeth old sores, and the distilled water of the herb and flowers doth the like. It is used by some among other potherbs to open the body, and make it soluble; but the roots washed clean, and boiled in ale and drank, provoke to stool more than leaves, but yet very gently. The root boiled in water and the places of the body most troubled with vermin and lice washed therewith while it is warm destroyeth them utterly. In Italy it is used against the plague, as in Saxony against the jaundice, as Camerarius saith."

Garden rue is supposed to be an "herb of the sun and under Leo" and "the leaves, taken either by themselves, or with figs or walnuts, is called Mithridates counter poison against plague, and causeth all venomous things to become harmless." So Culpepper concludes his treatment of garden rue with the following:

"What an infamy is cast upon the ashes of Mithridates, or Methridates (as the Augustines read his name) by unworthy people. They that deserve no good report themselves, love to give none to others; viz., that renowned king of Pontius fortified his body

(1) Culpepper, N. - British Herbal and Family Physician - pg. 293
against poison. He cast out devils by Beelzebub, prince of the devils. What a sort is he that knows not if he had accustomed his body to cold poisons, hot poisons would have dispatched him? On the contrary, if not, corrosions would have done it. The whole world is, at this present time, beholden to him for his studies in physic, and he that useth but the quantity of an hazel nut of that receipt every morning, to which his name is adjoined, shall, to admiration, preserve his body in health, if he do but consider that rue is an herb of the sun, and gather it and the rest accordingly." (1).

**KEY TO SPECIES OF THALICTRUM NATIVE OF MASSACHUSETTS**

Leaflets revolute; waxy-glandular beneath; achenes glandular-pubescent ———— T. revolutum

Leaflets not revolute; not waxy-glandular; achenes usually glabrous.

Spring-flowering; flowers purplish; filaments capillary or slightly thickened upward; achenes sessile—— T. dioicum

Summer-flowering; flowers white; filaments club-shaped, often as wide as anthers; achenes stipitate.

Leaflets and achenes glabrous ——— T. polygamum

Leaflets and achenes pubescent ——— T. polygamum var. hebecarpum

**THALICTRUM DIOICUM** L. Sp. Pl. 545. 1753

(Early Meadow Rue, Poor Man's Rhubarb, Shining Grass, Quick Silver Weed, Feathered Columbine)

Thalictrum — (see under genus name)

dioicum — meaning dioecious, in reference to the flowers

Slender, smooth and pale or glaucous, erect, 3-6 dm. high, leafy. Roots not yellow. Leaves two to three, all with

(1) Culpepper, N. — British Herbal and Family Physician — pg. 293
general petioles, three- to four-ternate; leaflets thin, pale beneath; drooping; orbicular or broader, often cordate; three- to seven- or nine-lobed; the terminal somewhat cuneate. Flowers dioecious; greenish or purplish white; drooping or spreading in elongated panicles of numerous lateral corymbs or umbels. Filaments longer than sepals; anthers linear, blunt, longer than filaments. Stigma elongated. Achenes ovoid, sessile or minutely stipitate; strongly ribbed; much longer than style. (Plate 25, A-E)

Woods; central Maine to Alabama, Saskatchewan and Mississippi. Ascending forty-five hundred feet in North Carolina. Recorded from Labrador. April-May.

This species "belongs to upland wooded areas rather than to Cape Cod region" or Massachusetts (1).

THALICTRUM POLYGAMUM Muhl.

(Fall Meadow Rue, Silver Weed, Rattlesnake Bite, Musket or Musquash Weed)

Thalictrum polygamum Muhl., Cat. 54. 1813
Thalictrum Cornuti T. & G., Fl. N. Am. 1;28. 1836. Not L. 1753

Thalictrum - (see under genus name)

polygamum - from the Greek, meaning that flowers are sometimes perfect, and sometimes imperfect

Stout; glabrous or pubescent but not glandular nor waxy; branching, leafy; 0.5-3.6 m. high. Stem leaves sessile, all three- to four-ternate; leaflets moderately thick, light

(1) Rhod. 32:103-110
green above and paler or sometimes puberulent beneath, orbicular to obovate-oblong, with three main apical pointed or obtuse lobes often with mucronate tips. Panicle of flowers very compound, leafy, 3 dm. or more long. Flowers polygamous; white or rarely purplish; fertile ones with some stamens; filaments white, broadened upward, narrowly clavate; anthers oblong, short, blunt, not drooping. Achenes glabrous, ovoid, short stipitate, six- to eight-winged. (Plate 25, F-H)

Wet sunny meadows and along streams; Newfoundland to Florida, Ontario and Ohio. July-September.

The variety hebecarpum Fernald has leaflets pubescent beneath and achenes pubescent. It is more common in eastern part of Massachusetts than in the western part, though Gray's Manual gives the range as Newfoundland to southern Ontario and New Hampshire.

**THALICTRUM REVOLUTUM DC.**

*(Waxy Meadow Rue)*

*Thalictrum revolutum* DC., *Syst.* 1:173. 1818
*Thalictrum purpurascens* and *variety ceriferum* Austin, A. Gray *Man.* Ed. 5, 38. 1867

**Thalictrum** - (see under genus name)

**revolutum** - from the Latin, meaning to roll back, referring to the margins of the leaflets, which are revolute

Stem mostly stout, often purplish, 1-2.5 m. tall, glabrous or nearly so. Leaves three- to four-ternate, the lower petioled; upper sessile or short-petioled; leaflets firm in texture; ovate or obovate, one- to three-lobed above the middle or entire, dark green above, paler and waxy-resinous or glandular-pubescent beneath; their margins somewhat revolute. Flowers
dioecious or polygamous. Filaments capillary or slightly thickened above, twice as long as the linear anthers, early-drooping. Achenes very short-stipitate or sessile, ridged.

(Plate 25, I-K)

Dry or rocky hillsides, woods and river banks; eastern Massachusetts to New Jersey, southwestern Ontario, southern Indiana and North Carolina and southward. May-June.

This species, like T. polygamum var. hebecarpum, is more common in eastern Massachusetts, though it has been collected in Berkshire County.

Family BERBERIDACEAE

(The Barberry Family)

Perennial shrubs or herbs. Leaves alternate; simple or compound; exstipulate, but with dilated bases. Flowers solitary or in racemose or cymose inflorescences; bisexual; actinomorphic; cyclic; hypogynous; trimerous or sometimes dimerous. Perianth imbricated in bud, usually in two to four whorls; generally differentiated into calyx and corolla; often succeeded by two whorls of "honey leaves". Androecium of two whorls (rarely more) of free, sometimes sensitive stamens; stamens generally as many as petals and opposite them; filaments short; anthers introrse, usually opening by two valves or lids hinged at top, or rarely longitudinal dehiscence. Gynoecium generally with solitary, unilocular carpel; ovary superior; style short or none; stigma large, disc-like; anatropous ovules many to few (rarely one) on ventral suture, or solitary at base of carpel; integuments two, the outer strongly developed and longer than the inner. Fruit a berry or capsule, or rarely an achene. Seed often arillate; endosperm abundant; embryo small
and straight.

The name of the family as well as of the genus Berberis is from the mediaeval name "berbery" probably of Arabic origin (1).

There are some twenty genera with about one hundred and fifty to two hundred species of Berberidacean trees and shrubs chiefly distributed in the north temperate zone, the Andes and temperate South America and Asia.

Two well-marked subfamilies have been recognized by some botanists: the Podophyloideae and the Berberidoideae. The Podophyloideae are characterized by leaves without honey leaves and with foliage leaves which are not pinnately divided. Hydrastis, which we are including in the Ranunculaceae (following Engler and Gray) is by some botanists included in this subfamily, while Glauadium, usually included in the Papaveraceae, is sometimes admitted here. Other genera which belong to the Podophyloideae are Podophyllum, Jeffersonia, Diphyllea and Achlys. The Berberidoideae have honey leaves in the flower, and the foliage leaves are pinnately compound or simple. Berberis (including Mahonia) is the most important member of this subfamily as well as of the whole family Berberidaceae, and Nandina, Epimedium, Leontice and Caulophyllum are the other members.

Phylogenetically and systematically this is a very interesting family. The long cotyledonary stalks in Podophyllum and Leontice are united and the plumule breaks through laterally as in the monocotyledons and in certain of the anomalous Ranunculaceae. The stems of Podophyllum, Diphyllea and Leontice have the vascular bundles arranged irregularly as do the monocotyledons. These characters, and the trimer of the flower suggest a phyllogenetic relationship with the monocotyledons as a group. Hallier derives the angiosperms, both mono- and dicot- from the Berberidaceae (2).

The Ranunculaceae are very closely related to the Berberidaceae and about the only features which separate them are the cyclic flower, single carpel and usually woody habit of the berberids. The anthers of the Berberidaceae, with the exception of Podophyllum, open by uplifted valves—a detail which links the family with the Lauraceae.

With the exception of Berberis, this family does not contain many genera of horticultural interest. Podophyllum, Caulophyllum and one species of Berberis are found native in Massachusetts and will be considered later. Jeffersonia and Di-

(1) Loudon's Encyclopedia - pg. 236
(2) Rendle, A. B. - Classification of Flowering Plants - Vol. II, pg. 158
Diphylleia is listed by Bailey as an "interesting hardy perennial herb sometimes transferred to the wild garden". He also mentions that the species *D. cymosa*, a dwarf type, grows readily in dry soil under cultivation (1). It never bears more than two leaves, hence its name.

Jeffersonia is an attractive, hardy, perennial herb, useful in wild gardens (2). It was named after Thomas Jefferson by Barton seven years before the commencement of Jefferson's first term as President, or while he was Secretary of State in Washington's cabinet. Jefferson was noted for his interest in natural science, was acquainted with many scientists of his day, both at home and abroad, and was particularly concerned with the introduction of useful plants into the United States. It is interesting to note that the plant was first described by Linnaeus in 1753, who knew it only from a fruiting specimen collected in Virginia by John Clayton. He called it *Podophyllum diphylleum*. The plant has been grown successfully in the New York Botanic Garden although it is not a native of the Hudson Valley (3).

Epimedium is a genus of herbs "suitable for rock gardens and shady places (4). It includes some of the daintiest and the most interesting plants that can be grown in the hardy border. *E. macranthum* Morr. and Decne. is as distinct, complicated and fascinating as many of the rare, tender and costly orchids." Bailey goes on to say that "the whole family to which it belongs is exceptionally interesting and is one of the most striking of those rare cases in which the cultural, botanical and artistic points of view have much in common." The foliage of *Epimedium* is particularly attractive, being retained all winter if planted in sheltered spots under trees. It is bronze-tinted when young and contrasts well with the variously-colored flowers. Propagation is by the division of the roots. There are no Epimedias native of America.

The following are the main species of horticultural interest: *E. macranthum* Morr. and Decne., with spurs one inch or so long, white, and sometimes twice as long as the showy inner sepals which are violet; there are several white, pink,

(1) Bailey, L. H. - *Encyclopedia* - pg. 1016
(2) Ibid., pg. 1720
(3) Barnhart, J. H. - *Aquisonia* - 5:31
(4) Bailey, L. H. - *Encyclopedia* - pg. 1121
rose and other varieties. E. alpinum L. variety rubrum Hook. is characterized by medium-sized spurs and bright red sepals; and E. pinnatum Fisch., with spurs shorter than sepals, flowers bright yellow and leaves biternate. The variety elegans Hort. has larger, brighter and more numerous flowers.

Leontice comes from Italy and the Orient and is a genus of "hardy herbaceous perennials of low growth and distinct appearance". It is "likely to be advertised with Dutch bulbs". L. Leontopetalum L. was "used in Holyland against epilepsy" (1).

Nandina from Japan and China is a small, tender shrub with bright red or white berries and is said to be cultivated in every little garden in Japan. The foliage is evergreen and "graceful at all times". N. domestica Thunb. "is an old time favorite in southern California, ultimately reaching to eight feet in height, though of slow growth. For a few years past its use in local gardens has steadily increased and bids fair to rival that accorded it in Japan ... It grows well in whole or part shade and if well supplied with water does equally well in hottest sunshine. If it is used in sunny position it will be found to thrive best when planted in lawns, evidently needing more atmospheric humidity than our climate naturally affords. Its terminal trusses of white flowers, followed by brilliant scarlet berries, added to winter change of foliage from green to red, unite to make it an interesting and attractive shrub throughout the year". It is held in great reverence in China and there withstands considerable frost when the wood is well ripened (2). Pammel lists it as poisonous, with opium as its poisonous compound (3).

**KEY TO GENERA OF BERBERIDACEAE NATIVE OF MASSACHUSETTS**

- Shrubs
- Herbs

**Shrubs**

Stamens 12-15; anthers opening by valves; fruit few-seeded — — — — Caulophyllum

Stamens 6; anthers opening longitudinally; fruit many-seeded — — — — Podophyllum

**BERBERIS** (Tourn.) L. Sp. Pl. 330. 1753

(1) Bailey, L. H. - Encyclopedia - pg. 1859
(2) Ibid., pg. 2105
(3) Pammel, L. H. - Manual of Poisonous Plants - pg. 610
"Spiny", deciduous or evergreen shrubs with yellow inner bark and wood. Leaves alternate, often fascicled; one-to nine-foliolate; usually glabrous. Flowers yellow, in elongated or umbel-like, drooping, rarely compound racemes; or fascicled; or solitary. Sepals six to nine, roundish, petaloid, with two to six bracts outside. Petals (honey-leaves) six; obovate; concave; imbricated in two series, each with two basal glands inside above the short claw; often smaller than sepals. Stamens six, irritable and closing around the stigma when stimulated; anthers opening by uplifted apical valves. Pistil one; ovary superior, one-celled with one to many ovules; stigma peltate, depressed. Fruit a one-to few-seeded "sour" berry; seeds oblong, erect and with a "crustaceous" integument.

**Berberis** is a genus of some one hundred and seventy-five species widely distributed in the north temperate zone and spread from North America through Mexico along the chain of the Andes to Tierra-del-Fuego. It is also found in Asia, Europe and northern Africa.

Five species have been described from Tertiary deposits of southern France, eastern Italy and Switzerland (1).

The section **Mahonia** of the genus differs from the true barberries in the pinnately compound leaves, in the racemes appearing in the axils of the bud scales, and in the spineless branches. Though we prefer to leave the Mahonias in the genus **Berberis**, the modern tendency is to raise the section **Mahonia** to generic rank.

The spines of the barberry are morphologically leaves, while the true leaves are borne on short branches in their axils. The seeming simple leaves are in many cases unifoliolate compound leaves, as indicated by the stalks (particularly in young seedlings), where the petiolule is jointed to a distinct petiole.

