

Aquatic and Wetland Plants of the Arnold Arboretum

Patricia A. Dalton and
Alejandro Novelo R.

Illustrations by Amy Storey

In contrast to terrestrial plants, aquatic and wetland plants are not permanent in their habitats. Year after year we find that a species that may be abundant in one year disappears in another. Because of fluctuating water levels, artificial destruction, pollution, and modification of the surface soil, some species are unable to survive. Such disturbances also create new habitats that allow alien species to become naturalized. As a result, we receive only glimpses of the complex relationships between the plants and their environment. It is important, therefore, to document the flora of an area over time, so that changes brought about by human modifications and environmental factors may be measured.

The aquatic and wetland plants in the Arboretum are unique in that their status has been assessed from time to time throughout the history of the institution. E. J. Palmer's *Spontaneous Flora of the Arnold Arboretum*, the first account of wild plants in the Arboretum, was written in 1930. Palmer, who was a botanist on the staff of the Arboretum, recorded the following species as growing in the meadow or in shallow water at that time: calamus (*Acorus calamus*), bur-reed (*Sparganium eurycarpum*), St. John's-wort (*Hypericum majus*), cardinal flower (*Lobelia cardinalis*), great blue lobelia

(*Lobelia siphilitica*), waterweed (*Elodea canadensis*), two pondweeds (*Potamogeton foliosus* and *P. epihydrus*), and even a rare aquatic in the primrose family (*Hottonia inflata*). Today not one of these plants can be found. Yet Palmer observed that even then the number of native species was decreasing rapidly in proportion to that of encroaching cultivated trees and shrubs

The term *aquatic plant* usually refers to plants having a life cycle that revolves around water, being either completely submerged, emergent, or floating. Many definitions of this term exist, however, as these plants exhibit a wide range of morphological expression, and a clear distinction between wet and dry environments is often impossible to achieve. Furthermore, in many areas there are seasonal fluctuations of the water table; for example, plants growing in dry soils most of the year may be flooded during the rainy season, and habitats with standing water may dry out during the summer months.

Wetlands are transitional areas between aquatic and terrestrial environments, where the water table is usually at or just below the surface or where the land is covered by shallow water. At the Arnold Arboretum the most familiar wetland type is what is termed *wet meadow*. Though the water table may

be slightly below the surface of the ground, the soil on these sites receives a continuous supply of moisture. The vegetation includes grasses, which are usually the dominant species, sedges, and other marsh plants such as smartweeds, arrow-heads, rushes, and cat-tails. Like most meadows, these areas would soon grow to trees and shrubs if they were not mowed annually in the fall.

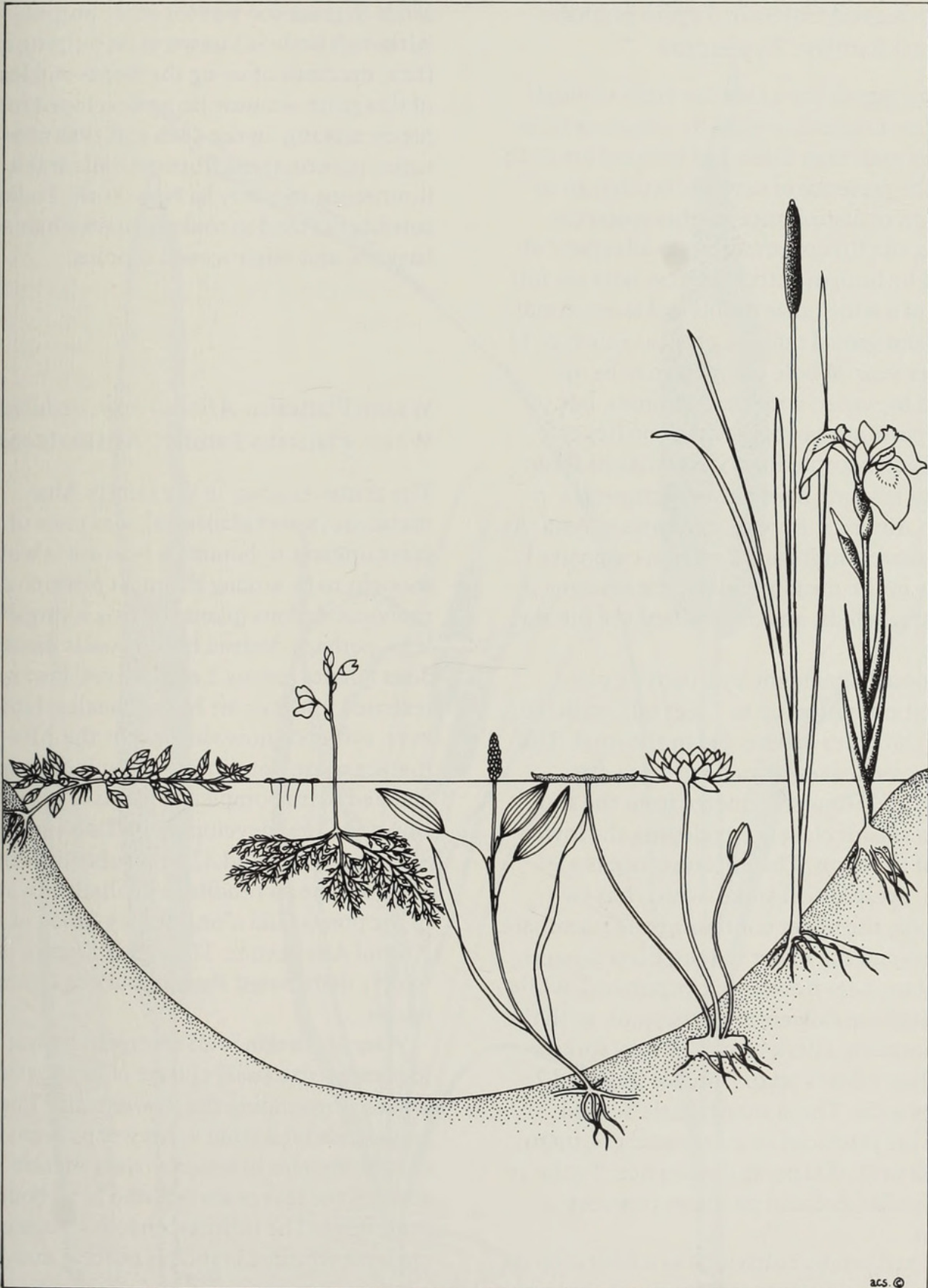
One of the most familiar features of aquatic vegetation is the zonation or sequence of life forms, which is typically repeated in lakes, ponds, canals, swamps, and slow-moving rivers that are not drastically disturbed by humans. An illustration of this zonation may be found on page 9. The emergent plants occupying the shoreline, or marginal zones, are first in this sequence and are called *attached emergent hydrophytes*. These plants are attached to the substrate with a portion of the stem arising from the water, for example, cat-tails (*Typha*), iris (*Iris*), and pickerelweed (*Pontederia*). All the reproductive parts of the plant are above water.

The next group in the sequence is those plants found growing between the shoreline and the deeper waters, the transitional zone. This group includes three life forms. The *attached floating-leaved hydrophytes* are first. These plants are attached to the substrate, with the leaves floating on the surface of the water, for example, water-lilies (*Nymphaea*) and water-chestnuts (*Trapa*). The reproductive organs may be floating or emerging. The *attached submerged hydrophytes* are second. These plants are attached to the substrate, and their vegetative parts are fully submerged, for example, pondweed (*Potamogeton*) and naiads (*Najas*). The reproductive parts may be submerged, floating, or emerging. The third life form in the tran-

sitional zone is the *attached floating-stemmed hydrophytes*. These plants are attached to the substrate with the stems floating on the surface of the water, for example, false loosestrife (*Ludwigia*) and some grass genera. The leaves may be emerging or floating, and the reproductive organs are usually aerial.