(1) Engler and Prantl - *Die Pflanzenfamilien* - Teil III, Abteilung 2, pg. 77
The sensitive stamens and the pollination of the barberry flower was observed by Linnaeus who saw that when the bees in search of nectar touched the filaments, the anthers approximated the stigma and "exploded" the pollen (1). Karl Sprengel in his work on the mechanisms of flowers and their relation to insects, figured barberry flowers and interpreted the irritability of the stamens as a device to ensure self-pollination. Although self-pollination may ultimately ensue, Hermann Muller decided that this irritability was rather a means for promoting cross-pollination. Rendle explains it in the following manner (2):

"The flowers are made conspicuous by the three large bright yellow petals (sic!). The six honey leaves have each a pair of large nectaries just above their base. As the flower opens the six anther filaments bend outwards and come to lie each opposite the middle line of the honey leaf. The nectar collects between the stamens and ovary and the bee in search of it will touch with its proboscis the adjacent bases of two filaments. The anthers open as soon as the petals expand, the little valve moving up and rotating at the same time so that the masses of pollen which it carries with it come to face the center of the flower. When the stamens are stimulated by the touch of the bee, they spring inwards and the pollen-bearing valves strike the insect's head. As the stigma is represented by the papillose sticky edge of the disc surmounting the ovary, the bee, on visiting the next flower, will probably deposit on the stigma some of the pollen derived from the last. It is interesting to note that in the position assumed by the stamens as a result of irritation, the pollen bearing valves are above, not on a level with, the stigmatic ring. Muller observes that, failing insect visits, self-pollination is possible, the masses of pollen coming into contact with the stigma by the bending inwards of the anthers as the flowers wither. He also states that hive bees after being once struck by the springing inwards of the stamens do not probe the same flower again but fly instead to another. Humble-bees, on the contrary, were observed to thrust the proboscis again and again into the same flower, in which case doubtless some pollen was placed on the stigma of its own flower."

Berberis is a genus of "ornamental deciduous or evergreen shrubs, cultivated for their handsome foliage assuming in most species brilliant autumnal tints, and for their bright yellow flowers and attractive fruit. . . . The different species of hardy deciduous barberries are excellent decorative shrubs" for borders, walks, drives, hedges, etc. "The flowers of most of them in spring and early summer, while not conspicuous, are very attractive, and the fruits of nearly all are highly orna-

(1) Loudon's Encyclopedia - pg. 286-287
(2) Rendle, A. B. - Classification of Flowering Plants - Vol. II, pg. 152-153
mental in late summer, fall and early winter on account of their red, dark blue or nearly black color." (1)

Best results are obtained with most barberries by planting in moist, rich loam which is well drained, although the deciduous species can be grown in drier situations. They may be grown from seed, which should be separated from the pulp and then sown in "flats" or "broadcast in beds in the fall where they will germinate the following season". Seeds of rare and scarce species should be sown in the greenhouse where they will germinate during the winter... Most species can be propagated from green cutting of young wood taken from the first to the middle of June, and placed in sand in shaded hotbed precisely the same way as lilacs, viburnums or hydrangeas are treated -- the best way to perpetuate individuals of strikingly characteristic habits. Rarer kinds and varieties are sometimes grafted on B. vulgaris or B. Thunbergii in August or September under glass, or in early spring in the greenhouse. Grafting, however, is not to be recommended, for the stock usually throws up suckers which are often overlooked on account of the similarity of the foliage or many species. They will overgrow the scion in a short time and smother it. A good plan is to use the purple-leaved barberry as a stock; the suckers are thus easily noticeable and may be removed in time (1).

B. aristata DC. from the Himalayas is the strongest-growing species and attains a height of twelve to thirteen feet in twenty years. It has gracefully arching branches, thickish, semi-persistent leaves and violet red fruit. It is a near ally of, and often hybridizes with B. vulgaris. It is said to be hardy at the Arnold Arboretum, and Bentley and Trimen speak of it as hardy in English gardens. In India and Nepal the fruits are dried like raisins (2). There, also, the root is sometimes collected in the fall when it abounds in the bitter principle berberin, and the bark stripped off and dried. It is a tonic, antiperiodic and diaphoretic, and is of great value in fevers, debility and dyspepsia. From the bark of the root a watery extract is prepared, called Rusot or Pasot, and used for an eye disease or as a febrifuge (3). Pammel mentions that the roots are used in India as fish poison (4).

B. canadensis Mill., the American Barberry of the Alleghenies, "forms a neat, compact bush three to three and a half feet with upright spreading branches" (5). It is not as

(1) Bailey, L. H. - Encyclopedia - pg. 487-493
(2) Smith's Dictionary of Economic Plants - pg. 39
(3) Bentley, R. and Trimen, H. - Medicinal Plants - Vol. I, No.16
(4) Pammel, L. H. - Manual of Poisonous Plants - pg. 469, 810
(5) Bailey, L. H. - Encyclopedia - pg. 487-488
tall as *B. vulgaris* and is considered more graceful. "The small clusters of bright red fruits are very attractive," and "of an agreeable acidity". The foliage turns scarlet in autumn. It is a rare shrub in cultivation and *B. vulgaris* has often been sold for it. Saunders says: "Wild currants, gooseberries, plums and cherries all play into the jelly maker's hands; and so do the acid scarlet berries of the eastern Barberry (*B. canadensis*), found in mountain woods from Virginia to Georgia, as well as the European Barberry (*B. vulgaris)*" (1).

*B. sinensis* Poir. of Caucasus regions is "a neat, graceful shrub with pendulous branches three and one-fourth to four feet high and bears numerous clusters of bright red fruits." It is quite hardy (2).

*B. diaphana* Maxim. is a low, densely compact shrub from western China. It grows two and one-half to three feet, but its chief decorative value is in its rich fall coloring, as the solitary flowers and large fruits are relatively inconspicuous. It is hardy at the Arnold Arboretum.

*B. Regeliana* Koehne, from Japan "has an upright, dense habit, and grows from five to six feet. It has the largest leaves of any of the deciduous species and the orange red fruits are remarkably ornamental throughout late summer and fall, until midwinter. This is perhaps the most beautiful barberry in cultivation.

*B. Sieboldii* Miq. is slow-growing, but is a very choice species. The habit is upright and compact, and the fall coloring is brilliant. The leaves are purplish when unfolding and marked with green veins. They turn a deep vinous-red in autumn. The small vermillion-red fruit clusters are very attractive and retain their color for a long time. This shrub is perfectly hardy at the Arnold Arboretum.

*B. Thunbergii* DC. is the Japanese barberry known to everyone. It is excellent for ornamental hedges and since it makes a rather broad, low hedge the plant is most beautiful when it is not necessary to trim it. "It is one of the most valuable species especially remarkable for low, dense, horizontal growth, its large, brilliant red fruits which remain fresh until the next spring, and its brilliant scarlet fall coloring." "Though not as famous as the rose or lilac, the Japanese barberry ranks with the California privet as one of our most useful garden plants." (3) It is very hardy. Several

(1) Saunders, C. F. - *Useful Plants of the United States and Canada* - pg. 97
(2) This and following notes on species of *Berberis* in cultivation from Bailey's *Encyclopedia*, pg. 487-488
(3) *Addisonia* 10:58
varieties are known and among them is the one with leaves variegated with white—called variety Silver Beauty. This originated in Franklin, Massachusetts. B. Thunbergii hybridizes with B. vulgaris quite readily. The species is of particular interest to the botanist because it tends to naturalize in New England (1).

B. Wilsoniae Hensl. "is a small beautiful shrub two to two and a half feet with slender branches and small leaves. The coral red fruits are very distinctive. The tips of the branches usually are winter-killed, but the plants recover rapidly in summer and the shrub is considered hardy in somewhat sheltered positions at the Arnold Arboretum.

B. Polyantha Hensl. with pale red fruit is very handsome in the spring with large panicles of deep yellow flowers. It comes from western China and is not quite hardy in Massachusetts.

B. Francisci-Ferdinandi Schneid. from western China grows to ten feet and has drooping panicles of scarlet fruits which are very handsome.

Few of the evergreen species are dependable in the northeastern States. B. Sargentiana Schneid. is probably the hardiest of all evergreen species and is quite hardy at the Arnold Arboretum. It is a handsome shrub, attaining a height of about six feet, with rather large, oblong, dark green leaves. B. buxifolia Poir. grows only three feet tall and ranges from Chile to the Straits of Magellan. It is very graceful, free-flowering and one of the hardiest of evergreen species. It will stand the winters of the north if somewhat protected. B. stenophylla Mast. has slender arching branches and is of garden origin. It is reported as hardy at the Arnold Arboretum in sheltered positions. B. verruculosa Hensl. and Wilson has dense dark green lustrous foliage, and is likewise almost hardy in Massachusetts. It originated in western China. B. concina Hook. f. from the Himalayas is considered one of the most graceful of barberries, almost hardy here. B. Neubertii Lem. "rarely has the leaves scorched by winter's cold, but is very slow growing."

The section Mahonia (named after Bernard M'Mahon, a prominent American Horticulturist; 1745-1816) gives us some of the finest of ornamental shrubs. They bear handsome evergreen leaves with large conspicuous panicles of yellow flowers which are followed by dark blue berries. Unfortunately most of the species are tender, but B. repens, B. aquifolium, B. nervosa and B. pinnata variety Wagneri are hardy as far north as Massa-

(1) Rhodora 15:225
chusetts. They need some protection from the winter winds and sun, or the leaves are liable to be "scorched" (1).

This group of barberries spreads rapidly by suckers, or they may be propagated by seed sown after maturity or stratified and sown in the spring. Sometimes cuttings of half-ripened wood put under glass, or layers, are used for propagation. They prefer humid soil and may be easily transplanted.

B. Aquifolium Pursh. is the Oregon grape, and has several varieties and some forms with variegated leaves. It grows three to six feet tall and is very handsome. It is found from British Columbia to Oregon and is the floral emblem of the latter. The fruits are edible (2).

B. repens Lindl. (B. Aquifolium Brit. and Brown) rarely grows over one foot tall and is harder but less handsome than the previous species. It is native of territory from British Columbia to California and New Mexico. It does the best of any species with us. It spreads rapidly and the foliage is rarely scorched during our winters. The numerous clusters of showy yellow flowers render it most attractive at the end of May. The berries are emetic and cathartic when fresh, and they are injurious to birds (3).

B. pinnata Lag. from California to Mexico grows two to six feet. The variety Wagneri is the one usually in cultivation, a very desirable shrub. It is about as hard as B. Aquifolium but it grows taller. It is the most beautiful evergreen species though it requires protection from wind and sun. It is, possibly, a hybrid with B. Aquifolium. The berries are "sweet and pleasant" (4).

B. nervosa Pursh. is a very dwarf species from the west, while B. nepalensis with its racemes of flowers over ten inches long comes from the Himalayas.

B. japonica Spreng. from China and the Himalayas, and only cultivated in Japan, has very effective "large bold foliage". It is hardy at the Arnold Arboretum in sheltered positions and will succeed in most places in Massachusetts if given a sheltered situation. There are several horticultural varieties of the species.

Other barberries not mentioned, but which are of use for other than ornamental purposes are: B. vulgaris, to be

(1) Bailey, L. H. - Encyclopedia - pg. 1970-1971. (Following material on culture of various species largely from Bailey)
(2) Saunders, C. F. - Useful Plants of the United States and Canada - pg. 97-98
(3) Pammel, L. H. - Manual of Poisonous Plants - pg. 472
(4) Smith's Dictionary of Economic Plants - pg. 89
discussed later; B. trifoliata of Texas and New Mexico used in making "currant" tarts (1); B. glumacea used for planting game covers in this country (1); B. Lycium of Nepal, with bark of use in medicine as an aperient and for the ague (1); B. maderiensis with bright yellow wood employed by Funchal cabinet makers (1); and several species with roots used in medicine.

BERBERIS VULGARIS L.
(European Barberry, Common Barberry)

Berberis vulgaris L. Sp. Pl. 330. 1753

Berberis - derived from Berbery, the Arabic name of the fruit vulgaris - from the Latin vulgare, meaning common

A glabrous shrub; six to eight feet high; the branches grooved, arched and drooping at the ends; the twigs gray. Leaves alternate or fascicled; obovate or oblong-spatulate; unifoliolate; obtuse; thick, 2.5-5 cm. long; closely bristly-serrate; pale or grayish-green beneath; most of those on the young shoots reduced to three-pronged spines, the fascicles of the succeeding year appearing in their axils. Racemes terminating later branches pendulous, many-flowered, 2.5-5 cm. long (7.5-10 cm. in fruit); flowers bright yellow, 0.5-0.8 cm. broad with a disagreeable odor; petals entire. Berries oblong-ovoid or ellipsoid; scarlet when ripe; acid. (Plate 21)

"Thickets and waste grounds in eastern and southern New England where it has become thoroughly wild; elsewhere occasionally spontaneous". May-June. Naturalized from Europe.

(1) Smith's Dictionary of Economic Plants - pg. 39
This species is commonly grown in gardens and has become extensively naturalized. It bears large clusters of brilliantly colored fruits, and is a most useful shrub in border plantations. It is prolific in many varieties and garden forms (1). Perhaps the most effective of these is the variety atropurpurea Regel, with purple leaves. The variety macrophylla Paul and Sons has larger leaves of a deeper purple color. Other varieties are: albo-variegata Zabel, variegated with white and a rather small shrub; variety aureo-marginata Zabel with yellow margin and a large shrub; variety alba Don., white-fruited; variety dulcis Loud., less acid-fruited; variety lutea Don. (variety xanthocarpa Hort,) yellow-fruited; variety macrocarpa Jaeger with larger fruits; and variety asperma Don., without seeds. This latter variety has been reported growing wild at Sherborn, Massachusetts, where, when reported in 1913, it had been known for forty years (2). Specimens of this variety are included in the Gray Herbarium and in the Boston Society of Natural History collection.

B. vulgaris has been planted in gardens of England for years, both for an ornamental and for a fruit shrub. It was early introduced into the gardens of New England and there it increased rapidly. In 1754 the Province of Massachusetts passed an act to prevent its spreading (3).

Of interest is a figure of this barberry which appeared as part of a large wood-cut in Parkinson's Paradisus Terrestria (1629) (4).

Loudon says of it (5): "B. vulgaris is at once an ornamental shrub, a fruit tree, a hedge plant, a dye, a drug, and a reputed enemy to the corn farmer. When covered with flowers in the spring, or with fruit in the autumn, it is a fine object. The leaves are yellowish or blueish green, and gratefully acid to the taste. The smell of the flowers is offensive when near, but pleasant at a distance. Berries are so acid that birds seldom touch. However it is often cultivated for the berries which are pickled and used for garnishing dishes; boiled with sugar they form a most agreeable rob or jelly; used as sweetmeat and put into sugar plums or comfit. As a medicine - considered a mild astringent acid, agreeable to the stomach and of efficacy (like other vegetable acids)

(1) Bailey, L. H. - Encyclopedia - pg. 489
(2) Rhod. 14:207
(3) History Massachusetts Horticultural Society 30: 1880
(4) Arber, Agnes - Herba/s - pg. 114
(5) Loudon's Encyclopedia - pg. 286-287
in hot bilious disorders, and in a putrid disposition of the humours. Roots boiled in Iye yield a yellow color and in Poland they dye leather of a fine yellow with the bark of the root. The inner bark of stems will dye linen a fine yellow with the assistance of alum. Kine, sheep and goats eat it; horses and swine refuse it. Species varies with red, purple, pale yellow and stoneless fruit."

"Insects are fond of the flowers and the Aecidium Berberidis its particular inhabitant, is supposed to generate the dust which, carried from the bush by winds, and lighting on wheat and other growing corns, gives rise to a Puccinia, a minute fungus which closes up the pores of the leaves and appears like rust or mildew."