The last group is comprised of plants growing in the deeper waters offshore. This includes the *free-floating hydrophytes* and the *free submerged hydrophytes*. Free-floating hydrophytes are unattached to the substrate, and their vegetative and reproductive organs float on the surface of the water, for example, duckweed (*Lemna*), water-fern (*Azolla*), and water-hyacinth (*Eichornia*). *Free submerged hydrophytes* are plants unattached to the substrate, with the vegetative organs submerged and the reproductive organs emerging from the water. An example of this is the bladderwort (*Utricularia*).

Life forms of aquatic plants. Left to right: Attached floating-stemmed hydrophyte (*Ludwigia*); free-floating hydrophyte (*Lemna*); free submerged hydrophyte (*Utricularia*); attached submerged hydrophyte (*Potamogeton*); attached floating-leaved hydrophyte (*Nymphaea*); and attached emergent hydrophytes (*Typha* and *Iris*).



Broad-leaved Cat-tail: *Typha latifolia*

Cat-tail Family: Typhaceae

Cat-tail stands are a familiar sight throughout New England, especially along roadside ditches and other disturbed wetland areas. In fact, the presence of cat-tails is often an indication of disturbance, as this species is among the first to invade areas adversely affected by human activities. Cat-tails are tolerant of a wide range of soil and water conditions and spread rapidly, often as much as 17 feet per year. Whole colonies may be uprooted by water, wind, and animals, but loose parts are carried to other bodies of water and become firmly established. The species is found over most of temperate North America, Europe, and eastern Asia. At the Arboretum it can be seen in extensive stands in the meadow, along the margins of the three ponds, and on the banks of Bussey Brook.

A rooted, emergent hydrophytic plant, this cat-tail grows up to 7 feet tall, with long, stout rhizomes submerged in the mud. The light green leaves, which are erect, flat, linear, and elongate, emerge from the water, with a sheath closely enveloping the lower part of the stem. The inflorescence is a dense, cylindrical spike, which has two portions, the upper containing the staminate flowers and the lower the pistillate flowers. The staminate flowers are ephemeral, while the pistillate flowers are persistent, with the fruit forming a dark brown, showy spike with hairy fruits up to 7 inches long and 2 inches wide. These small single-seeded fruits are produced in great numbers, up to 20,000 to 70,000 per inflorescence. *Typha* is wind pollinated and produces powdery pollen.

Cat-tail can be cultivated as a fiber crop on

lands that are too wet for other purposes.

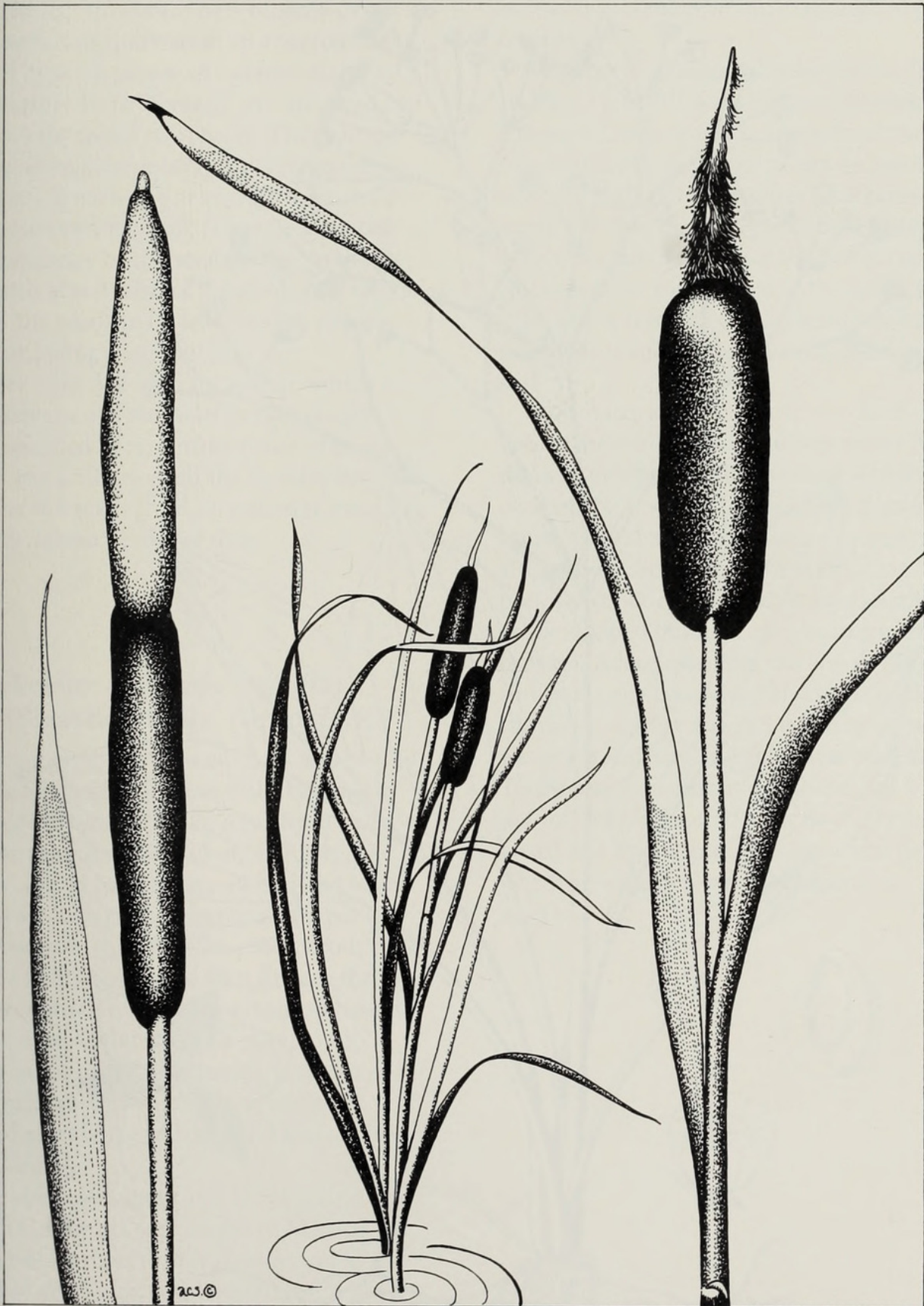
Although little is known of its pulping qualities, methods of using the stems and leaves of this plant are now being developed for paper-making. In the 18th and 19th centuries papermaking from cat-tails was a flourishing industry in New York. Today the soft fiber is used in making mats, chair seats, baskets, and other woven articles.

Water-Plantain: *Alisma subcordatum*

Water-Plantain Family: Alismataceae

The genus *Alisma*, in the family Alismataceae (water plantains), was once of great interest to botanists because it was thought to be among the most primitive monocotyledons (plants having a single seed leaf), perhaps derived from aquatic dicotyledons (plants having 2 seed leaves) best represented in the order Nymphaeales. However, evidence now shows that the Alismataceae are not primitive but highly specialized, with complex vegetative organization and floral development. Two species, *Alisma triviale* and *Alisma subcordatum*, are frequent on mudflats, in shallow waters of the ponds, and along Bussey Brook at the Arnold Arboretum. The genus *Alisma* is widely distributed throughout the United States.

Water-plantain is an emergent hydrophytic plant with a basal cluster of long-petioled leaves surrounding the flower stalk. The leaves exhibit a wide variety of patterns and may be slender to broadly ovate. In rare instances the leaves are reduced to ribbonlike structures. The inflorescence is a large panicle with whorled branches bearing many



Common Cat-Tail (*Typha latifolia*)



Water-Plantain (*Alisma subcordatum*)

small perfect flowers. The 3 broadly ovate green sepals are persistent and surround the 3 small pinkish petals. Six stamens and approximately 10 to 25 pistils are arranged in a ring on a flattened receptacle. The fruit of *Alisma* is an achene (dry, indehiscent, and one-seeded) with one or two grooves and a minute ascending beak. It has been stated that dormancy in the seeds is due to the mechanical restraint of the seed coat, which allows the seeds to lie in water for years without losing their viability.