A quotation from Culpepper will add a few more interesting touches (1): "This shrub is so well known by every boy and girl that hath but attained to the age of seven years, that it needs no description". Then under the head of Government and Virtues he adds: "Mars owns the shrub, and presents it to the use of my countrymen to purge their bodies of choler. The inner rind of the barberry tree boiled in white wine, and a quarter of a pint drank each morning, is an excellent remedy to cleanse the body of choleric humours, and free it from such diseases as choleric causes, such as scabs, itch, tsett, ringworms, yellow jaundice, scaldings, heat of the blood, heat of the liver, bloody-flux; for the berries are as good as the bark, and more pleasing; they get a man a good stomach to his victuals, by strengthening the attractive faculty which is under Mars, as you may see more at the end of my Ephemeris for the year 1651. The hair washed with the lee made of ashes of the tree and water, will make it turn yellow, viz of Mars' own color. The fruit and rind of the shrub, the flowers of brooms and of heath, or furze, cleanses the body of choler by sympathy, as the flowers, leaves and bark of the peach tree do by antipathy; because these are under Mars, that under Venus."

Sturtevant speaks of a celebrated preserve made from the stoneless variety at Rouen, France, and that the berries of the common barberry are imported from Afghanistan into India under the name of currant. (2).

John Gerard mentions the leaves as formerly used to season meat in England (3).

A black variety found by Tournefort (2) on the bank of the Euphrates is supposed to have had deliciously flavored fruit.

(1) Culpepper, N. - British Herbal and Family Physician - pg. 29-30
(2) Sturtevant's Notes on Edible Plants - pg. 88-89
(3) Herbal - pg. 326
The bark of the root of *B. vulgaris* is included in the United States Pharmacopoeia Secondary. Its medicinal properties are due to the two alkaloids berberin \(\text{C}_{21}\text{H}_{18}\text{NO}_4\) and oxycanthin \(\text{C}_{19}\text{H}_{21}\text{NO}_3\). The drug is tonic in small doses and cathartic in larger. It was used as a gentle purgative in jaundice "by the celebrated botanist John Ray" but the idea of the cure for this disease rests upon the Doctrine of Signatures which implies that since the skin of a person is yellow in jaundice, and the bark is yellow, it must be a remedy (1).

In some parts of Europe a cooling astringent, antiscorbutic drink is made from the fruit or bark which is given in febrile diseases and diarrhoea (1).

**CAULOPHYLLUM** Michx. *Fl. Bor. Am.* 1:205. 1803

Erect, glabrous, perennial herbs with "matted knotty rootstocks". Leaves large; triternately compound; sessile or nearly so. Flowers small, yellowish-green; panicled; appearing before the leaves open. Sepals six, ovate-oblong, subtended by three to four bracts. Petals six, much smaller than the sepals, thick and gland-like, somewhat kidney-shaped or cucullate, with short claws and opposite the sepals. Stamens six; anthers oblong, dehiscent by uplifted valves. Pistil one, gibbous; style short, stigma minute and unilateral; ovary bursting soon after flowering by pressure of two erect enlarging ovules. Seeds spherical, drupe-like, blue, freely exposed, stipitate. Endosperm horny.

Two species, one in eastern North America and other in Asia.

CAULOPHYLLUM THALICTROIDES (L.) Michx.
(Blue Cohosh, Papoose Root)

Leontice thalictroides L., Sp. Pl. 312. 1753
Caulophyllum thalictroides Michx., Fl. Bor. Am. l:305. 1803

Caulophyllum - Greek stem and leaf, referring to the stem, which seems to form a stalk for the large sessile leaf at the base of the panicle
thalictroides - Greek thalictrum plus diminutive adjectival termination, referring to the resemblance between the leaves of this plant and of Thalictrum

Glabrous; glaucous when young; 3-9 dm. high, with two to three large sheathing bracts at base. One large, ternate, nearly sessile leaf near summit and one, generally smaller and binate, near base of inflorescence. Leaf divisions long-petiolated, ternately- or pinnately-compound; ultimate segments thin, one to three inches long, oval, oblong, obovate or wedge-shaped, three- to five-lobed near the apex. Flower panicle terminal, 5-7.5 cm. long; flowers greenish-yellow or purplish, 0.7-1.3 cm. broad, appearing while leaf is yet small. Seeds globular, 0.7 cm. in diameter, blue, glaucous, borne on short stalks about 0.5 cm. long. (Plate 26)

Deep, rich woods; New Brunswick to Manitoba and southward. April-May.

This plant, rare in the eastern part of Massachusetts (1), is "sometimes removed from the woods to cultivated grounds" in other parts. "It is always attractive because of trim growth and interesting habit. In fall when foliage is dead, the drupe-like seeds stand erect on dry stalks and afford one of the richest and best of deep blues" (2).

(1) Rhod. 12:187
(2) Bailey, L. H. - Encyclopedia - pg. 895
PODOPHYLLUM L. Sp. Pl. 505. 1753

Erect, perennial herbs with horizontal rootstalks and thick fibrous roots. Stem with two large, peltate, palmately-lobed leaves. Flowers solitary, white; bud with three fugacious bractlets. Sepals six, petaloid and fugacious. Petals six to nine, flat, obovate, and longer than sepals. Stamens equal to, or twice as many as the petals; anthers linear-oblong, not opening by uplifted valves but by longitudinal dehiscence. Pistil of one, rarely of several carpels; ovary ovoid, with many ovules in many rows covering the large lateral placentas; stigma sessile, large, thick and undulate. Fruit a large, fleshy berry. Seeds numerous, obovate and inclosed in fleshy arils.

There are two species in the genus Podophyllum: P. peltatum L. of eastern North America, and P. emodi Wall. of the Himalayas. The latter has white or pale rose-colored flowers and brilliant red fruits which are as large as hen's eggs and edible. The foliage of this species is particularly attractive, being a fine bronzy red in early spring (1). The leaves and rhizomes are poisonous due to the same active principles as are present in our native species (2).

PODOPHYLLUM PELTATUM L.

(May Apple, Wild Mandrake, American Mandrake, Wild Lemon)

Podophyllum peltatum L. Sp. Pl. 505. 1753

Podophyllum - from the Greek foot and leaf, referring either to the stout petioles or to the resemblance of the leaf to the foot of some aquatic birds

peltatum - from the Greek and Latin for shield, referring to the shield-shaped leaves with petiolar attachment on the under surface.

(1) Bailey, L. H. - Encyclopedia - pg. 2736
(2) Sturtevant's Notes on Edible Plants - pg. 447; Pammol, L. H. - pg. 610
Erect, 3-4.5 dm. high. Basal leaf of flowerless stem centrally peltate, nearly one foot in diameter; long-petioled, deeply seven- to nine-lobed; the lobes oblong and rather wedge-shaped, somewhat two-cleft and dentate at apex; glabrous or pubescent and light green underneath, darker above. Flowering stem bearing two one-sided, five- to nine-lobed leaves similar to the basal leaf; or occasionally leafless. Flower white, 5 cm. broad; nodding; stout peduncled; appearing at the fork of the two stem leaves. Stamens twelve to eighteen, or twice as many as the petals. Fruit ovoid, 2.5-5 cm. long, yellowish, sweet-scented and slightly acid but edible. (Plate 27)

Rich woods from western Quebec and western New England to Minnesota and southward to Florida and Texas. Blooming in May or June, and fruiting in June or July.

This plant is comparatively rare in Massachusetts, as shown by the few specimens from only five counties - Middlesex, Norfolk, Worcester, Franklin and Berkshire - (New England Botanical Club Herbarium).

Abnormally, instead of the regular two leaves, out of the fork of which grows the flower, the flower comes directly out of the ground from the apex of the rhizome, with no trace of leaves other than scales at the base of the scape. This has been called Podophyllum peltatum forma aphyllum Plitt. (1) Another abnormality gives us a second form, P. peltatum forma polycarpum Clute (2). Instead of a single fruit, a cluster of fruits occurs and the entire cluster weighs three or four times as much as the average fruit.

The plants of Podophyllum peltatum are offered by several dealers in hardy, herbaceous perennials, and a colony of them is "most desirable for a wild garden. They are of easy culture, requiring a deep, rich soil and partial shade. They are useful only for spring effects as the foliage dies down by midsummer or before. Propagation is by division of the rhizome or by seed" (3). The plant was first cultivated in England in 1664 and is now found in most botanic gardens.

(1) Rhod. 33:228-229
(2) American Botany - 21:93. 1915
(3) Bailey, L. H. - Encyclopedia - pg. 2726
there and throughout Europe (1). In France the plants are frequently grown in flower gardens (2).

The rhizome, roots and leaves are acrid and poisonous, but the pulp of the fruit is less so and contains active medicinal qualities "being in repute as a substitute for calomel" (3). Podophyllin is common in drugstores and is the resinous substance obtained for the drug trade from the rhizomes of the plant which are collected late in summer and dried. The chief supply for the commercial drug trade comes from the central States (4) and the manufacture is carried on chiefly in Cincinnati (1). The rhizomes and roots contain from three and one-half to five per cent of podophyllin. It owes its active properties to podophyllotoxin \( \text{C}_{11}\text{H}_{14}\text{O}_{6}.3\text{H}_2\text{O} \) and picropodophyllin \( \text{C}_{11}\text{H}_{14}\text{O}_{4}.\text{H}_2\text{O} \). It also contains picropodophyllinic acid, podophyllinic acid, picropodoqueritin, berberin and saponin (5). Podophyllin is bitter, acrid, and nauseous with a disagreeable odor. It is narcotic, emetic, and cathartic and is used in cases of constipation, liver troubles and sometimes for bronchitis and pulmonary affections or as a counter irritant (1). Care must be exercised in the use of the drug for it is poisonous if given in large doses or continued too long. As a poison (one-fourth to one-half grain) it causes inflammation, nausea, vomiting and severe pain, weak pulse, drowsiness and cold extremities. Employees engaged in the preparation of the rhizomes or the resin are often greatly troubled, for the powder has a peculiarly irritating effect on the skin and may even cause ulcers on the eye balls (5).

The medicinal virtues of Podophyllum were well known to the Indians of North America and the early botanist, Catesby, remarked that the roots were an excellent emetic (5). Newport speaks of "certaine ground apples, a pleasante fruite" around the James River region. Porcher mentions the fruit as relished by many and considered extremely delicious to most but to some it is an aperient (2). Saunders says (6): "When green the fruit exhales a rank, rather repulsive odor, but when fully matured it is changed into an agreeable fragrance, hard to define—a sort of composite of cantaloupe, summer apples and fox grapes. Brought indoors, two or three will soon perfume a whole room. As to palatability, tastes differ; some people

(2) Sturtevant's Notes on Edible Plants - pg. 447-448
(3) Smith's Dictionary of Economic Plants - pg. 270
(4) Bailey, L. H. - Encyclopedia - pg. 2726
(5) Pammel, L. H. - Manual of Poisonous Plants - pg. 470-471; also Merck's Index
(6) Saunders, C. F. - Useful Plants of the United States and Canada - pg. 99-100
loathe the flavor, others are fond of it. It ought not to be condemned on the evidence of the unripe specimens, but should be tested fully mature at which stage the little 'apples' are yellowish in color and drop into the hand at a touch. They may be eaten raw in moderation, the outer rind being first removed, or they may be converted into jelly."

Family MENISPERMACETAE
(The Moonseed Family)

Glabrous or slightly pubescent; semi-woody or woody lianes. Leaves alternate; palmate or peltate, sometimes simply lobed; alternate; long-petioled; exstipulate. Flowers small, in axillary racemes; dioecious; actinomorphic (with the exception of the zygomorphic pistillate flowers of Cissampelos); cyclic; hypogynous; trimerous or sometimes dimerous; sepals usually in two whorls; petals similar or shorter than sepals, in one whorl, or absent; imbricate in bud. Staminate flowers with many stamens usually in two whorls; anthers four-loculed, dehiscing longitudinally; rudimentary pistils generally present. Pistillate flowers with six sterile or rudimentary stamens generally present; carpels three or more, free; stigmas broad; style short; ovary one-celled with single hemi-anatropous, pendulous, doubly-integumented ovule on ventral suture. Fruit a bluish-black drupe, "the apex of which thru strong dorsal growth often approaches the base"; seed or stone flattened, crescent-shaped or curved; endosperm present, sometimes ruminate, or absent; embryo often bent.

The family name as well as that of the chief genus is derived from the Greek moon and seed, referring to the crescent shape of the seed (and sometimes to the fruit).
There are several interesting floral tendencies evident in the family. The petals of the menispermaceous flower may be compared with the honey leaves of the Ranunculaceae and Berberidaceae. Occasionally there is a union of the calyx and corolla parts, while the stamens frequently unite in a bundle. In Cissampelos and allied genera they unite so completely that the androecium forms a central column. An increase or decrease in the number of sepals and stamens sometimes occurs (1).

Of morphological interest is the abnormal secondary growth in the climbing stem of many genera of the family. After one or two years "the original cambium ceases to function and its place is taken by a ring of meristem in the cortex in which new collateral bundles are formed. Repetition of this process leads to the formation of concentric rings of bundles" (1).

The Menispermaceae is an important tropical family with about seventy genera and three hundred species. "A few genera pass into the north temperate zone in North America, the eastern Mediterranean region and eastern Asia, and also into the south temperate zone. Fossil species from the Tertiary beds in Europe and North America indicate a former more extended northerly range." (1).

Some species of the family are cultivated as ornamental plants, and all members of the family are "rich in bitter and poisonous properties". Jatrophora colomba (also called Menispermum palmatum Lam. and M. Columba Roxb.) of East Africa yields the officinal Columba root so much esteemed for its intense bitterness. It is used as a bitter stomachic and a mild tonic, and is of value in cases of diarrhoea and dysentery, and as a wash for putrid sores (2). It contains several alkaloids, but most interesting to us is the presence of berberin (2). The fruits of Anamirta cocculus are used as fish and fly intoxicants or poisons, the former being called "Grains-of-Paradise" by the natives of the East Indies (3). Their toxic and poisonous properties are due to the presence of nicotin (C_{15}H_{16}O_{6}) and nicotin (C_{15}H_{18}O_{7}) (4). Cocculus indicus is the common name for the fruit of A. cocculus L. (sometimes called Menispermum cocculus) and the berries of this species are imported into Britain from Bombay at the rate of thirty to fifty thousand pounds annually (5). They are used in medicine in the preparation of an ointment to destroy lice and in obstinate cases of chronic skin disease. The berries are also

(1) Rendle, A. B. - Classification of Flowering Plants - Vol. II, pg. 155
(2) Loudon's Encyclopaedia - pg. 844
(3) Warning and Potter - Systematic Botany - pg. 380
(4) Pammel, L. H. - Manual of Poisonous Plants - pg. 472
used for this purpose and both are used by "brewers and publicans" for increasing the bitterness and intoxicating powers of malt-liquors. (But there is a heavy penalty for those caught using them!) They are also used for "drugging" but caution must be used, for an overdose causes death (1). Cocculus plukenetii produces berries which are made into a paste in the East Indies and used to intoxicate not only fish and vermin but also birds. (3) The ripe berries of C. cebotha are acrid but edible and a spirituous liquor is obtained from them (3). C. limacia also has acrid but edible berries (3). Several Brazilian species of the genus Cocculus are said to possess powerful febrifugal properties (4). C. carolinus (L.) DC. is found within the range of Gray's Manual. Coscinium fenestratum (Gärtn.) Colebr. yields a yellow dye (5). Chonocrodendron tomentosum Ruiz. and Pav. is used in Brazil to cure snake bites and also in medicine as a mild tonic and diuretic and aperient (5). It is the true Pareisa brava root, while Cissampelos Pareira L. produces the false (6). Tinospora cordifolia (Willd.) Miers. of India is used as a tonic, antiperiodic, diuretic and specific for "bites of insects and venomous snakes" (6).

Besides various alkaloids such as menispermin, pelosin, berberin, picrotoxin, columbianum, etc., saponin is of frequent occurrence in the family. (7)

The only three genera coming within the range of Gray's Manual are Cocculus, Calycocarpus and Menispernum. The last named genus is the only one getting as far north as Massachusetts.

**Menispernum** (Tourn.) L. Sp. Pl. 340. 1753

(Moonseed)

High climbing vine with small, whitish flowers, in loose, axillary racemes. Sepals four to eight in two series; petals shorter than sepals, and six to eight in number. Stamine flowers with twelve to twenty-four stamens as long as sepals; anthers four-celled. Pistillate flowers with six ster-

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(2) Loudon's Encyclopedia - pg. 844
(3) Sturtevant's Notes on Edible Plants - pg. 180
(4) Loudon's Encyclopedia - pg. 1055
(6) Engler & Prantl - Die Pflanzenfamilien, III Teil, II Abiet.-
(lung, pg. 84
ile stamen filaments and two to four carpels inserted on slightly elevated receptacle; stigma broad and flat. Fruit a nearly globular or ovoid drupe, laterally flattened; the stone wrinkled, grooved and laterally flattened and curved into a spiral; crested on sides and back; embryo slender, horseshoe-shaped; cotyledons filiform.

The genus *Menispernum* consists of two species: *M. dahuricum* DC., native of central and eastern Asia; and *M. canadensis*, native of eastern North America from western Quebec and western New England westward and southward. Both are easily propagated and cultured, and are of some use ornamentally.

**MENISPERMUM CANADENSIS** L. Sp. Pl. 340. 1753

*(Canada Moonseed)*

*Menispernum* - from the Greek moon and seed, referring to the shape of the stone

*canadensis* - of, or pertaining to, Canada

Stems climbing over bushes or walls; six to twelve feet, slender; slightly pubescent or glabrous. Flowers white, 2 mm. wide; racemes bracteolate. Leaves peltate near the edge; slender-petioled, broadly ovate, 1-2 cm. wide, cordate or truncate at base, cuneate, acute or obtuse, three- to seven-angled or lobed, pale beneath. Drupes black with a bloom; globose-oblong, 0.6-1 cm. in diameter; stone spirally curved; ripe in September. (Plate 31)

This species is usually found growing on banks of streams from Manitoba south to the Gulf, yet "it is scattered or lacking in many areas and therefore not widely known, for it may be locally abundant or entirely absent". There are four reports of it in Massachusetts: one specimen from Westfield, two from Sheffield and one from Hadley. By means of fossil
remains its ancestry has been traced back to the time of the first appearance of the angiosperous type of vegetation in the early Cretaceous period. Under the extinct genus *Menispermites* some twenty or more North American species have been described besides other closely allied species from the genus *Cocculus* of the Tertiary and Quarternary periods (1).

"The noxious berries sometimes tempt children to their sorrow" as they look like chicken-grapes. Stories of poisoning from the eating of wild grapes sometimes get into the newspapers and are generally traceable to this plant (2).

Family **NYMPHAEACEAE**

(The Water Lily Family)

Aquatic, perennial herbs with horizontal, endogenous rootstalks rooted in the mud. Leaves generally large; simple and cordate or peltate; long-petioled; floating or emersed; submerged leaves sometimes dissected; vernation involute. Flowers usually large and solitary; bisexual; actinomorphic; acyclic, hemicyclic or cyclic; hypogynous to perigynous. Perianth leaves free, six to indefinite in number; generally differentiated into calyx and corolla; calyx of three to six members; corolla of three to indefinite members, usually passing through gradual transitions to stamens. Androecium of six to many stamens. Gynoecium of three to indefinite, generally numerous, free or united carpels. Ovules one to many, borne on sides or back (or when solitary hanging from summit) of cells, not on ventral suture; each with two integuments. Fruit indehiscent. Seed often arillate and generally with both

(1) Addisonia 8:41
(2) Saunders, C. F. - Useful Plants of the United States and Canada - pg. 248
endosperm and perisperm. Embryo enclosed in a little sac at end of endosperm next hilum (except in *Nelumbo*, which has no endosperm). Cotyledons thick and fleshy, inclosing well-developed, two- to four-leaved plumule; hypocotyl small.

The family name, as well as that of the genus *Nymphaea*, is the ancient name given to the ladies dedicated by the Greeks to the Water Nymphs, hence Loudon's reason for calling *Nymphaea* the "Nymph or Naiad of the streams" (1). This also recalls the Greek myth of Dryope, a beautiful young princess and daughter of Baucis. She married Andraemon, a worthy young prince, and they became the parents of a charming son. Every day Dryope carried the child along the banks of a little lake close by the palace, where blossomed a profusion of gayly colored flowers. One day she saw a lotus blossom and pointed it out to the child who no sooner saw the brilliant flower than he stretched out his hands for it. To please him the mother plucked it, but had scarcely done so when blood trickled from the stem; and while she stood there, speechless with wonder, a voice was heard accusing her of having slain Lotis, a nymph, who had assumed the guise of a flower.

"Lotis the nymph (if rural tales be true),
As from Priapus' lawless love she fled,
Forsook her form; and fixing here became
A flowery plant, which still preserves her name."

- Ovid (Pope's translation)

(Dryope was turned into a tree, and when its leaves rustled the ancients said it was "Dryope's lone lulling of her child").

Rendle sums up the "high spots" in the morphology of the *Nymphaeaceae* thus (2):

"The cotyledons are hypogeal; in germination the plumule elongates and bears first an awl-shaped leaf (except in *Nelumbo*, where the adult peltate form is at once assumed); this is generally followed by lanceolate, sagittate, or ovate submerged leaves which precede the development of the adult floating form. The stem is a rhizome which is short, thick and erect, as in *Victoria*, where it lives for a few years, and in *Nymphaea* for one year; or a long-lived branched rhizome creeping in the mud, as in our native *Nuphar* (*Nymphaezanthus*) and *Nymphaea*. The vascular bundles have the woody elements much reduced; in the absence of cambium and their scattered arrangement in the parenchymatous ground-tissue they recall the arrangement characteristic of monocotyledons. Laticiferous vessels are present. So-called stellate hairs, or radiating supporting cells, frequently occur in the angles of the walls of the large intercellular spaces, especially of the leaf-stalks."

(1) Loudon's Encyclopedia - pg. 463
(2) Rendle, A. B. - Classification of Flowering Plants, Vol. II, pg. 161
As to the classification of the Nymphaeaceae, they fall quite naturally into three subfamilies: the Cabomboideae with its two genera Cabomba and Brasenia having free carpels and both endosperm and perisperm; the Nelumboideae with the single genus Nelumbo, also with free carpels but no endosperm; and the Nymphaeideae with Nymphaea, Nymphaeanthus, Victoria, Euryale and Barclayea having the carpels united. Only the first and the last of the subfamilies mentioned are represented in the flora of Massachusetts.

The subfamily Cabomboideae with its small flowers, free hypogynous parts and pod-like fruits, seems to ally the Nymphaeaceae with the Ranunculaceae, while the dimorphic leaves of Cabomba recall the Batrachium section of Ranunculus in particular. The scattered distribution of fibrovascular bundles in the water lilies recalls Podophyllum and allied genera in the Berberidaceae as well as Actaea, Cimicifuga, Thalictrum, etc. of the Ranunculaceae. The frequent presence of an aril around the seed also suggests an affinity with the Berberidaceae.

"The presence of latex in the tissues, the superficial placentaion of the ovules, and the large, peltate, rayed stigmas seem to suggest a relation to the Papaveraceae" (1).

The water lilies have had their generic names changed many times and the history of these changes is worthy of attention. The following very general account from the English Grete Herball (1528) is one of the earliest references: "Menufar is an herbe that growth in water, and hath large leaves and hath a floure in maner of a rose, the rote thereof is called treumyan and is very bygge. It is of two maners. One is whyte, and another yelowe" (2). In general, previous to the time of Linnaeus, the European white and yellow water lilies were treated as constituting one genus, Nymphaea. This nomenclature was continued by Linnaeus, until 1764 when his conception of a genus changed. Then the white water lilies definitely seemed to be indicated in his description of Nymphaea, since in redefining he excludes N. lutea while including N. alba. Herman Boerhaave, followed by Ludwig, a Dutch botanist (1720), called the yellow water lilies Nymphaea and the white ones

(1) Rendle, A. B. - Classification of Flowering Plants - Vol. II, pg. 161

(2) Arber, Agnes - Herballs - pg. 139. See also pg. 139 for figure of water lily which was printed in 1498 (Arnaldus de Villa Nova, Tractatus de virtutibus herbarum); and pg. 44 for figure of water lily printed in 1529 (Grete Herball). The former figure is worth noticing for the curious method of representation of scars of leaf bases on rhizomes. On pg. 141 is figured a much superior and very recognizable drawing of a white water lily done but a year after the wretched Grete Herball figure (Brunfel's Herbarum vivae eicones)
Leuconymphaea. Linnaeus knew Boerhaave and since in Linnaeus' first edition of Genera Plantarum he described Nymphea, Leuconymphaea and Nelumbo, Mackenzie maintains that Nymphea was meant to describe the yellow water lilies; consequently Edition 5 of Genera Plantarum (1794) merely has the matter concerning the yellow water lilies left out.

In 1805 Salisbury divided the old Nympheae into two parts: Nympheae the cow lily; and Castalia the white water lily. In May 1806 L. C. Richard published Nymphozanthus for the cow lily or spatter dox, while Smith's Nuphar for this same yellow water lily did not appear until the last of 1806 or the beginning of 1807. However, Smith's Nympheae for the white water lily and Nuphar for the yellow was generally accepted, since Salisbury, in spite of priority, in dividing the old genus Nympheae, retained the old name for the portion containing the fewest number of species (and this is contrary to International Rules - Art. 45). So Smith's name was accepted, being supported by Conard and others, until Fernald proved the priority of Richard's publication and Nympheae was applied to the white water lilies and Nymphozanthus to the yellow (1).

The family Nympheaeaceae is composed of eight genera and some fifty to sixty true species, besides innumerable horticultural varieties and hybrid forms. They are widely distributed in fresh water ponds and streams, some being natives of tropical Asia, Africa and South America while others are native of temperate regions, particularly in America.

The following quotation well indicates the ornamental value of these water lilies and the position they hold in the gardens of our country:

"Water lilies or nympheaeas are among the most royal, gorgeous, diversified and universally admired plants in cultivation. No class of plants in our public parks can compete with them in attracting the people. Moreover, America is the most highly favored country in the world for the cultivation of aquatic plants. Ours is the only country which can have so rich and continuous a display of aquatics in flower from April to October in the open without artificial heat. . . in the eastern States, especially near the coast, where the nights are cool, the season is much longer, and the color of some of the pink varieties is more intense. Following the hardy nympheaeas come the nelumbiums in all their oriental splendor, brightening the summer season, and bridging over the declining period of the hardy nympheaeas and the approaching season.

of the tropical
nymphaeas which arrive at maturity toward the
latter end of July or beginning of August, and continue until
fall. Finally, the grandest of all aquatic plants, Victoria
regia, may be seen in America growing in natural ponds and
producing its chaste flowers as late as the middle of October" (1).

The culture of water lilies will be treated later
under the genus Nymphaea.

Economically, the Nymphaeaceae have some importance
aside from their ornamental value. This can best be dis-
cussed under individual species.

Nelumbo (Ceylonese name) is a genus of two species,
one North American and the other Asiatic and Australian. The
genus shares with Nymphaea a distinctive place in the Nymphae-
aceae both historically and economically. Nelumbo nucifera
Gaertn. (Nelumbium speciosum Wild., Nelumbo Nelumbo Karst., or
Nymphaea Nelumbo L.) is the Oriental Lotus, native of India,
Persia, China, Japan and Australia. Although it is usually
called the Egyptian Lotus, Sacred Bean, Pythagorean Bean,
Egyptian Bean or Holy Cyanus, it is not the true Egyptian Lotus;
for historically, Nelumbo is not native of Egypt and never has
grown wild there, though it was cultivated along the Nile in
the Roman period, probably for food, and then its flower furn-
ishèd the design for one form of capital of Egyptian columns
(2).

Smith says (3): "Although not now found in the
Nile, it nevertheless appears at one time to have been common
there, and was held sacred by the worshippers of Isis, as is
evident by the sculptures and representation of the flower
found in the ruins of the ancient temples. It is noticed by
Heroditus (413 B.C.) who says - 'Another Lily grows in the
same place (see Lotus), much like a rose, with a certain
fruit found at the foot of the stem, in form not unlike a
wasp's nest, and covered with a pellicule, containing divers
kernels of the size of an olive stone, which are either eaten
tender or dried.' Although the above description is brief
it is nevertheless-sufficient to prove that Nelumbium grew
in the Nile at the time of Heroditus, and even as late as
the time of Dioscorides (50 B.C.) who calls it Cyanus, and
by some writers it is called Lotus Plant."

Recent writers believe the figures and carvings
with the exception of the form found on some of the columns

(1) Bailey, L. H. - Encyclopedia - pg. 8307
(2) " " " " Economic Plants - pg. 559
(3) " " " " Encyclopedia of Economic Plants - pg. 359
are of Nymphaea caerulea and N. Lotus rather than Nelumbo. If Heroditus saw
Nelumbo growing in Egypt it was probably there under cultivation, but he, and other ancient writers spoke of water
lilies indiscriminately as 'Lotus' of Egypt (1).

However, in Hindustan Nelumbo is carved on walls of
cave temples and there it was venerated as was also Nymphaea
stellata, N. rubra and N. Lotus. In all India, Tibet, China
and Japan this 'lotus' was deemed sacred and grown about the
temples where it is still used in religious invocations and
ceremonies. But the sacredness of the plant has not limited
it to a merely ornamental purpose. The leaf stalks abound in
spiral fibres which are extracted and made into wicks to burn
before idols, and its leaves are used as plates on which offer-
ing are placed. Particularly in Pekin and other Chinese cities
the ditches on the outskirts are literally choked up with its
abundance and it is often cultivated in large handsome pots in
gardens and houses of the mandarins and called by the Chinese
Lien-wha. The richly farinaceous rhizomes form an important
food ingredient and are served with ice in summer or pickled in
salt and vinegar for winter use. The young leaf stalks are
eaten as pot herbs and a dish made of the seeds of the plant and
slices of the hairy rhizome with kernels of apricots and walnuts,
and alternate layers of ice, frequently presented to British
ambassador at breakfast given him by principal mandarins. The
seeds are edible and about the size of an acorn, oblong, hard
and smooth, with a taste which is supposed to be more delicate
than almonds. They possess a remarkable power of vegetating
even after as many as forty years' drying, and then they are
reported to blossom the first year (2).