Water-plantain secretes nectar, which may attract such pollinators as flies and short-tongued bees. Unlike those of most plants, the anthers in all the flowers dehisce at about the same time, so pollen is available for only a short period of time.

Duck-Potato: *Sagittaria latifolia*

Water-Plantain Family: Alismataceae

A botanist on the Lewis and Clark Expedition observed an Indian woman collecting duck-potato (*Sagittaria latifolia*) roots from a canoe near the mouth of the Columbia River. The woman would paddle out to where the water was breast high and use her toes to separate the tuber from the root. The tuber, about the size of a hen's egg, would then float to the top, and the woman would throw it into a basket in the canoe. Although duck-potato is no longer eaten by human beings, it is of considerable value to wildlife and has been planted as a source of both food and shelter for wildfowl.

The species ranges from Nova Scotia and British Columbia southward to Mexico. At the Arnold Arboretum it is common in the meadow and along pond margins and Bussey

Brook. It blooms from July through September.

This rooted, emergent hydrophytic plant reaches 3 feet tall, with its root submerged in the mud. Duck-potato is a perennial that overwinters by means of tubers. In late summer and early fall the stolons (elongate underground stems) begin to produce terminal tubers by an enlargement of the 2 or more short, thickened internodes next to the apical bud. The tubers, now full of starch, are enclosed by scale leaves and are deeply embedded in the soil.

Like many aquatic plants, the duck-potato, or arrow-head, exhibits many bewildering morphological variations within various habitats, which for the duck-potato may include pond margins, lakes, swamps, and sluggish streams. The emergent, long petioles produce leaves that are generally arrow-shaped but may also be linear to ovate in form. Accompanying the leaves is an inflorescence composed of whorls of flowers that are usually arranged with the upper whorls staminate and the lower pistillate. There may be as many as 10 or more whorls per inflorescence, and each flower is composed of 3 sepals and 3 showy white petals. The fruits are in a dense head and are beaked.



Duck-Potato (*Sagittaria latifolia*)

Arrow-Arum: *Peltandra virginica*

Arum Family: Araceae

The starchy root from which arrow-arum (*Peltandra virginica*) grows was once eaten by the Indians in Virginia, who called the plant tuckaho. The root, which is extremely acrid and poisonous, was steamed in a heated pit, covered over with earth, and left undisturbed for a day or two. This process broke down the crystals of calcium oxalate that make the plant poisonous. The dried roots were then ground up into meal.

Arrow-arum ranges from Florida to Texas, north throughout New England and into Canada. At the Arboretum it grows in shallow waters in the three ponds and along Bussey Brook.

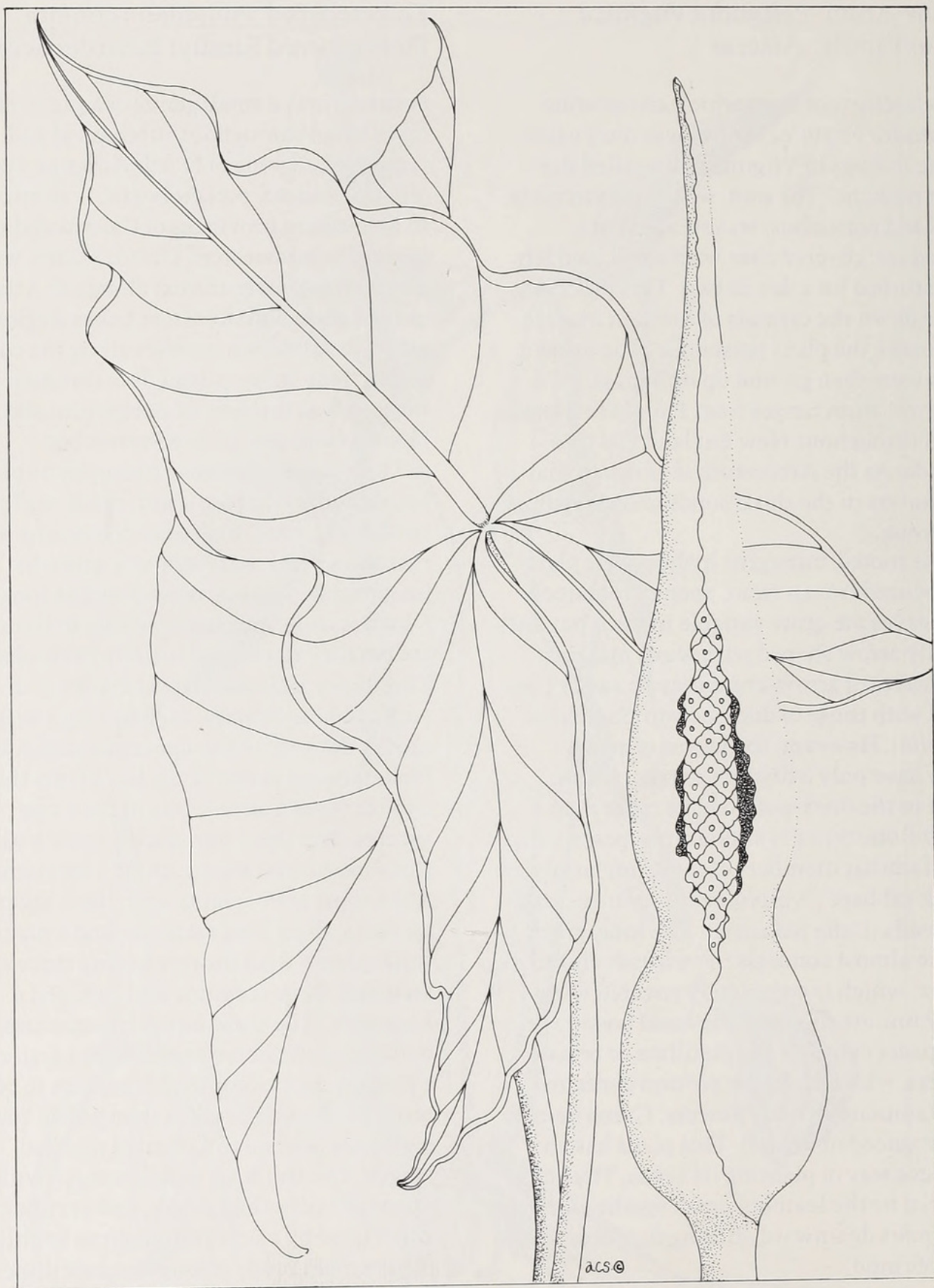
This rooted, emergent hydrophytic plant is produced from a stout, spongy rootstock. The leaves are quite variable in form but are usually arrow shaped with wavy margins. The leaves of arrow-arum may be easily confused with those of duck-potato (*Sagittaria latifolia*). However, the leaves of arrow-arum have only 3 distinct nerves, while those in the duck-potato have more than 3. The inflorescence is similar in appearance to such familiar members of the arum family as skunk cabbage (*Symplocarpus foetidus*) and wild calla (*Calla palustris*). The long, green spathe almost conceals the whitish clublike spadix, which is completely covered with many minute flowers. The basal portion of the spadix contains the pistillate or female flowers, while the upper portion contains the staminate or male flowers. Green berries are produced in the fall. This plant has an efficient way of planting its seeds. The stalk, covered by the leathery green spathe, curves and grows downward, driving the seeds into the soft mud.