Sturtevant gives the following interesting facts (3):
"The Lotus is an eastern flower which seems from time immemorial
to have been, in native estimation, the type of the beautiful.
It is held sacred throughout the East, and the deities of the
various sects in that quarter of the world are almost invariably
represented as either decorated with its flowers, seated or
standing on a lotus throne or pedestal, or holding a sceptre
formed from its flowers. It is fabled that the flowers obtained
their red color by being dyed with the blood of Siva when
Kamadeva wounded him with the love-shaft arrow. Kaleshimi is
called the lotus-born from having ascended from the ocean on
its flowers. The lotus is often referred to by the Hindu poets."
Perhaps one of the most beautiful references to the lotus, though
brief and not descriptive, is in the Indian prayer and invoca-

(1) Bailey, L. H. - *Encyclopædia* - pg. 4307
(2) Loudon's *Encyclopædia* - pg. 477
(3) Sturtevant's *Notes on Edible Plants* - pg. 382
tion translated into poetry so effectively in Sir Edwin Arnold's

*The Light of Asia*:

"The Dew is on the Lotus! - Rise, Great Sun!
And lift my leaf and mix me with the wave!
Om mani padme hum, the Sunrise comes!
The Dewdrop slips into the shining Sea!"

(In music we have Schumann's beautiful *Lotus Flower*.)

"The lotus floating on the water is the emblem of the world. It is also symbol of the mountain Meru, the residence of the gods and the emblem of female beauty. Both the roots and the seeds are esculent, sapid and wholesome and are used as food by the Egyptians. In China, some parts of India and Ceylon, the black seeds of this plant, not unlike small acorns in shape, are served at table. Tennent found them of delicate flavor and not unlike the pine cones of the Apennines. In the southern provinces of China, large quantities are grown. The seeds and slices of its hairy root are served at banquets and the roots are pickled for winter use. In Japan the stems are eaten. These stalks are not dissimilar in taste to our bread beet with a somewhat sharp after taste. The seeds are also eaten like filberts. The roots furnish a starch, or arrowroot, in China, called gaou-fun."

As to ornamental value little need be said. *Nelumbo* is a 'superb plant' often in cultivation, with leaves three feet in diameter, held above the water or sometimes floating, and with pink or sometimes white flowers four to ten inches across.

Our North American representative of the genus *Nelumbo* is *N. lutea* (Willd.) Pers., the Yellow *Nelumbo*, Water Chinquapin or Chinkapin, Wankkapin or yankapin, Duck acorn, or Water-nut found in rivers and lakes locally distributed from Massachusetts to Minnesota, Nebraska and Louisiana. (Sometimes a third species is distinguished, namely *N. jamaicensis* of Jamaica, but it is very close to our *N. lutea* and may or may not be specifically distinct.) Pammel states that *N. lutea* was first introduced into Massachusetts from the Mississippi Valley by the Indians for food (1). Whether or not this is true, at least the plant is now well known and well established in Massachu-
setts in the so-called 'Lily Pond' or 'Devil's Dish-bowl' north of the railway in West Peabody. The story of its introduction there is of interest (2). Mr. Daniel Brown of Peabody, a sportsman of Salem interested in shooting of duck, procured in 1870 a lot of *Zizania aquatica* from South Carolina. He sowed a half bushel or more of this

(2) *Rhod.* 33:230
wild rice around the shores of 'Lily Pond' and probably the lotus was among the seed, for a year or two later it appeared and has increased and persisted and now become very attractive.

Rafinesque mentions the rhizomes as being acrimonious when fresh but easily deprived of their dangerous qualities by washing and are then agreeable food to the Indians (1817). Don (1831) remarks that the seeds are very agreeable to eat and are eagerly sought by children and Indians (1).

Saunders gives us the following (2): 'A bread upon the waters is that majestic aquatic, native to quiet streams and ponds of the interior United States from the Great Lakes to the Gulf, the American Lotus or Water Chinquapin'. It is easily recognized by huge round leaves (sometimes two feet across and a 'favorite sunning place, by the way, for water snakes!') lifted high above the water on footstalks attached to the center of the concave leaf, and its showy, pale-yellow, papery flowers of numerous petals curving upward to be succeeded by curious flat-topped, pitted seed-vessels. It is an American cousin of the famous lotus of India and oriental romance. To American Indians it seems never to have appealed as a flower of contemplation but quite prosaically as an addition - an important one - to his dinner table. In this role, trebly useful: first for young leaves and footstalks as spinach; second, as ripened seeds baked or roasted, being palatable and nutritious with taste like chestnuts; third, for large tubers weighing one-half pound or more; when baked found to be sweet, and mealy like sweet potatoes. It is the plant referred to in Longfellow's Evangeline thus:

"Water-lilies in myriads rocked on the slight undulations
Made by the passing oars, and, resplendent in beauty, the lotus
Lifted her golden crown above the heads of the boatmen."

Victoria is the genus which includes the great water lily of the Amazon and its tributaries. (2)The genus was named in honor of Queen Victoria and contains but the two species V. regia Lindl. of British Guiana, and V. Cruzianna d'Orbigny of Paraguay. The latter is more commonly cultivated under the name of V. regia variety Trickeri or V. Trickeri. The large (six to eight feet across), round, floating leaves have very long petioles to enable them to adjust themselves to changes in water-level, and the blades have abruptly turned-up mar-

(1) Sturtevant's Notes on Edible Plants - pg. 382
(2) Saunders, C. F. - Useful Plants of the United States and Canada - pg. 30-35
(3) This and the following material on Victoria from Bailey's Encyclopedia - pg. 3466-3469
gins so that they resemble huge saucers floating on the water. These turned-up edges prevent the leaves from floating over one another. The flowers are large (twelve to eighteen inches across), creamy white in color and very fragrant. They bloom during the night and are open for two successive nights from five P.M. to about nine A.M. The plant in its native habitat grows in from four to six feet of still water and its leaves often make great patches several miles in extent.

Conard gives the following paragraphs of interest (1):

---"The gigantic leaves are covered beneath with a close network of prickly veins, the larger of which project an inch or more from the leaf surface; the tissues are full of air-spaces and canals, thus buoying up the mass of cellular matter. Besides many stomata on the upper surface of the leaf, which open into the air chambers of the mesophyll, there are countless tiny depressions, in each of which one can see with the hand lens that the leaf is perforated with a fine hole; these holes were called by Planchon "stomatodes". He considered them to be useful as air holes to let out gases which, rising from the mud or water, might be caught in the meshes of the netted veins on the under side of the leaf. It is also to be noted that, in spite of the cuplike form of the leaves, water from rain or other sources does not remain on the surface; it doubtless runs down at once through the tiny perforations. This would be an indispensable protection against fungi and algae, and for the function of assimilation."

"A single leaf by its buoyancy, may sustain a weight of one hundred and fifty or two hundred pounds. Gurney at Tower Grove Park, St. Louis, covers the leaf with a large round quilted pad, then lays on an equally large frame of thin wooden slats, and on this a person can readily stand, as if in a boat. Not the least remarkable feature of these leaves is their rate of growth. Gaspari found the maximum growth in length to be about an inch an hour when the leaf is just expanding; the surface increases four or five square feet in twenty-four hours, and a plant will produce in twenty-one to twenty-five weeks six or seven hundred square feet of leaf-surface. A great development of heat has been observed in the opening of the flowers of Victoria. About eight P.M., when the anthers are shedding their pollen (in second day flowers), the stamens may reach and maintain a temperature ten degrees Fahrenheit above that of the surrounding air."

Though doubtless known to Spanish traders and missionaries, and certainly of use to savages as food in early times, Victoria was first noticed botanically by Haenke in Bolivia

(1) Bailey, L. H. - Encyclopaedia - pg. 3466-3468
about 1801; but he died in the Philippines without recording his discovery. Bonpland, the companion of Humboldt, also saw it near Corrientes, Argentina, in 1819, and in 1825 sent seeds and a full description to Mirbel at Paris. In 1828 Poeppig found it on the Amazon, and gave the first published account of it in Froriep's "Notizen" in November of that year, under the name of Euryale amazonica. D'Orbigny saw the plant in 1837 at Corrientes, collected specimens, and sent them with drawings to the Museum of Natural History at Paris. In 1838 he saw it again in Bolivia, and several years later published accounts of his find. Robert H. Schomburgk, finding it again in 1846 on the Berbice River in British Guiana, sent home specimens and figures from which Lindley in 1837 (published in 1838) established the genus Victoria and described the species V. regia. This name has settled on the northern species, while the one found at Corrientes was named in 1840, by d'Orbigny, V. Cruziana in honor of General Santa Cruz of Bolivia.

The struggle to bring the 'queen of water-lilies' into captivity began with Schomburgk. He removed living plants from inland lakes and bayous to Georgetown, British Guiana, but they soon died. In 1846 Bridges obtained seed in the Bolivian locality, province of Moscos, and sent them in a jar of wet clay to England. Out of twenty-five seeds obtained at Kew, three germinated and grew vigorously as small seedlings until October, but died in December. In 1848 dry seeds were sent to England from the Essequibo River, along with rhizomes, the latter in Wardian cases; the rhizomes rotted, and the seeds refused to germinate. In 1849 an expedition from Georgetown succeeded in bringing back thirty-five living plants, but these all died. Finally some seeds were sent to Kew from the Demerara River in bottles of fresh water, by two English physicians, Rodie and Luckie. The first sending arrived February 18, 1849, and on November eighth a plant flowered at Chatsworth; the blossom was appropriately presented to Queen Victoria. From this stock Victoria regia was distributed to gardens in Europe, Asia and America. Van Houtte of Ghent first flowered it on the continent, and Caleb Cope of Philadelphia, was the earliest successful cultivator in this country. His gardener was the late Thomas Meehan. The first flower opened August 31, 1851. In 1852, John F. Allen of Salem, Massachusetts, had a plant from seed of Mr. Cope's growing. This plant lived through four summers and matured over two hundred flowers.

The next notable importation of seed was sent by Edward S. Rand Jr., from Para, Brazil, to Mr. Sturtevant, then at Bordertown, New Jersey. The resulting plants flowered in 1856 and, proving to be slightly different from the former type, was called V. regia variety Randii. It is doubtless the same form that was described by Planchon as V. amazonica, and retained with grave doubts by Casparry. In 1894 Mr. Tricker received from Europe seeds of quite another species, which was provisionally named V. regia variety Trickeri. It is much more amenable to out-of-door culture than the older type, and
has received a well-deserved popularity. Specimens grown at Kew from seeds sent by Tricker were regarded simply as garden forms of V. *regia*. Later investigation by Tricker and the writer brought out the fact that the stock came originally from Corrientes, Argentina, and that the plant is truly the *V. Cruziana* of d'Orbigny. Its far southern habitat (twenty-seven degrees south) explains its hardiness. At Riverton, New Jersey, seeds that have wintered in an open pond produce plants which flower by the end of August. The large starchy seeds of this species are used as food in Paraguay under the name Mais del Agua, 'water-corn'. The form of *Victoria* originally introduced from British Guiana had leaves entirely flat until the plant attained considerable size; then a low rim appeared. The leaf was deeply purple-colored beneath. *V. Cruziana* differs markedly from this. *V. regia* variety Randii approaches the latter; and Malme's recently described *V. Cruziana* forma matto-grossensis approaches *V. regia* in several details. Apparently the two species grade into one another in Matto Grosso where the tributaries of the Amazon and the Parana rivers interlace."

The cultivation of *V. regia* was at first a great expense and though the plant is now considered to be of easy culture, is only grown by fanciers and in a few public gardens. *V. Cruziana* is much better for out-of-door culture and "revels in a temperature of seventy-five to eighty degrees" while *V. regia* requires eighty-five to ninety degrees. Seeds for both are sown in pots in February and placed in shallow water and the seedlings repotted frequently until they can be placed in their summer quarters. The seeds and seedlings of *V. regia* require the water heated to eighty-five to ninety degrees while those of *V. Cruziana* will not germinate or grow well in a high temperature, and for them sixty-five to seventy degrees is sufficient. Good results are obtained in growing these water-lilies under glass but it is an expensive proposition and "it is by no means inviting even on a warm day to spend many minutes in such a structure. Compare this with a natural pond and its surroundings and a cool shady seat where these gorgeous plants may be viewed at leisure." But whether grown indoors or out, with us the plants are annual and "seedlings are of necessity raised every spring".

This water-lily has only one insect pest which is at all troublesome and that is the black-fly or aphis. Since insecticides damage the foliage, the safest remedy is to "introduce a colony or two of the well-known 'lady-bug'. They and their larvae will soon clear off all the aphides without any injury to the plant."

*Euryale* (Euryale in Greek mythology was one of the Gorgons, but neither she nor Stheno are often mentioned because of the prominence of the third Gorgon, Medusa) is a genus of one species, *E. ferox* Salis., from India and China where it has long been cultivated. It differs from *Victoria*
regia in having all its stamens fertile, in very small flowers and leaves smaller than Victoria, and in being "ferociously spiny". It does well as far north as Philadelphia and St. Louis, but since the introduction and successful culture of Victoria it has attracted little attention. It is an annual but sows itself every season (1).

Barclaya, according to Engler (2), has three species in Peru, Borneo, Malacca and Sumatra, but Baillon says (3): "La seule espece connue, le B. longifolia Wall., vit dans les eaux douces de la Malaisie. De son court rhizome sortent de longues feuilles petioles, non petees, et des hampe uniflores, axillaires." It is not even recognized by the horticulturists.

Cabomba (probably an aboriginal name) is a genus of six species of submerged aquatics of the western hemisphere. C. caroliniana Gray is a native of ponds and slow streams of the south (Illinois to North Carolina, Florida and Texas) but it is hardy as far north as Philadelphia. It is called fish grass because it is the commonest plant for fish bowls. It "roots easily in earth, grows well, is dense and bushy, and a good oxygenator; prefers water free from lime; propagated by cuttings set in earth in one to two feet of water at fifty-five to seventy degrees Fahrenheit. It is commonly sold for aquaria in bunches of six to twelve shoots, eight inches long, wrapped with lead at the base; and without earth the bunch lasts four to eight weeks, when it drops most of its leaves and must be replaced". There are several varieties, but none are of great importance (4).

KEY TO THE GENERA OF NYMPHILACEAE IN MASSACHUSETTS

A. Leaves peltate; flowers small, purple, with apocarpous gynoecia — — — — — — — — — — — — BRASILIA

A. Leaves not peltate; flowers mostly larger, yellow, white or pink, with syncarpous gynoecia.

B. Flowers yellow; petals small; stamens hypogynous — — — — — — — — — — — — NYMPHOZARTHUS

B. Flowers white to pink; petals large, numerous; stamens epigynous — — — — — — NYMPHANA

(1) Bailey, L. H. - Encyclopedia - pg. 1178
(2) Engler & Prantl - Die Pflanzenfamilien - Teil III, Abteilung II; pg. 10
(3) Baillon's Histoire des Plantes - Vol. III, pg. 67
(4) Bailey, L. H. - Encyclopedia - pg. 608
BRASENIA Schreb. Gen. Pl. 372. 1769

Aquatic perennial herb with slender creeping root-stalk. Stem slender, several feet long, branching and covered with gelatinous matter as are the petioles, peduncles and lower surfaces of the leaves. Leaves long-petioled; floating; alternate; centrally peltate; oval; entire or shallowly crenate; palmately veined. Flowers small, axillary, dull-purple. Sepals three or four. Petals three or four, sessile. Stamens twelve to eighteen; filaments filiform; anthers innate. Carpels four to eighteen, separate; stigmas linear; ovules two to three, and pendulous from the dorsal suture. Ripe "pods" club-shaped, indehiscent, coriaceous.

This is a monotypic genus of continental North America, Cuba, eastern and tropical Asia, western tropical Africa and Australia. While the genus is not found in Europe today, its species are represented in Tertiary strata of that continent (1). The genus has also been reported from the Pleistocene deposits of Canada and New Jersey (2).

Brasenia and Cabomba are the only two species belonging to the sub-family Cabomboidae. Both are similar in habit but the stem of Brasenia bears only the peltate, floating leaves, while Cabomba has dissected, submerged leaves as well as peltate floating ones.

BRASENIA SCHREBERI Gmel.

(Water Shield, Water Target, Frog Leaf)

Brasenia Schreberi Gmel., Syst. Veg. 1:353. 1796
Hydropeltis purpurea Michx., Fl. Bor. Am. 1:384 pl. 29. 1803

(1) Rendle, A. B. - Classification of Flowering Plants - Vol. II, pg. 158
(2) Rhod. 8:28
Brasenia peltata Pursh., Fl. Am. Sept. 889. 1814

Brasenia - name of uncertain origin, unexplained
Schreberi - commemorative

Leaves 5-10 cm. long, 4-10 cm. wide, thick, rounded at each end. Flowers 1-1.3 cm. in diameter; on long stout peduncles. Fruit oblong, 0.5-0.8 cm. long. (Plate 36)

Ponds and slow streams; June-August. In this country the plant is distributed locally from Nova Scotia to Florida, Manitoba, Nebraska and Texas, and on the coast from California to Washington.

It is a plant of little importance either as an ornamental, or for food or medicine, although it is sometimes used as an ornamental in outdoor pools and California Indians are reported to collect the tuberous rootstalks for food (1).

Nymphaea L. Sp. Pl. 510. 1753
(Water Lily)

Aquatic herbs with horizontal, perennial rootstalks rooting in mud and covered with three inches to six feet of water; rarely in bogs not submerged. Leaves floating or when crowded rising above water, round or oval; entire or dentate or sinuate; fusiform-cordate, often sub-peltate; two inches to two feet across. Flowers white, pink, yellow or blue and very showy. 1-1.4 cm. across. Sepals four, green outside, nearly free. Petals numerous, imbricated in few to many series and inserted all over the ovary, the innermost gradually passing

(1) Brewer & Watson, Bot. Calif. 1:16. 1880; under B. peltata
into stamens (1). Stamens many, inserted on summit of ovary, the outer with large petaloid or dilated filaments and elongated anthers. Carpels many, united into a compound pistil with broad cup-like depression and a knob in center with radiating, linear, projecting stigmas extended into linear and incurved sterile appendages; ovary twelve to thirty-five-celled. Fruit depressed-globular, covered with bases of the decayed petals, ripening under water. Seeds enveloped by sac-like aril.

There are about forty well marked species of Nymphaea with wide geographic distribution in warm and temperate climates, and many local varieties as well as numerous cultivated hybrids.

In America we have five particularly well known native nymphaeas. There is the white N. odorata, common throughout the east, with its two varieties, the pink-flowered variety rosea of Cape Cod, and the large white-flowered variety gigantea of the south. N. tuberosa is the white-flowered species of western lakes and N. flavo is a yellow species indigenous to Florida and other southern States but hardy as far north as New Jersey and southern New York.

The nymphaeas have three types of leaves arising in a spiral phyllotaxy, namely: thin, fragile, submerged leaves on short petioles; floating leaves which are thicker in texture and with stomata and palisade cells on upper surface only; and aerial leaves which are leathery and sometimes bear stomata on the under surface. The growing point of the stem (or rhizome) is protected by colorless stipules and by a dense growth of long, fine hairs. The roots arise from the stem in bunches just below each leaf. The flowers are extra-axillary, arising as members of the phyllotactic spiral or in a distinctive spiral of their own (2).

The phenology of the Nymphaea flower has been studied and it has been found that "every species opens and closes at a particular time each day" (2), so in a pond containing eighteen to twenty forms there is some change taking place at almost all hours. The hours of opening and closing are

(1) Illustrating homology of floral parts
(2) This and the following material on the culture of nymphaeas is from Bailey's Encyclopedia, pg. 2306-2315.
fairly regular for each species, though the tropical species are more sluggish in cool weather and hardy ones irregular in very warm times. Each flower opens on one or two to five or seven successive days or nights, being about an hour later to open and an hour earlier to close on its first than on subsequent days. After blooming the flower is drawn down into the water by a spiral coiling of the peduncle (or simply bending over if the water is shallow) and there the seed ripens. In six to ten weeks the pod matures and bursts; the seeds rise to the water surface and float for several hours by means of their buoyant arils which finally decay so that the seeds are dropped at some distance from the parent plant. Floating seeds may be dipped up in a wire sieve, or better still, the pods may be inclosed in muslin or cheesecloth bags before ripening.

The culture of nymphaeas in America has led to much hybridization of the species N. odorata and N. tuberosa. The latter bears the largest flower and is easily cross-fertilized but the hybrids rarely breed true from seed. There are several distinct forms of N. tuberosa, but none of them should be planted in small ponds with other water-lilies because they crowd out the less vigorous kinds. They are best adapted to natural lakes and ponds.

N. odorata was introduced into England during the eighteenth century and was the first foreign Nymphaea to be cultivated there. The nymphaeas were never popular in England and remained neglected until a few years ago when M. Marliac, a horticulturist of Temple-sur-Lot, France, crossed the English white (N. alba) with the Cape Cod pink (N. odorata variety rosea) and the Florida yellow (N. flava). "Nothing in the horticultural world has created more surprising results in blending of American and English species. These species have been the progenitors of numerous varieties which have made this class of plants the most popular and desirable of all aquatic decorative subjects and within the reach of all".

Bailey divides the genus Nymphaea into two main sections, the Apocarpae with the carpels free at the sides and united at their edges to the central column of the flower and at their backs to the receptacle; and the Syncarpae with carpels entirely fused together. Under the first section are two groups or "sub-genera", Anecnypha and Brachyceras, and under the second Castalia, Lotos and Hydrocallis. In hybridization it has been found that species of a single group or "sub-genus" hybridize readily among themselves, and hybrids of the Lotos and Castalia group are more or less fertile, ranging in color from the pure white N. Lotos variety dentata to the crimson-red N. rubra.

Authorities differ as to the best time to transfer pollen, but it is certain that the pistils are receptive on
the first day of opening only, whereas the pollen is shed on several successive days or at a late hour of the first day. Some say pollination is best effected in early morning or at daybreak while others believe it is most successful just as the flowers are closing for the first time.

The varieties are so numerous and varietal names have been so freely applied that an accurate classification is no longer possible.

The most famous hybrids are those introduced by N. Latour Marliac (previously mentioned) from 1858 to 1900. His methods are unknown but it is certain that excellent culture, careful selection and wise hybridization brought about these "magnificent results". There are two types among these hybrids, both hardy and free-flowering, but of uncertain parentage. The first group is of sturdy habit with leaves four to eight inches across and flowers three to six inches, with leaves well out of the water when crowded. The second group is of a much more slender habit with leaves three to six inches across and flowers two to four inches and both floating. N. alba is probably one parent of the first group, and N. alba variety rubra and N. tetragona are, perhaps, the parents of the latter. Nearly all these hybrids are sterile.

The most important species of water lilies are the following:

N. alba Presl. is the well known English white water lily, a robust species which is one of the first to bloom in spring and continues until frost. Its flowers are four to five inches across and are open from seven A.M. to four P.M. A most desirable white variety of this is candidissima. The variety rubra Lonnr. comes from Lake Fayer, Sweden and is the only distinct or true red-flowered hardy species, but unfortunately it is rather difficult to grow, since it requires cool water and subdued sunlight. There are fifteen named red varieties or forms belonging here, among which Wm. Falconer is one of the most popular.

N. Lotus L. (N. thermalis DC. of hot springs of Hungary) is the Egyptian white "lotus", to be spoken of later. Its outer petals are suffused with pink and the flowers measure five to ten inches across. Variety dentata Schum. and Thonn. has narrower petals. Both bloom in the morning but the latter opens a little later.

N. rubra Roxbg. comes from India. It produces fertile hybrids with N. Lotus and N. Lotus variety dentata so that all colors from a delicate pink to a deep purplish-crimson may be obtained. Some varieties are extremely floriferous while others are shy bloomers. The species and its varieties are night blooming and open from eight P.M. to eleven A.M.
N. tuberosa Paine is a luxuriant grower which spreads rapidly by tubers. It is a moderate bloomer, with flowers four to nine inches across which open for three to four days from eight A.M. to one P.M. There are several garden varieties and forms known. The plant is particularly valuable because it is susceptible of cross-fertilization, as mentioned before.

N. odorata Ait., the sweet-scented water lily, occurs in numerous garden varieties and they are some of the most valued of the nymphaeas that we possess, both for their odor and for the form and delicate coloring of their flowers.

N. mexicana Zucc. from Florida and Mexico will do well as far north as New York "when grown in two feet of water covered with boards and leaves in winter. Mexican stock is stronger and blooms more freely than that from Florida." The flowers are four inches or more across and of a bright canary yellow, open from eleven A.M. to four P.M.

N. flavo-virens Lehm. (N. gracilis of gardens) also comes from Mexico and when crossed with N. capensis variety zanzibariensis gives rise to a highly variable progeny. They are easily propagated from tubers, bloom very freely, and include the best of the tender day-blooming varieties. The species itself is white but the result of crossing produces flowers with colors ranging from deep blue to red and pink.

N. capensis Thomb. is the cape-blue-water-lily of South Africa and a very desirable plant. The flowers are open for four days from seven A.M. to four P.M. Its variety zanzibariensis Casp., as now cultivated, shows great variety in color of sepals and petals as well as in shape and number of petals and stamens. There are many named forms. Reproduction is only by offsets.

N. gigantea Hook. of Australia is very delicate and lovely, and bears some of the largest flowers of any Nymphaea. The original flower type was very large (sometimes called variety Hookeri) and has been found difficult to cultivate, but the form now in gardens is smaller, and more easily grown. It is called N. Casparyi, or in Australia, N. gracilis. White and pink forms are known. It opens for seven days from nine A.M. to six P.M.

N. caerulea Sav. is the blue Lotus of Egypt, a free bloomer, but not showy, and open only for three mornings.

N. stellata Wild. is the blue Lotus of India, also open for three days but for a somewhat longer time each day.

N. tetragona Georgi. from eastern Siberia, China and Japan, and also found in the western Hemisphere in Idaho to Ontario, is the smallest Nymphaea in cultivation and important chiefly among specialists. It is a free bloomer producing no side shoots and it is readily grown from seeds which are next to the largest of the genus. It opens for three or four days from twelve noon to five P.M.
Bailey gives the following as best for amateurs. For tender day-blooming kinds: N. pennisylvanica Conard (light blue); N. zanzibariensis Casp., deep blue; N. flavo-virens Lehm., white; Mrs. C. W. Ward, pink; N. Laubeniana Hort., dwarf pale blue. Tender night-blooming kinds: N. dentata Schum. and Thonn., white; N. Homarana (variety of N. rubra Roxbg.) magenta; Frank Trelease, dark crimson. Hardy kinds: N. chromatella, yellow (probably N. mexicana x N. alba or N. tuberosa); N. tetragona helvolua, dwarf yellow; N. Gladstoniana, white (N. alba x N. odorata rosea); N. tetragona Georgi., dwarf white; N. E. Shaw, pink; N. Laydekeri rosea dwarf pink (N. alba rubra x N. tetragona); N. Falconer, dark red (same cross as above).

All water lilies are best when grown as near as possible under existing natural conditions. a rich alluvial soil in abundance, water, and clear, uninterrupted sunlight. Usually the margins of sluggish streams, bays and sheltered nooks prove ideal. When artificial ponds have to be made they should have solid walls of reinforced cement with concrete bottom, outlet and overflow, with layer of soil nine to twelve or more inches deep in the bottom.

Sometimes the plants are placed in boxes or tubs in the pool. The boxes should be three to four feet square and one foot deep, and ample space should be left between them. One plant of a tropical lily, or three or four of the smaller species, may be planted in a box; they require fifty to one hundred square feet of water surface and water two to two and one-half feet deep. The top soil from a pasture composted with cow manure in proportion of one to three, prepared six months before planting is best for the boxes, and then the plants may be left undisturbed for two years. When planting the soil should be compacted moderately firmly and covered with an inch of sand. Plants should not be placed in newly constructed ponds or basins immediately, since caustic properties of the cement will injure them. The planting of hardy varieties should be made in April or May according to the latitude and lateness of the season. Tropical species should not be planted until summer has come.

There are some advocates of tub culture, and the plants of small species will grow under such treatment but soon the food in the tub is exhausted and the plants look miserable. Nymphaeas may also be grown in fountain basins if no stream or spray is kept running all the time to chill them.

Water lilies are subject to several diseases and insect pests. Aphids are perhaps the worst pest and the best remedy for them is their natural enemy 'lady bugs' or 'lady birds'. A recent insect causing much trouble is the leaf miner, the larva of which cuts channels through the leaf in all directions. A simple remedy is kerosene emulsion, applied with fine spray at evening after the flowers have closed. Another leaf pest is the leaf cutter, the larva of which cuts out pieces and
then hides between them or under them. When near maturity, this pest is ravenous, and the result is ruin to the plants. The best remedy is a lamp trap for the mature insect, or arsenate of lead spray for the larvae. They have natural enemies in frogs and dragon flies which keep the insects under control to some extent.

Of the fungus diseases, leaf spot, after warm spells of humid weather, is one of the worst. The leaves are then soon scorched and become crumpled, and the plant denuded of foliage, while new leaves are much smaller and weaker, as are the flowers, if they come out at all. This disease must be checked at once or severe set back and ruin to the plants results. A fine spray of Bordeaux mixture one-half strength is recommended or a light dusting of carbonate of copper will soon put the disease under control.

In winter the tender nymphaeas should be kept in tanks or tubs under glass, but hardy species need only be covered with boards, and dry leaves or coarse hay, or the roots may be taken out and buried in a sheltered place.

Aside from their ornamental value, nymphaeas offer other features of economic importance:

N. alba has roots which have an astringent, bitter taste. They have been used in France in the preparation of a kind of beer (1), and in Ireland, the highlands of Scotland, and the Islands of Jura, etc., "to dye a dark brown or chestnut color. The flowers, the herb and the root were formerly used in medicine, but are all now obsolete" (2).

N. gigantea has porous seed stalks which are peeled and eaten raw or roasted, only the brown or black-seeded stalks being used. The large rough tubers are roasted and said to be not unlike potatoes, being yellow and dry when cooked (1).