Pickerelweed: *Pontederia cordata*

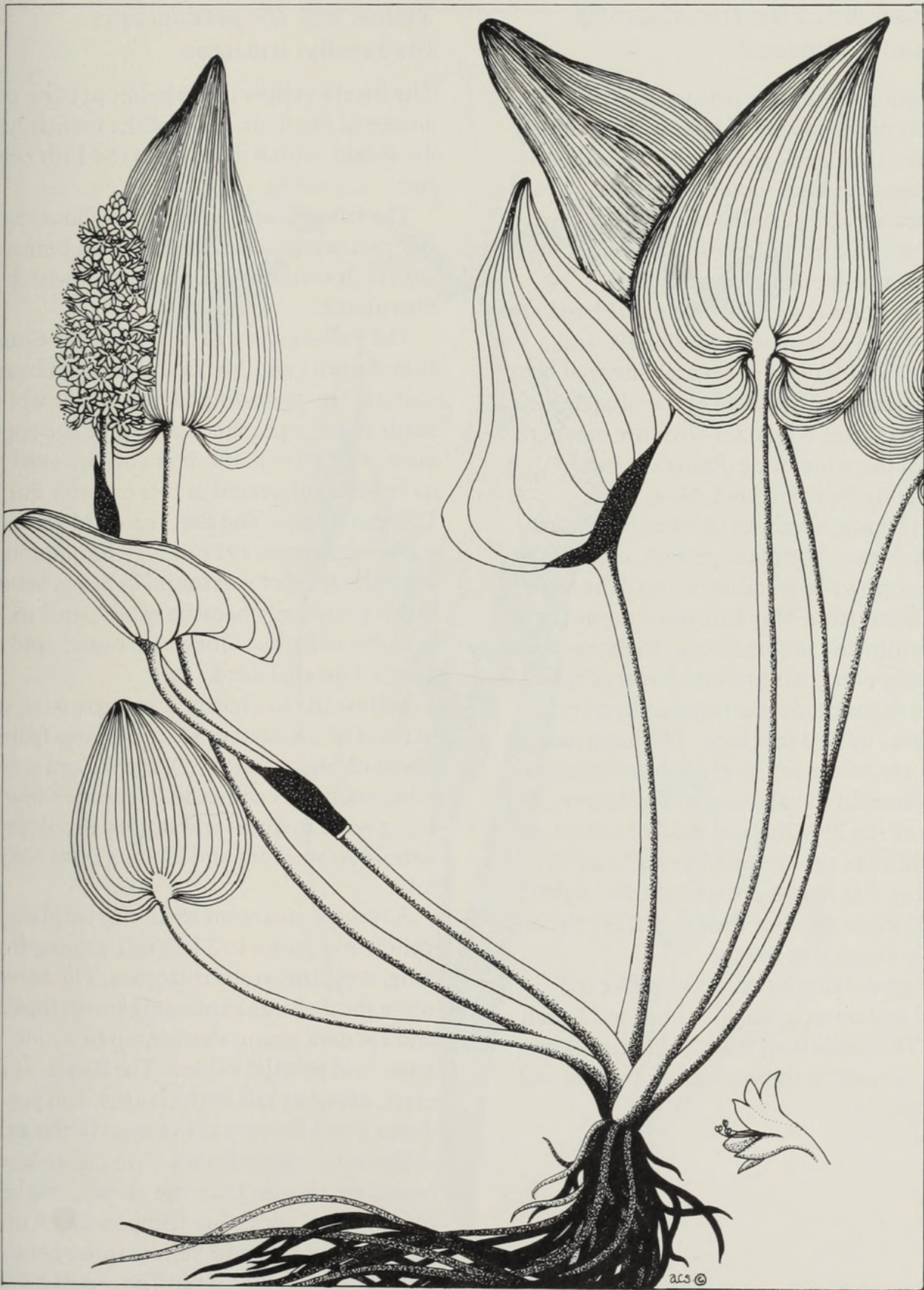
Pickerelweed Family: Pontederiaceae

Pontederia is a small genus of aquatic plants distributed throughout subtropical and temperate regions of North America. *Pontederia cordata*, pickerelweed, is restricted to the eastern provinces of Canada and the eastern to midwestern United States, with its greatest concentration along the Atlantic coastal plain and the Great Lakes Region. It grows in saltwater marshes along the coast and in fresh water inland. It is common in the ponds at the Arnold Arboretum and blooms from July to late September.

This rooted, emergent hydrophytic plant has rhizomes that are short, thick, and prostrate in the mud. Reproduction occurs when rhizomes break and form new growths. The long-petioled leaves, up to 9 inches long and 5 inches wide, are quite variable in form but are parallel veined and usually heart-shaped. The showy inflorescence is a spike of deep purplish blue flowers, each having a yellow spot at the base of the upper perianth lobes. Pickerelweed is one of the few plants that exhibit three flower forms of the same species. The three forms are: plants with three medium stamens, three long stamens, and a short style; plants with three short stamens, three long stamens, and a medium style; plants with flowers having three short stamens, three medium stamens, and a long style. The three forms ensure cross-pollination. Pollen transfer from a stamen to a pistil of equivalent length appears to be more productive of seeds than pollen transfer from a stamen to a pistil of unequal length. The fruits are small, winged with several longitudinal ridges, and very buoyant. Travel by water is thought to be this plant's main mode of long-distance dispersal.



Arrow-Arum (*Peltandra virginica*)



Pickerelweed (*Pontederia cordata*)

Common Blue Flag: *Iris versicolor***Iris Family: Iridaceae**

The common blue flag (*Iris versicolor*) is a member of the family of plants aptly named after Iris, the Greek goddess of the rainbow. This beautiful blue-violet flower has 3 broad recurved sepals (the falls) boldly veined with green, white, and yellow, and 3 smaller erect, slender petals (the standards).

This species is a gregarious one. Plants are rarely found as isolated individuals, and single colonies of up to several hundred have been observed. The range of the blue flag in North America coincides with the northern range of the white pine (*Pinus strobus*), comprising New England, New York, Pennsylvania, northern Ontario, and northern Michigan. The plant prefers moist soils but also grows in standing water. The blue flag blooms from May through June at the Arboretum and is common in the meadow and along pond margins and Bussey Brook.

This rooted, emergent hydrophytic plant has stems up to 3 feet long. The long, narrow leaves are pale green to grayish and sheathed at the base. In the absence of the flowers, the leaves of the blue flag can easily be confused with those of the cat-tail (*Typha latifolia*). The blue-flag leaves are straight and tightly folded, while those of the cat-tail are flat and slightly twisted at the top.

The greenish fruit of the blue flag is 3 angled and up to 1½ inches long and 1 inch wide. The seeds float readily and travel by water, spreading themselves along lake and river margins.

Yellow Iris: *Iris pseudacorus***Iris Family: Iridaceae**

The lovely yellow iris is believed to be the source of the fleur-de-lis of the French heraldic shield, which dates from the 12th century.

The *Iris* genus is found throughout the temperate regions of the northern hemisphere. It contains 300 species, of which 10 are aquatic.

The yellow iris was introduced to Canada from Eurasia and Africa and escaped from cultivation, spreading to freshwater wetlands to such an extent as to give the appearance of a native plant. It is also believed to have been cultivated in this country during Colonial times. The first record of an escapee dates from 1911 in Newfoundland. By 1915 the species was found in Nova Scotia, and it eventually became established in British Columbia, Quebec, Ontario, and Prince Edward Island.

Yellow iris has become an aggressive weed in parts of the eastern United States from Massachusetts south to Virginia and west to Wisconsin. It is common in the meadow and along pond margins and Bussey Brook at the Arnold Arboretum and blooms from May to July.

A rooted, emergent hydrophytic plant, the yellow iris grows to 3 feet tall, arising from long, creeping, stout rhizomes. The leaves often form clumps emerging from the water and are dark green, slender, up to 1 inch wide, and parallel veined. The flower stalk is erect, about as tall as the leaves, and produces 1 to 2 flowers at the apex in the axils of the small upper leaves. The 2 involucral bracts are shorter than the showy, bright yellow flowers, which are composed of 3 outer recurved sepals and 3 yellow inner petals, slender, to 4 inches long. The sepals have



Common Blue Flag (*Iris versicolor*)



Yellow Iris (*Iris pseudacorus*)

delicate brown lines or flecks at the base and on the claw. The fruit capsule is bright green and often lustrous. It is bluntly 3-angled and contains somewhat round corky seeds.

Swamp Loosestrife: *Decodon
verticillatus*

Loosestrife Family: Lythraceae

The genus *Decodon* is monotypic, that is, it includes only one species, *Decodon verticillatus*, swamp loosestrife. This species grows only in the United States, ranging from Louisiana to Florida and northwards to Minnesota and Maine. Fossil material has been found in Asia and Europe. At the Arboretum the swamp loosestrife grows in the pond near the lilacs and blooms from July to October.

Swamp loosestrife, or water willow, as it is also called, has a unique way of reproducing. The stems, which can reach 6 to 8 feet in height, are weak and remain upright for only a short time before bending over. When the apex of the stem touches the surface of the water, swelling occurs, and aerenchyma (spongy tissue with large air spaces) develops, producing adventitious roots that anchor it. Thus, a new offshoot is established some distance from the mother plant.

This rooted, emergent hydrophytic herb, or short-lived shrub, has four- to six-sided stems. The bark of the submerged parts is spongy and thick. The leaves are short-stalked, opposite or whorled, slender, and pointed at the tip. The upper leaves have clusters of 1 to 3 flowers in their axils. Like other members of the loosestrife family, the

flowers are trimorphous. The petals are bright magenta and crinkly. The number of stamens is usually twice the number of petals. The stamens vary in length and are arranged in two whorls. The fruit is a capsule.

Fragrant Water-Lily: *Nymphaea
odorata*

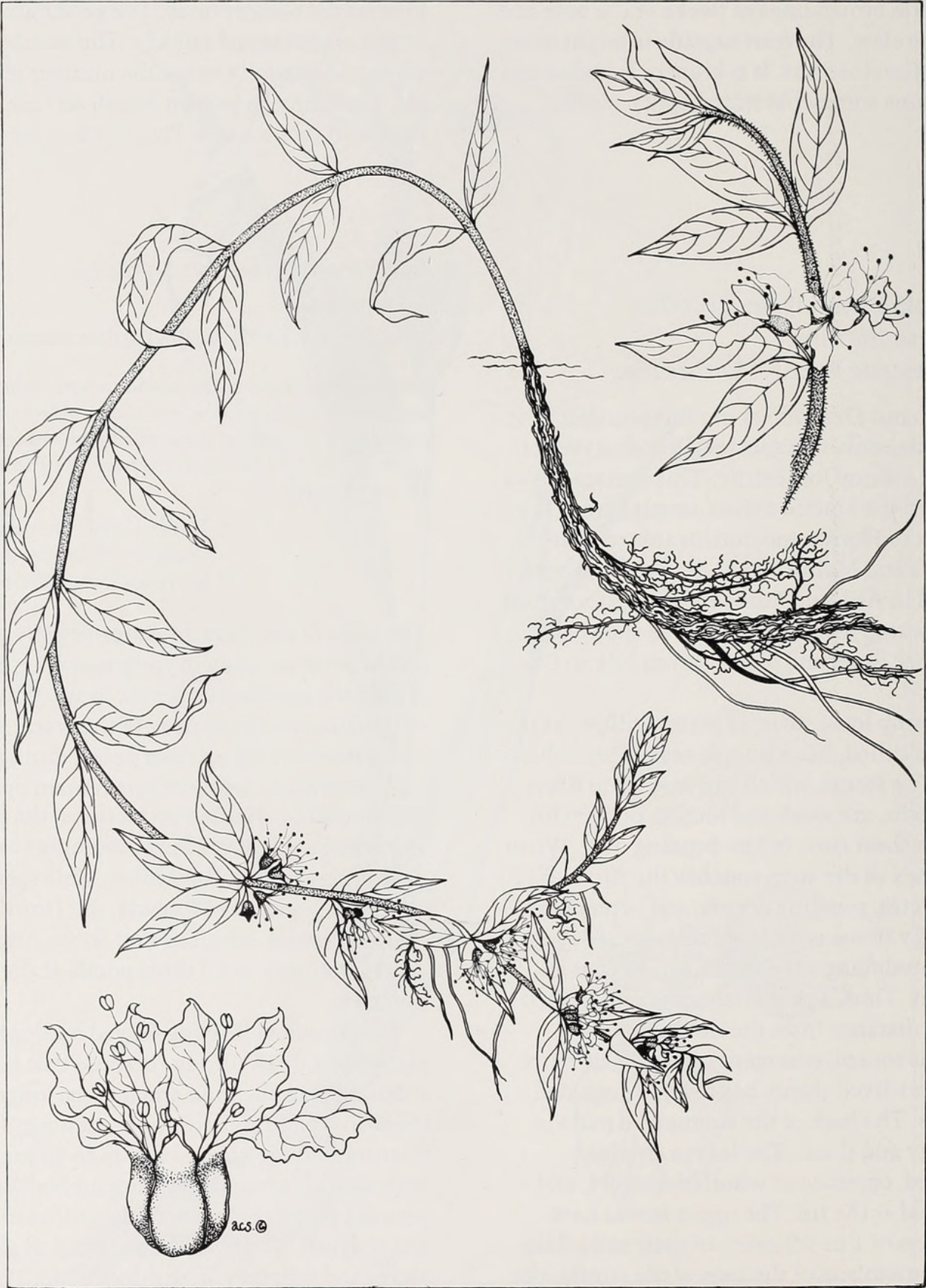
Water-Lily Family: Nymphaeaceae

Growing in stagnant and muddy water, it bursts up so pure and fair to the eye and so sweet to the scent, as if to show us what purity and sweetness reside in and can be extracted from the slime and muck of earth.