N. caerulea and N. Lotus are the sacred water lilies of Egypt. The rhizome of N. caerulea is said to have been pointed out as edible by Isis - or by Menes. The flowers, buds and leaves of both are often depicted on monuments, those of N. caerulea often in color. The flowers of these water lilies were among the offerings under the fourth dynasty (2998-2721 B.C.) and the plants were certainly known from the fifth dynasty. Petals of both species were found in the tomb of Rameses II, the Pharaoh of the Israelitish captivity. N. Lotus was perhaps less highly esteemed than N. caerulea in Egypt, though it was an object of veneration in India along with Nelumbo. Some authors believe that N. Lotus was the Sacred Egyptian Lotus, under Nelumbo (3).

(1) Sturtvant's Notes on Edible Plants - pg. 382
(2) Loudon's Encyclopedia - pg. 463
(3) Bailey, L. R. - Encyclopedia - pg. 2807; also Smith's Dictionary of Economic Plants - pg. 438
In *The Idyll of the White Lotus*, a story of initiation of a young priest in Old Egypt, the "Lady of the Lotus" plays an important part, and many Egyptian tales mention the "White Lotus". It resembles *N. alba* and *N. odorata*, but is a native of more tropical climates. It is supposed to be very common in ponds, lakes and rivers of Jamaica, and grows in vast quantities in the plains of lower Egypt, near Cairo, during the time when they are under water (1). Heroditus says (2): "When the river (the Nile) swells, great numbers of lilies which the Egyptians call Lotos, shoot up through the water. These they cut down, and after they are dried in the sun, take out the heart of the plant, which resembles a manox (oppy); they would it into paste and bake as bread. They likewise eat the Lotos (root?) which is round, and equal to an apple in bigness." The root-stalks are said to be used for starch and eaten by poorer classes in India (3). The small seeds, called *bheta*, are fried in heated sand and are said to make a light, easily digested food. In Ceylon the seeds are chewed by children and both capsules and seeds are either pickled or put into curries, or ground and mixed with flour to make cakes (3). The tubers are "much sought after by natives for food and medicine" (3).

*N. stellata* is figured in cave temples of Adjuncta and in Brahmanical cave temples. In Upper Nile region it is called *macongee-congee*, and its flowers and roots are eaten by the Wakiyon (3).

Culpepper gives the following as to the use of the white and yellow water lilies in "medicine" (4):

"(Government and Virtues) The herb is under the dominion of the moon, and therefore cools and moistens like the former (lettuce). The leaves and flowers of the water lily are cold and moist, but the roots and seeds are cold and dry; the leaves do cool all inflammations; both inward and outward heat of agues; and so doth the flowers also, either by the syrup or conserve; the syrup helpeth much to procure rest, and to settle the brain of frantic persons, by cooling the hot distemperature of the head. The seed as well as the root is effectual to stay fluxes in man or woman; also running of the reins, and passing away of the seed when one is asleep; but the frequent use thereof extinguisheth venerous actions. The root is likewise very good for those whose urine is hot and sharp, to be boiled in wine and water; and the decoction drunk. The distilled water

(1) Loudon's *Encyclopedia* - pg. 463  
(2) Smith's *Dictionary of Economic Plants* - pg. 261  
(3) Sturtevant's *Notes on Edible Plants* - pg. 562  
(4) Culpepper, N. - *British Herbal and Family Physician* - pg. 194
of the flowers is very effective for all the diseases aforesaid, both inwardly taken, and outwardly applied, and is much commended to take away freckles, spots, sunburn, and morphea from the face, or other parts of the body. The oil made of the flowers, as oil of roses is made, is profitably used to cool hot humours, and to ease the pains, and help the sores."

**KEY TO SPECIES OF NYMPHAEA NATIVE OF MASSACHUSETTS**

Flowers white or nearly so.

Leaves 0.5-2.2 dm. across, flat; flowers 0.5-1.3 dm. across, very fragrant — — — — *N. odorata*

Leaves 2-4 dm. broad, margins turned up; flowers 1-1.5 dm. across, less fragrant — — — — — — — *N. odorata* var. gigantea

Flowers pink or pink-red — — — — — — — *N. odorata* var. rosea

**NYMPHAEA ODORATA** Ait.

(Sweet-Scented White Water Lily, Pond Lily, Water Nymph, Water Cabbage)

*Castalia pudica* Salisb., in Konig & Sims, Ann. Bot. 1:72. 1805
*Castalia odorata* Wood & Wood, in Rees' Cyclop. 6 No. 1. 1806

*Nymphaea* - Greek name for water-nymph
*odorata* - sweet-scented

Rootstalk thick, simple or with few persistent branches. Leaves floating; orbicular with entire margin and deeply cordate-cleft or reniform base; 1-3 dm. in diameter; glabrous; somewhat coriaceous, dark green and shining above and more or less pubescent beneath. Stipules broadly triangular and almost kidney-shaped, notched at apex and appressed to root-
stalk. Petioles and peduncles slender, greenish or brownish, with four main air channels. Flowers white, 7.5-15 cm. across; very fragrant, opening from early morning until afternoon. Sepals green, tinged with reddish-brown. Petals twenty to thirty, in many rows; narrowly oblong, ovate or lance-ovate, obtuse. Stamens fifty to one hundred seventy-five, yellow; outer with filaments broad, white, petaloid; anthers blunt. Fruit globose or slightly depressed; seeds 3 mm., stipitate, oblong to ellipsoid, shorter than aril. (Plate 33)

Common in ponds and still or slow-flowing water; Newfoundland to Manitoba, south to Florida and Louisiana and west to Kansas. June-September.

This is the Water Lily of MacDowell's Woodland Sketches "a most remarkable piece of tone painting. It suggests most effectively the water lily floating on the quiet water of the lake. The entrancing middle section describes a disturbance of the water and for a few minutes the flower rocks unsteadily in the breezes. The opening theme then returns and the exquisite melody comes to an end". (1)

NYMPHAEA ODORATA Ait. var. GIGANTHA (Tricker) Fernald

(Ricefield Water Lily)

Leaves large, 2-4 dm. across, green beneath, at times tinged purplish toward margin; edge often turned up; petioles green. Flowers white or nearly so; less fragrant, 1-1.5 dm. in diameter; sepals green; petals twenty-four to thirty-one; stamens sixty-nine to one hundred twenty.

(1) Faulkner, Anne L. - What We Hear in Music - 3th rev. ed., pg. 489
Delaware to Florida, Mexico, Cuba, British Guiana.

This is the rarest *Nymphaea* in Massachusetts, having been reported only from Barnstable County.

**NYMPHAEA ODORATA** Ait. var. *ROSEA* (Pursh) Britton
(Cape Cod Water Lily)

Leaves dark reddish on both sides when young, becoming green above. Flowers pink or bright pink-red, fading on the successive days of opening; 10 cm. across.

Shallow ponds mostly near coast on Cape Cod, but collected in Belchertown ponds and in Berkshire County.

**NYMPHOZANTHUS** Rich. Anal. du Fruit, 65, 68, 103. 1805
(Yellow Pond Lily, Spatter-Dock)

Aquatic herbs with thick, cylindric, horizontal rootstalks. Leaves large, cordate-ovate or sagittate, with a deep sinus; some submerged; others either floating or standing erect above water. Flowers usually above water, yellow or purplish; single, on long scapes. Sepals five to six, roundish-concave, thick, and constituting the showy part of the flower. Petals mostly numerous, small, stamen-like or scale-like. Stamens very numerous and short; hypogynous. Carpels many, united into compound pistil; ovary short, globular-ovoid; stigma sessile, disciform, eight to twenty-four-rayed and at length recurved. Fruit an ovoid, naked capsule ripening above water with many non-arillate endosperous seeds.

The name *Nymphozanthus* comes from two Greek words meaning *nymph* or *maiden*, and *yellow*, referring to the color of these particular 'water nymphs'. It is a genus of eight species
native of the north temperate zone, and found mostly in North America. Aside from our chief native species, *N. variegatus*, the only ones of importance are *N. luteum* Sibth. and Sm., a native of Europe and America; *N. polysepalum*, native of the western coast, and *N. advena* of southern United States and Europe.

*Nymphozanthus luteum* has had several uses in many lands. The Turks are said to make a refreshing drink from its flowers, perhaps because they are supposed to smell like brandy (1). In Finland and Russia both the rhizomes and leaf stalks are eaten (2). In Sweden, in years of scarcity, the rhizomes are pounded into cakes along with the inner bark of *Pinus sylvestris* (3). Linnaeus states that swine are fond of the leaves and roots; that goats do not like them; and that kine, sheep and horses refuse them; also that crickets are driven out of houses by the smoke of them burning, and that both crickets and cock-roaches are destroyed by the roots rubbed or bruised with milk (1).

*Nymphozanthus polysepalum* furnishes pods called *wokas* which are used for food by the Indians of the northwest (4).

*Nymphozanthus advena* is another plant, the seeds and rhizomes of which have been used much in the past for food. The 'seed pods' were often collected in large quantities (hundreds of bushels) for winter use, and the seeds then used as staple article of diet among the Klamaths of southern Oregon, and other Indian tribes of the northwest. The seeds taste much like kernels of broom corn and are very nutritious. The rhizomes, after long boiling, taste like sheep liver and are reported by Josselyn (1672) to have been 'eaten by natives' of New England (2).

Several species of the genus are offered by dealers but most of them are of small value for cultivation, although the foliage effects of *N. advena* may be striking, and *N. japonicum* DC., with its red-tipped stamens and sepals is sometimes worth cultivating (5).

**KEY TO SPECIES OF NYMPHOZANTHUS NATIVE TO MASSACHUSETTS**

Leaves 12.5–30 cm. long; stigma nine- to twenty-four-rayed; petals truncate, fleshy; fruit with a ring of partly-decayed filaments.

Leaves 15–30 cm. long; stigma nearly entire, twelve- to twenty-four-rayed; fruit green, scarcely contracted above, 3.5–5 cm. long—*N. variegatus*

1. Loudon's *Encyclopedia* - pg. 464
2. Sturtevant's *Notes on Edible Plants* - pg. 369
3. Loudon's *Encyclopedia* - pg. 1065
5. Bailey, L. H. - *Encyclopedia* - pg. 2291-2292
Leaves 12.5 cm. long; stigma crenately toothed, nine- to thirteen-rayed; fruit bright red or crimson, decidedly contracted above, 2.5 cm. long —— —— —— —— N. rubrodiscus

Leaves 5-10.5 cm. long; stigma seven- to ten-rayed; petals spatulate, thin; fruit naked at base —— —— —— —— —— —— —— —— —— —— —— N. microphyllus

**NYMPHOZANTHUS MICROPHYLLUS** (Pers.) Fernald

*(Small Yellow Pond Lily)*

*Nuphæa lutea* var. Kalmiana Michx., Fl. Bor. Am. 1:311. 1805
*Nuphæa microphylla* Pers., Syn. 2:63. 1807
*Nuphar Kalmiana* Sm., Bot. Mag. pl. 1. 43. 1809

**Nymphozanthus** — (see under genus name)

**microphyllus** — small-leaved

Very slender and with slender rootstalk. Floating leaves broadly elliptical, 3.5-10 cm. long and 2.5-7.5 cm. broad, the sinus deep, narrow, open or closed. Submerged leaves always present, sometimes larger, thin-membranaceous, orbicular-reniform. Flowers 2.5 cm. or less in diameter, Sepals usually five. Petals spatulate or obovate, thin. Stamina in three to four rows, narrowly linear with anthers one-fourth the length of filament. Stigmatic disc crenate or stellate, about 0.5 cm. broad, seven- to ten-rayed, dark red. Fruit globular, 1-1.8 cm. in diameter with a short neck. *(Plate 35, A-D)*

New Brunswick to Pennsylvania and Minnesota, and northwest. Later flowering than is *N. advena*.

An important diagnostic character of this water lily
not given in descriptions of the plant, but mentioned by Professor Fernald (1) is that the fruit is quite naked at base and without usual rings of partly decayed filaments found abundantly at base of fruit of other species of the genus. This is of particular value in separating N. microphyllus from small forms of N. rubrodiscum, and is clearly shown in photograph in Miller and Standley's paper on The North American Species of Nymphaea (2).

**NYMPHOZANTHUS RUBRODISCUS** (Morong.) Fernald

*Nymphaea hybrida* Peck
*Nuphar advena* var. *minus* Morong.

Similar to *Nymphozanthus variegatus* but more slender and leaves somewhat smaller (12 cm.); submerged leaves usually present. Flowers smaller, 3.5-4 cm. across, yellow. Sepals five to six and 2.5-3 cm. long. Petals spatulate. Stigma crenately toothed, nine-to thirteen-rayed, bright red or crimson. Fruit 2.5 cm., decidedly contracted above. (Plate 35, E-G)

Ponds and slow streams; New Brunswick to Michigan and Pennsylvania.

**NYMPHOZANTHUS VARIEGATUS** (Engelm) Fernald (3)

*Nuphar advena* var. *variegatum*
*Nymphaea advena* var. *variegata*

Floating leaves on "flattened petioles" with closed or narrow sinus, 15-50 cm. long. Inner surface of sepals suffused with reddish-purple. Fruit commonly suffused with red, 3.5-5 cm. long. (Plate 34)

(1) *Rhod.*, 19:111
(2) *Contribution to U.S. National Herbarium*, 16, pt. 5 + 35, 1912
(3) *Rhod.*, 19:33; 16:137-141
This, our commonest yellow water lily, has passed for a long time as identical with the southern N. advena. They are very similar in habit and differ only in range and in leaf, stigma and fruit characters mentioned above.

Family **CERATOPHYLLACEAE**

(The Hornwort Family)

Aquatic, herbaceous plants; submerged; slender and fragile; rootless. Leaves sessile; cartilaginous; exstipulate; verticillate; finely dissected (dichotomously), the narrow linear segments shallowly serrate on outer edges. Branches arising only in axil of one leaf of a whorl. Flowers minute; axillary and sessile; male and female flowers in different axils; unisexual; without perianth but with an eight- to twelve-cleft involucre, which is hypogynous and calyx-like. Male flowers with numerous (ten to twenty) stamens spirally arranged on a convex receptacle; stamen filaments short; connectives thick and extending above anther sacs, with two or three sharp points; anthers large, extrorse. Pollen grains round or elongated with but one coat. Female flower with solitary carpel; ovary one-celled with single orthotropous, suspended, single-integumented ovule. Fruit a beaked achene with slender persistent style and sometimes with a short, pointed horn or tubercle on either side. Seed with large, highly-developed embryo of two thick cotyledons surrounding a well-developed, many-leaved plumule; hypocotyl short; endosperm large-celled but scanty. Pollination by water.

The name of the family is taken from its only genus - **Ceratophyllum** - derived from the Greek for horn and leaf, referring to the horn-like, rigid divisions of the leaves.
The Ceratophyllaceae represent a group of plants difficult to relegate to any systematic place and so have been called "vegetable vagabonds" because of this wandering in classification. Asa Gray and others place them near the Nymphaeaceae because of the several leaved, involucral-perianth, many stamens, convex axis and free carpels. Also the embryo sac resembles that of the Nymphaeaceae in the differentiation of its lower part into an absorptive haustorium (1).