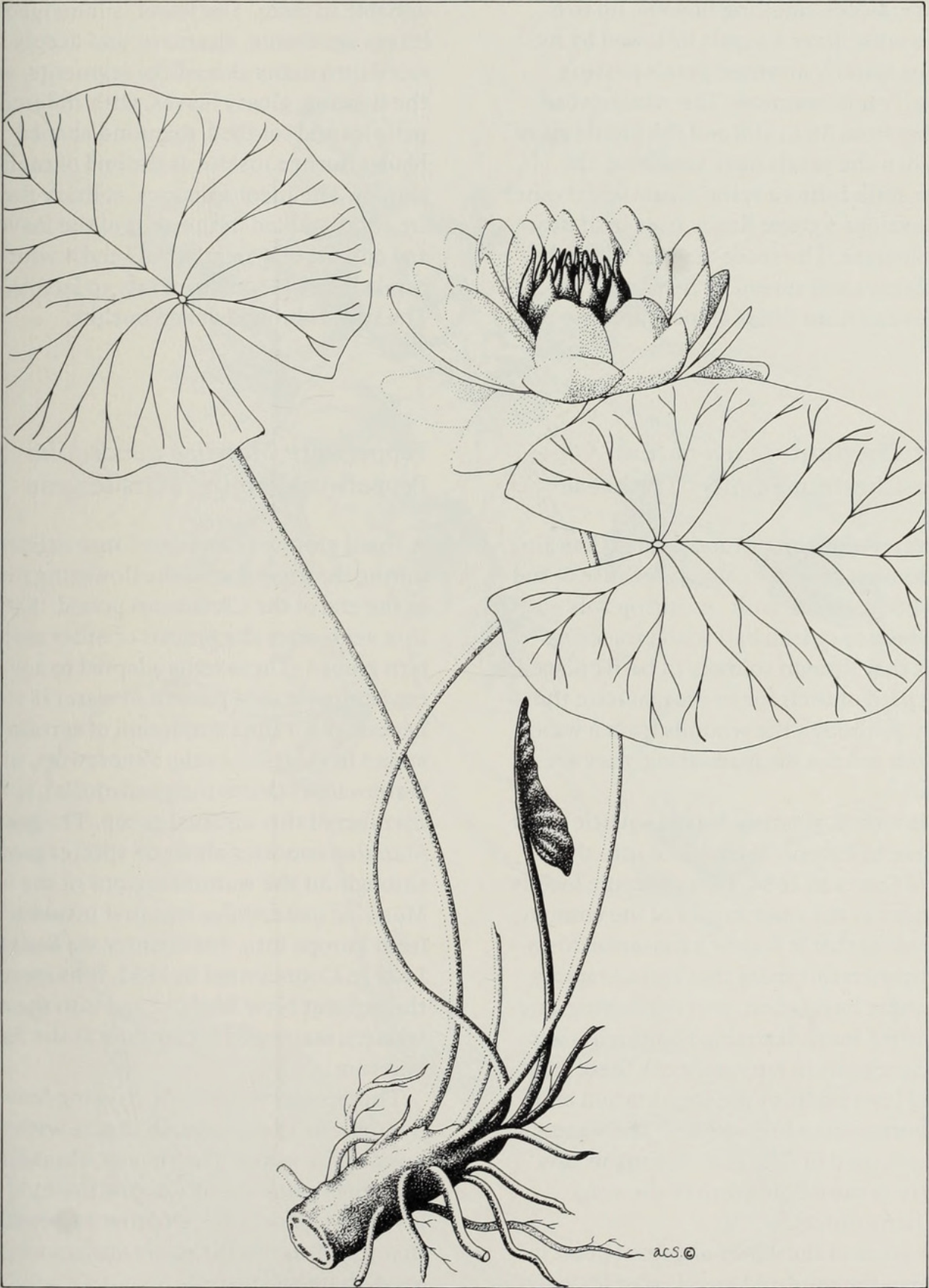
Henry David Thoreau
*Summer: From the Journal
of Henry David Thoreau*

The buds of the fragrant water-lily (*Nymphaea odorata*) open in early morning, exposing the spectacular white, waxy flowers, which float on the surface of the water. Some flowers fold up their petals during the early afternoon, while others remain open. In addition to its other attractions, the fragrant water-lily has a long blooming season, from June through September. This species is native to southern Canada, the United States, Central America, and South America and is common in all three ponds at the Arboretum.

This attached floating-leaved hydrophytic plant has a thick, fleshy rhizome that is submerged in the mud and may be long- or short-lived and creeping or branching. The floating, rounded leaves are up to 10 inches wide and are attached by long rubberlike petioles that vary in length according to the water depth. The blades are green and glossy above and purplish on the underside. The



Swamp Loosestrife (*Decodon verticillatus*)



Fragrant Water-Lily (*Nymphaea odorata*)

solitary, sweet-smelling flowers, up to 6 inches wide, have 4 sepals followed by numerous spirally arranged petals passing gradually into stamens. The stamens can number from 36 to 100 and the pistils up to 20. When the petals have withered, the flower stalk forms a spiral shape underwater and develops a green fleshy fruit in or near the substrate. The seeds emerge when the fruit decays and spread by floating. This species can form dense stands rapidly.

Water-Chestnut: *Trapa natans*
Water-Chestnut Family: Trapaceae

The water-chestnut (*Trapa natans*) has also been known as water caltrop because of the sharp points on its fruit. A caltrop was a small bronze or iron ball with projecting spikes that Roman soldiers in battle placed in the path of their foe to incapacitate the horses. Although the wounds from a water-chestnut are not incapacitating, they are painful.

This rooted, floating-leaved aquatic plant is native to Europe. Introduced into the United States in 1884, it has become locally abundant in the eastern part of the country, so much so that it is now a nuisance, forming impenetrable mats that spread rapidly and hinder navigation, prevent fishing, and overcrowd more desirable plants (e.g., bur-reed (*Sparganium eurycarpum*)). State and federal laws prohibit the importation and transportation of this species. The water-chestnut used in Chinese cooking in this country is the edible corm of the sedge *Eleocharis dulcis*.

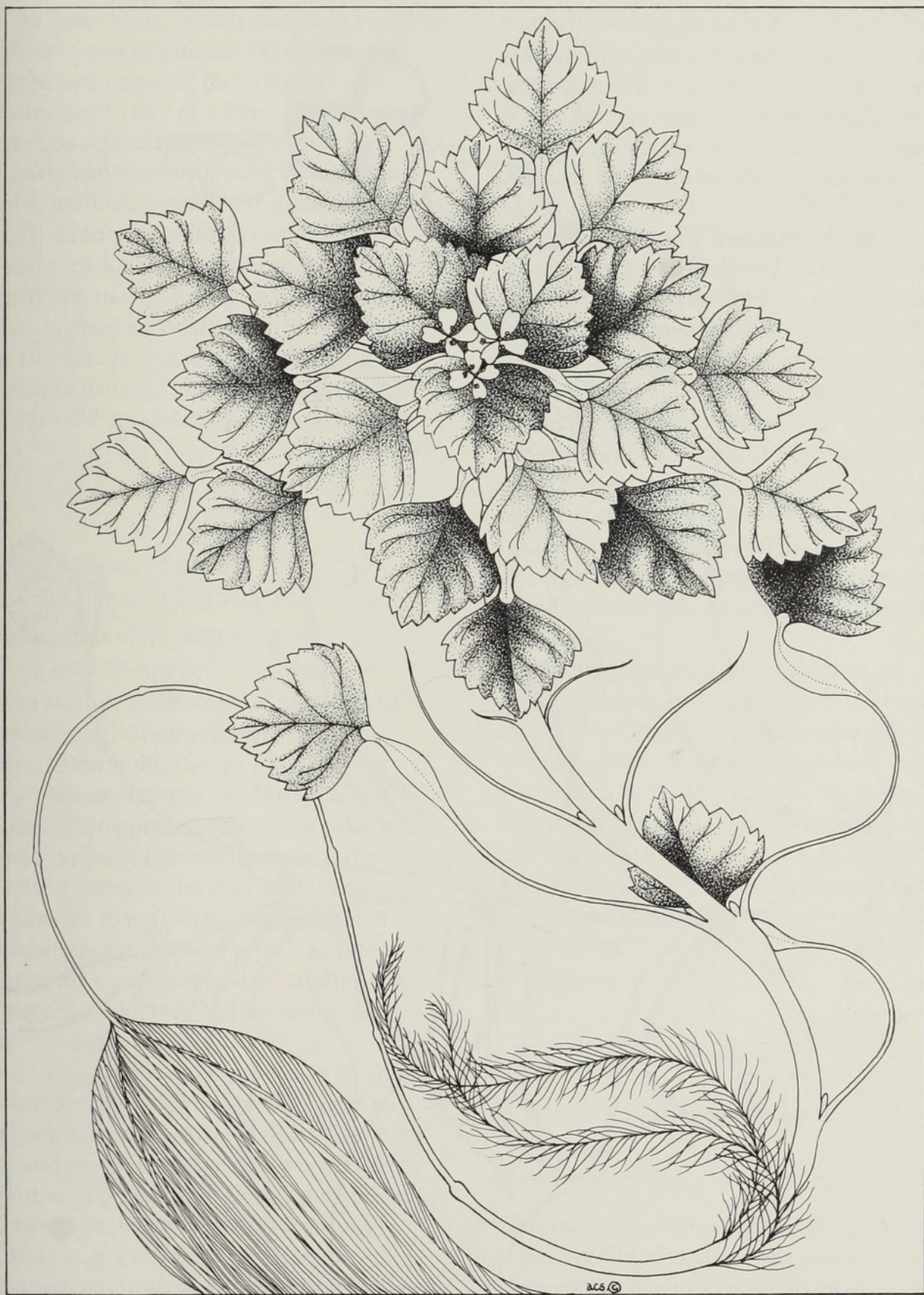
The stem of the water-chestnut plant is rooted in the mud and has slender leaves

variable in form. The lower, submerged leaves are sessile, alternate, and deeply divided into many threadlike segments, while the floating, glossy leaves, with inflated petioles and toothed, diamond-shaped blades, form a rosette at the end of each branch. The inconspicuous, solitary flowers are short stalked in the axils of the leaves and consist of 4 green sepals and 4 white petals. They bloom from July to late August. The fruit is brownish and nutlike.

Pepperwort: *Marsilea quadrifolia*
Pepperwort Family: Marsileaceae

A small group of ferns came into existence during the great rise of the flowering plants at the end of the Cretaceous period, 300 million years after the genesis of other major fern groups. These ferns adapted to a watery environment, and growth in water is still necessary for the completion of certain stages in their life cycle. Pepperwort, or water-clover (*Marsilea quadrifolia*), is a member of this unusual group. The genus *Marsilea* contains about 65 species growing throughout the warmer regions of the world. *Marsilea quadrifolia* was first introduced from Europe into this country via Bantan Lake in Connecticut in 1862. It has spread throughout New England and into the mid-western states and is common at the Arboretum.

This species is a rooted, floating-leaved hydrophyte that increases in size with the level of the water. The slender, threadlike rhizomes creep slightly below the mud and give rise to a delicate, shamrock-shaped leaf that may float on the water surface or stand erect above the water.



Water-Chestnut (*Trapa natans*)



Pepperwort (*Marsilea quadrifolia*)

Unlike most ferns, which generally produce their spores in clusters on the underside of the leaf or frond, the water-clover houses its spores in 1 or 2 hard, brown bean-shaped structures known as sporocarps. These sporocarps are produced on a slender brownish stalk that rises near the base of the leaf stalk. Each sporocarp has many compartments, each containing numerous spores. When the spores are mature, the capsule bursts open vertically into halves, exposing the compartments, which are linked by a gelatinous ring. This ring floats on the water with the spore masses attached.

Duckweed: *Lemna minor*

Duckweed Family: Lemnaceae

The green mantle of the stagnant pool

— William Shakespeare *King Lear*

In 1936 a strange phenomenon occurred in the Sudbury and Charles Rivers in Massachusetts. "Millions of Small Plants Cover Charles" one newspaper headline read. "Millions of tiny plants, resembling shamrocks in color and appearance turned the surface of the 5 miles of the Auburndale section of the Charles River bright green yesterday," the article reported. It was soon discovered that the same condition existed in the Sudbury, yet the two rivers had no connection whatever.

The green phenomenon proved to be an explosion of the duckweed plant (*Lemna minor*), one of the world's smallest flowering plants, and its causes have never been fully understood. It is believed today that a correlation exists between the spread of duckweed and the presence in the water of soluble nitrates from sewage. Soluble ni-

trates turn the naturally acidic waters of eastern Massachusetts nearly neutral, a condition that is favorable to duckweed.

The genus *Lemna* is found throughout the world. *Lemna minor* is common in drainage ditches and in the meadow at the Arboretum.

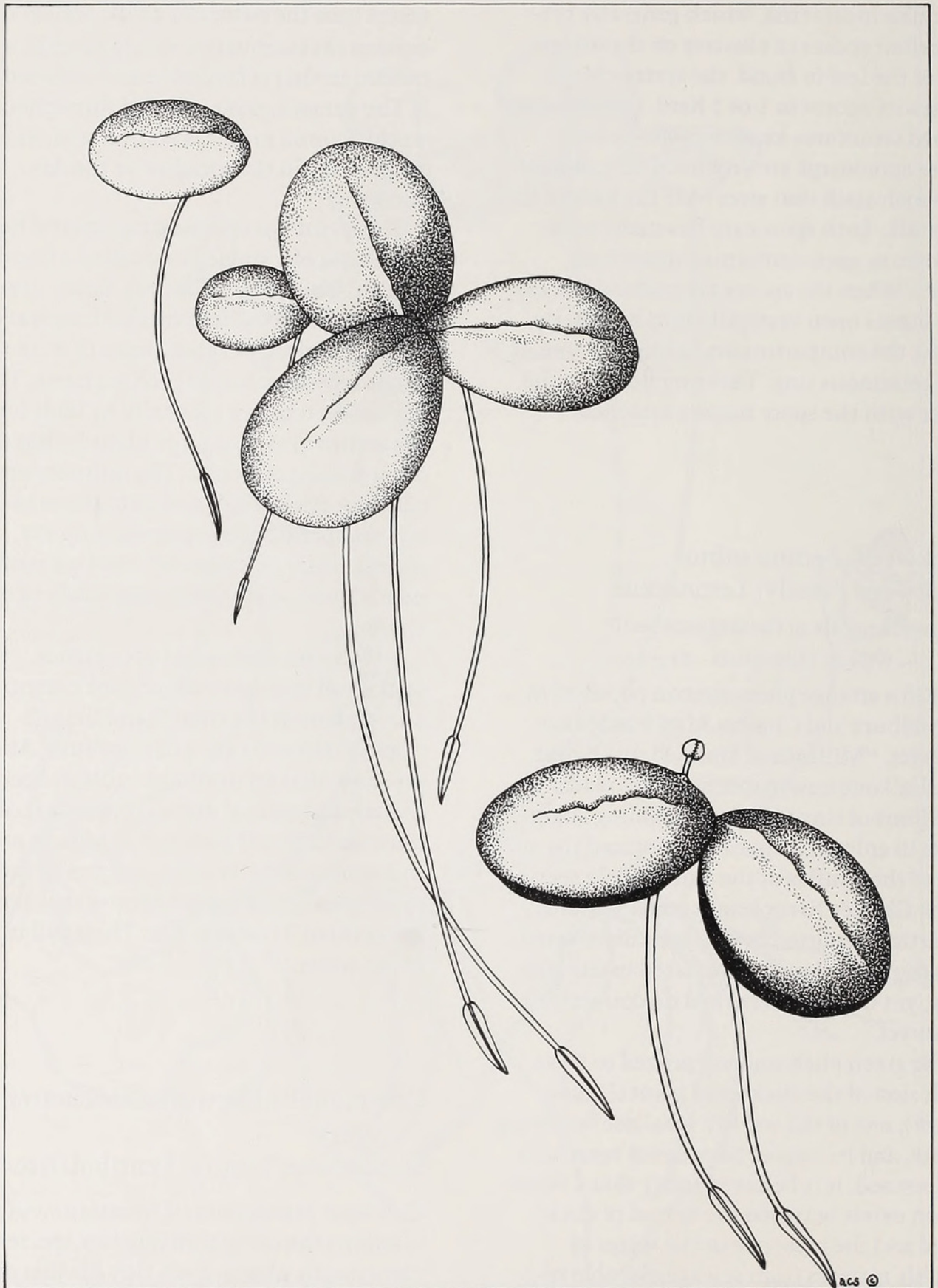
This plant is a free-floating aquatic herb consisting of a single body called a frond or thallus. This small, flat oval, rarely over ¼ inch long, is not differentiated into leaves or stem. It is often purplish beneath with a single root attached to each segment. The thallus reproduces asexually by buds forming groups of two or more plant bodies that often remain attached. The inflorescence is naked or enclosed in a membranous spathe; it is comprised of one pistillate flower, consisting solely of one pistil, and two staminate flowers, each consisting solely of one stamen.