Ceratophyllums never have any true roots, but in addition to normal leaves, delicate whitish rhizoidal leaves are produced and act as anchoring and absorptive organs. The plants are found growing upright, but wholly submerged, in water of slow streams and ponds sometimes at a depth of even thirty feet. Their temperature range is marked; they occur in the superheated pools of Fiji, or, in our own waters, they are often ice-bound for several months of the year. They fruit well only in temperatures above eighty degrees Fahrenheit. Sometimes the plants grow in such abundance as to prove troublesome by impeding the movement of boats (2).

This is a small family containing but one genus, Ceratophyllum, with three species found all over the earth.

In Massachusetts we have but a single species of the genus.

**CERATOPHYLLUM DEMERSUM** L. Sp. Pl. 932. 1753

(Hornwort or Water-Weed)

Ceratophyllum - from the Greek for horn and leaf, referring to the numerous horned divisions of the leaf
demersum - from the Latin, meaning to plunge, and down, referring to the submerged state of the plant

(For technical description of this genus as regards habit, habitat, leaves, flowers and type of fruit, refer to the family description.)

'Sttem two to eight feet, according to the depth of water. Five to twelve leaves in verticils; linear; two- to three-forked, ends of segments capillary or rigid; 0.7-2.5 cm. long; ripe fruit oval, 0-6 mm. long, with straight or curved

beak 3-7 mm. long. (Plate 32)

Slow streams and ponds, across the continent, except in the extreme North. June-July.

The plant has been reported as comparatively uncommon in the southeastern part of Massachusetts (1). In the vicinity of Amherst the reported stations are quite numerous - Amherst, Brimfield, Granby, Hadley, Ludlow, Palmer, Southwick, etc.

The fruit of Ceratophyllum demersum is characterized by its smooth, marginless, long-beaked achene with a single short spine or tubercle at the base on either side of the beak or "style".

Though Ceratophyllum is often referred to as an insignificant aquatic weed with no beauty, yet the perfect regularity of its whorls of finely-dissected or thrice-forked leaves, its graceful branching and the delicate character of the whole plant when seen growing in the water renders it an attractive water plant to the botanist. Schleiden once described it as "a Christmas tree for tiny water nixies".

An interesting report of spontaneous swaying movements in the plants by Rodier in 1877 has had no recent affirmation. He claimed that the plants swing back and forth every eight to twelve hours.

An interesting feature in connection with the leaves is that the "juvenile" ones are simple and linear, and not forked like the adults. The forked ones never appear until the fourth node above the cotyledon is reached (2).

In this plant adaptation to the water life has reached its ultimate expression. Not only do the plants grow entirely submerged, but even the stigmas are pollinated under water. Each stamen consists of two pollen sacs below, but above they are filled with air, which renders the whole stamen lighter than water. They mature under the surface and then are pressed out of the "calyx" and rise to the top of the water where they dehisce and shed their pollen grains. These are slightly heavier than water and so sink gently to the stigmas below (2).

Another example of adaptation to its environment is seen in the plant's over-wintering habits. In autumn the whole plant becomes brittle and snaps into many pieces, which

(1) Rhod. 32:103-110; in earlier report (Rhod. 18:39-80. 1816) said not to be found south of Boston in eastern Mass.
(2) Torrey, H. E. - Unpublished Notes on Systematic Botany of Higher Plants - p. 32
remain at the bottom of the pond or stream, weighted down by aquatic animals, diatoms, algae and the like. In spring new shoots arise from these pieces and new plants are started (1).

*Ceratophyllum* is a plant which may have originated in the tropics, for it needs much heat to mature the fruits. As to its wide distribution, there has been much discussion. Its abundant occurrence in high latitudes is partially explained by its curious method of vegetative reproduction just discussed. Yet it is found all over the world and nothing seems to have proved an insuperable barrier to its migrations. Alphonse de Candolle was so strongly impressed by these facts that he adopted Schou's hypothesis of multiple creation in different places.

The most widely accepted explanation for the distribution of the hornwort is that of "relict endemism" (2). The present wide distribution is interpreted as an indication of a more extensive range in ancient days while the present discontinuous distribution arose from the sinking or former land bridges such as the hypothesized "Atlantic", "Lemuria", etc. Darwin objected to this raising and sinking of continents "in a quite reckless manner" and he and his followers prefer to look to winds, birds and water-currents as the pertinent agents of dispersal. But since the fruit of *Ceratophyllum* "sinks like a stone", neither water-currents nor winds seem to account for their transportation from Europe to America.

(1) Torrey, R. E. - Unpublished Notes on *Systematic Botany of Higher Plants* - pg. 58
(2) M. L. Fernald of Harvard the chief exponent.

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Plate 1*

**MAGNOLIA VIRGINIANA L.**
(Sweet or Laurel Magnolia, Sweet Bay, Beaver Tree)

A. Portion of flowering branch, x 1/2.
B. Flower cut longitudinally, x 1 1/2.
C. Outer petal, x 2.
D. Inner petal, x 2.
E. Stamen, x 5.
F. Fruiting head, x 1/2.
G. Seed cut longitudinally, x 5.

Plate 2

**LIRIODENDRON TULIPIFERA L.**
(Tulip Tree)

A. Portion of fruiting branch, x 1/2.
B. Flower, natural size.
C. Flower cut longitudinally, x 2.
D. Stamen, back view, x 3.
E. Stamen, front view, x 3.
F. Fruit, x 5.
G. Fruit cut longitudinally, x 7 1/2.
H. Seed, x 7 1/2.

Plate 3

**CAITHA PALUSTRIS L.**
(Marsh Marigold, Cowslip)

A. Plant, x 1/2.
B. Flower, x 2.
C. Flower cut longitudinally, x 3. After Baillon.
D. Carpel cut longitudinally, x 6. After Gray.
E. Sepaline bract, natural size.
F. Fruiting head, x 2.

Plate 4

**HEPATICA ACUTILOBA DC.**
(Sharp-lobed Hepatica)

A. Plant, natural size.
B. Flower, x 4.
C. Flower cut longitudinally, x 6.
D. Fruiting head, x 2.
E. Leaves showing tendency to become 5-lobed, x 1/2.
F. Achene, x 7.

**HEPATICA AMERICANA (DC.) Ker.**
(Common Hepatica)

G. Leaf, x 1/2.
H. Achene, x 7.

* The figures indicating size of parts refer to original drawings which were on plates 8 1/2 x 11 inches. This and following plates were reduced to 1/4 of photographic plate 5 x 7 inches.
PLATE 9

**RANUNCULUS SEPTENTRIONALIS**

Poir.

(Marsh Buttercup)

A. Plant, x 1/2.
B. Petal, x 4.
C. Achene, x 5.

**RANUNCULUS REPENS** L.

Var. **VILLOSUS** Lamotte

(Swamp Buttercup)

D. Plant, x 1/2.
E. Petal, x 4.
F. Achene, x 5.

PLATE 10

**RANUNCULUS FICARIA** L.

(Lesser Celandine)

A. Petal, natural size.
B. Petal, x 5.
C. Achene, x 10.

**RANUNCULUS CYNTHALARIA** Pursh.

(Seaside Crowfoot)

D. Plant, x 3/4.
E. Petal, x 5.
F. Achene, x 25.

PLATE 11

**RANUNCULUS REPTANS** L.

(Creeping Spearwort)

A. Plant, natural size.
C. Petal, x 10.
D. Fruiting head, x 10.
E. Achene, x 15.

**RANUNCULUS REPENS** L.

Var. **OVALIS**

B. Leaves, natural size.

**RANUNCULUS LAXICAULUS**

(T. & G.) Darby

(Water Plantain Spearwort)

F. Basal portion of plant, x 3/4.
G. Tip portion of plant, x 3/4.
H. Petal, x 10.
I. Achene, x 15.

PLATE 12

**RANUNCULUS AQUATILIS**

Var. **CAPILLACEUS** DC.

(Common White Water Crowfoot)

A. Portion of plant, natural size.
B. Petal, x 10.
C. Achene, x 10.

**RANUNCULUS LONGIROSTRIS** Godr.

D. Portion of plant, natural size.
E. Achene, x 10.

**RANUNCULUS DELPHINIFOLIUS**

Torr.

F. Portion of plant, natural size.
G. Petal, x 10.
H. Achene, x 10.
PLATE 15

**RANUNCULUS ABORTIVUS** L.
(Small Flowered Crowfoot or Kidney-leaved Buttercup)

A. Plant, x 2/3.
B. Flower, x 5.
C. Flower cut lengthwise, x 10.
D. Sepal, x 10.
E. Petal, x 10.
F. Fruiting head, x 5.
G. Achene, x 10.

**RANUNCULUS ABORTIVUS** L.
Var. **EUCYCLUS** Fernald

H. Leaf, x 2/3.

**RANUNCULUS ALLEGHENIENSIS** Britton
(Mountain Crowfoot)

I. Sepal, x 10.
J. Petal, x 10.
K. Achene, x 10.

PLATE 16

**RANUNCULUS SCELERATUS** L.
(Celery-leaved Crowfoot)

F. Plant, x 3/4.
G. Sepal, x 10.
H. Petal, x 10.
I. Fruiting head, x 5.
J. Achene, x 10.
PLATE 21

Clematis verticillaris DC.
(Purple Clematis)

A. Portion of plant, x 3/4.
B. Flower in longi-section, x 2.
C. Petal, x 5.
D. Petaloid stamen, x 5.
E. Stamen, x 5.
F. Achene, x 3.

PLATE 22

Clematis virginiana L.
(Common Virgin's Bower)

A. Portion of plant, x 3/4.
B. Staminate flower, x 4.
C. Perfect flower, cut longitudinally, x 8.
D. Stamen from staminate flower, x 10.
E. Stamen from perfect flower, x 10.
F. Achene, x 4.

PLATE 23

Cimicifuga racemosa (L.) Nutt.
(Black Snakeroot, Black Cohosh)

A. Plant, x 1/8.
B. Portion of flowering raceme, natural size.
C. Flower bud, x 6.
D. Flower cut lengthwise, x 6. After Bentley and Trimen.
E. Sepal, x 10.
F. Staminode, x 4.
G. Fruit, x 5.

PLATE 24

Actaea rubra (Ait.) Willd.
(Red Baneberry)

A. Plant, x 1/8.
B. Flower bud just opening, x 5.
C. Flower expanded, without calyx, x 8. After Baillon.
D. Flower cut lengthwise, x 10. After Baillon
E. Infrutescence, natural size.
F. Seed, x 4.

Actaea alba (L.) Mill.
(White Baneberry)

G. Infrutescence, natural size.
H. Seed, x 4.
PLATE 25

THALICTRUM DIOICUM L.
(Early Meadow Rue)

A. Plant, x 1/2.
B. Flower, x 3.
C. Stamen, x 6.
D. Slightly immature fruiting head, x 6.
E. Mature Achene, x 6.

THALICTRUM POLYGAMUM Muhl.
(Fall Meadow Rue)

F. Leaflet, natural size.
G. Stamen, x 6.
H. Achene, x 6.

THALICTRUM REVOLUTUM DC.
(Waxy Meadow Rue)

I. Leaflet, natural size.
J. Stamen, x 10.
K. Achene, x 10.

PLATE 26

CAULOPHYLLUM THALICTROIDES
(L.) Michx.
(Blue Cohosh)

A. Plant, x 2/3.
B. Flower bud, x 5.
C. Flower, x 5.
D. Petal, x 15.
E. Stamen, x 10.
F. Infrutescence, natural size.
G. Carpel before maturity, x 2.
H. Fruit showing one abortive and one fertile drupe-like seed, x 2.

PLATE 27

BERBERIS VULGARIS L.
(Common Barberry)

A. Portion of fruiting twig, natural size.
B. Portion of twig with inflorescence, natural size.
C. Bud of flower, x 5.
D. Opened flower, x 5.
E. Flower cut longitudinally, x 10.
F. Glandular petal, x 10.
G. Stamen, x 20.
H. Fruit cut lengthwise, x 5. After Baillon.
I.-N. Transitions from normal leaf to thorns. After Torrey.
PLATE 29

SASSAFRAS OFFICINALE
Nees. and Eberm.
(Sassafras)
A. Portion of fruiting branch, natural size.
B. Inflorescence, natural size.
C. Pistillate flower, x 10.
D. Sepal of pistillate flower with stamen rudiments, x 12.
E. Pistil, x 15.
F. Staminate flower, x 10.
G. Sepal with stamen attached, x 12.
H. Inner stamen with stalked glands at base, x 12.
I. Fruit, x 2 1/2.

PLATE 31

MENISPERMUM CANADENSE L.
(Moonseed)
A. Portion of plant, x 1/2.
B. Staminate flower, x 10.
C. Pistillate flower, x 10.
D. Stamen, x 15.
E. Inflorescence, x 1/2.
F. Seed cut longitudinally, x 5.

PLATE 30

BENZOIN AESTIVALE (L.) Nees.
(Spice Bush, Benjamin Bush)
A. Portion of plant, x 1 1/2.
B. Portion of flowering twig, natural size.
C. Staminate flower, x 10.
D. Sepal with young stamen from outer row of stamens of staminate flower, x 20.
E. Stamens with glands at base from inner row of stamens of staminate flower, x 20.
F. Pistillate flower, x 10.
G. Portion of fruiting branch, natural size
H. Single fruit, x 2.

PLATE 32

CERATOPHYLLUM DEMERSUM L.
(Hornwort, Hornweed)
A. Portion of plant, natural size.
B. Leaf, from upper portion of plant, x 7.
C. Leaf, from lower portion of plant, x 7.
D. Staminate flower, x 10
E. Stamen, x 20.
F. Pistillate flower, x 10.
G. Achene, x 6.
H. Achene, longisection, x 7.
PLATE 33

NYMPHAEA ODORATA Ait.
(White or Sweet-scented Water Lily)

A. Small leaf, natural size.
B. Flower, x 1 1/2.
C. Fruit, x 3.
D. Fruit cut lengthwise, x 5.
E. Young ovary in cross-section, x 3.
F. Seed cut lengthwise, x 10.

PLATE 34

NYMPHOZANTHUS VARIEGATUS (Engelm.) Fernald
(Yellow Water Lily, Spadder Dock)

A. Floating leaf, x 1/2.
B. Underwater leaf, x 1/2.
C. Flower, natural size.
D. Flower in longitudinal section, x 2.
E. Petal, x 3.
F. Young stamen, x 3.
G. Seed in longitudinal section, x 15.

PLATE 35

NYMPHOZANTHUS MICROPHYLLUS (Pers.) Fernald
(Small Yellow Pond Lily)

A. Plant, x 2/3.
B. Petal, x 5.
C. Stamen, x 5.
D. Fruit, natural size.

NYMPHOZANTHUS RUBRODISCUS (Morong.) Fernald

E. Petal, x 5.
F. Stamen, x 5.
G. Fruit, natural size.

PLATE 36

BRASENIA SCHREBERI Gmel.
(Water Shield)

A. Portion of plant, x 1/2.
B. Flower, x 3.
C. Sepal, x 4.
D. Petal, x 4.
E. Stamen, x 5.
F. Fruiting head, x 2 1/2.
G. Fruits, x 4.
Approved by:

[Signature]

[Signature]

[Signature]

Graduate Committee

Date