Despite its unpleasant appearance, duckweed may have significant potential as a crop plant in the tropics and the subtropics, where its growth is profuse. Analyses show that its nutritive value in both human and animal diets exceeds that of most agricultural plants; it is high in protein and amino acids. *Wolffia*, a genus in the same family, contains a species that is eaten in northern Thailand. The Thais call it "eggs of the water."

Common Bladderwort: *Utricularia vulgaris*

Bladderwort Family: Lentibulariaceae

Common bladderwort (*Utricularia vulgaris*) is among the comparatively few species of carnivorous plants. Each tiny bladder on the



Duckweed (*Lemna minor*)

underwater stem has an opening that functions as a trap door. The "door" is pressure sensitive and when touched opens in 1/250th of a second. When the prey enters, the door closes, trapping it within. Even when it is too large to be contained inside the bladder, the prey is often held at the opening and ingested by the plant over time. The smallest traps can catch microscopic single-celled protozoans and rotifers, while larger traps can catch fish fry, water fleas, and mosquito larvae. Small aquatic plants, such as duckweed (*Lemna*) and watermeal (*Wolffia*), also have been found in the bladders.

Common bladderwort is distributed throughout the eastern and midwestern United States and north to southern Labrador and Alaska. Although it is common in New England, it was found at the Arboretum for the first time only last year, growing in shallow water in the smallest pond.

This free, submerged hydrophytic plant lacks roots and grows freely and unattached in the water, usually just beneath the surface. The plant overwinters by forming small clusters of crowded modified leaves called turions. In cold regions, where the plant must lie dormant for several months and produce winter buds, it usually bears fewer flowers or none at all and produces fruit infrequently. The much dissected segments produce numerous bladders, and at the height of the summer as many as 100 can be seen on a single segment.

The erect scape arising above the water supports as many as 20 yellow flowers that resemble small snapdragons. The broad, somewhat lobed lower lip is delicately striped in brown and orange and is shorter than the curved spur. The seeds are brown and lustrous. See page 2 for illustration.

Skunk Cabbage: *Symplocarpus foetidus* Arum Family: Araceae

Skunk cabbage (*Symplocarpus foetidus*) is one of the plants in the Araceae family that produce enough heat to render themselves warmer than the surrounding air. An unusually high rate of respiration in these plants is responsible for the heat, which in the skunk cabbage is retained by the spongy tissue of the spathe. During the early stages of blooming, the clublike central spadix maintains a temperature of 36°F to 63°F higher than the surrounding air (Knutson 1979) for as long as two weeks. This period coincides with the maturation of pollen and egg cells, and the heat helps to attract such pollinators as bees. Although honeybees do not fly well if air temperature is below 65°F, they are known to visit skunk cabbage at temperatures as low as 42°F (Knutson 1979). The sweetish scent of the uninjured spathe may also attract bees. The offensive odor of the spathe when damaged is believed to attract insect pollinators.

The genus *Symplocarpus* has two widely disjunct areas of distribution: one in eastern North America, ranging from Quebec and Nova Scotia south through New England to Georgia and Tennessee and west to Minnesota and Iowa; the other is in eastern Asia.

Individual skunk cabbage plants are known to endure for a very long time, possibly even longer than the giant redwoods (Knutson 1979). The species is also present in Japan and on the eastern edge of the Asian continent. It grows in swamps, muddy ground, wet meadows, woods, and along stream banks, often in dense stands. It is not common at the Arboretum, but it can be found in moist, low-lying areas in the meadow along with cat-tails and irises.



Skunk Cabbage (*Symplocarpus foetidus*)

This perennial herb produces many large, clustered basal leaves, which appear as the spathe matures. These leaves, which may be up to 4 feet in length, are ovate and conspicuously veined. The flower buds develop on the underground rootstocks. By winter, shoots several inches in length emerge, with one flower bud per shoot forming as lateral offshoots of the leaf bud. Occasionally, the flower buds are lacking and the leafy shoot appears alone. The inflorescence, which is unique to the arum family, consists of the cream-colored spadix subtended by the fleshy green-purple or brown-spotted spathe. Many individual flowers cover the spadix, each comprising 4 perianth segments and 4 fleshy stamens opposite the segments. The seeds are embedded in the enlarged, spongy spadix.

Purple Loosestrife: *Lythrum salicaria*
Loosestrife Family: Lythraceae

Purple loosestrife (*Lythrum salicaria*), one of the more recent additions to the list of nuisance plants, is native to the eastern hemisphere, Eurasia, North Africa, and Australia. Palmer, in *The Spontaneous Flora of the Arnold Arboretum* (1930), described the plant as "common in low meadows and about ponds and sometimes in drier waste ground." Today it forms massive, spectacular colonies in the meadow, around pond margins, and along Bussey Brook and is eliminating some of the native wetland species.

Records show that by the late 19th and early 20th centuries this species had spread into the glaciated wetlands of North America and had become an aggressive weed in

some areas, particularly in the Great Lakes Region, the St. Lawrence River Valley, and the Hudson River Valley. South of the Wisconsin glacial border, however, it is scattered.

The first report of *Lythrum salicaria* in North America was in Pursh's *Flora Americae Septentrionalis* in 1814. Two eminent botanists, John Torrey and Asa Gray, were doubtful of the previous records, and Gray wrote in 1856 that its status as a native plant was "not clear." It was not until 1890, when the sixth edition of *Gray's Manual of Botany* was published, that the species was treated as a plant naturalized from Europe and therefore a nonindigenous member of the North American flora.

The first record of the plant in Massachusetts dates from 1844 in Cambridge. By 1900, purple loosestrife was recorded in several localities throughout the state, and it is believed to have been introduced in the Merrimac River Valley through seed washed out of wool at a plant near Abbots Mill at Graniteville.

The stem of this perennial grows to 5 feet, produces narrow, sessile leaves that are opposite to whorled and heart shaped at the base. The purplish red flowers are borne in a colorful spikelike panicle, up to 1 foot long, and bloom from June to late August. The perianth lobes vary in number from 4 to 6 with stamens either equal to or twice the number of the petals.



Purple Loosestrife (*Lythrum salicaria*)

Drooping Sedge: *Carex crinita*
Sedge Family: Cyperaceae

Although the hairy-looking spike drooping from the top of the stem of the sedge is not usually recognized as such, it is in fact a cluster of flowers, and the sedges belong to a flowering plant family, the Cyperaceae. Sedges are further designated as monocots, because they produce a single seed-leaf upon germination. Other monocots include irises, lilies, orchids, and rushes.

The drooping sedge (*Carex crinita*) is distributed throughout the eastern and southeastern United States and is the most common wetland species at the Arboretum. It grows in large clumps in the meadow and along pond margins and Bussey Brook.

Members of the sedge family are often mistaken for grasses (Gramineae). General differences between the two families are as follows: the sedges have solid stems, closed sheaths, and 3-ranked leaves, and the fruit has a seed that is not fused to the ovary wall. The grasses have hollow stems, open sheaths, 2-ranked leaves, and the fruit has a seed joined to the ovary wall.

The drooping sedge is a tufted, grasslike perennial herb with branching, scaly rhizomes. The leaves arise from the base and are long and slender. In the *Carex* inflorescence the male flowers are borne separately from the female flowers. The terminal spike is staminate, while the subterminal spikes are pistillate, and all these are produced on long, drooping stalks that become progressively longer from top to bottom. The female flowers are enclosed in a saclike structure called the perigynium. The stigmas protrude through the opening at the top of the perigynium, and as many as 130 perigynia may comprise one flower spike in this species.

The seeds are brownish and somewhat triangular in shape.

Turk's-cap Lily: *Lilium superbum*
Lily Family: Liliaceae

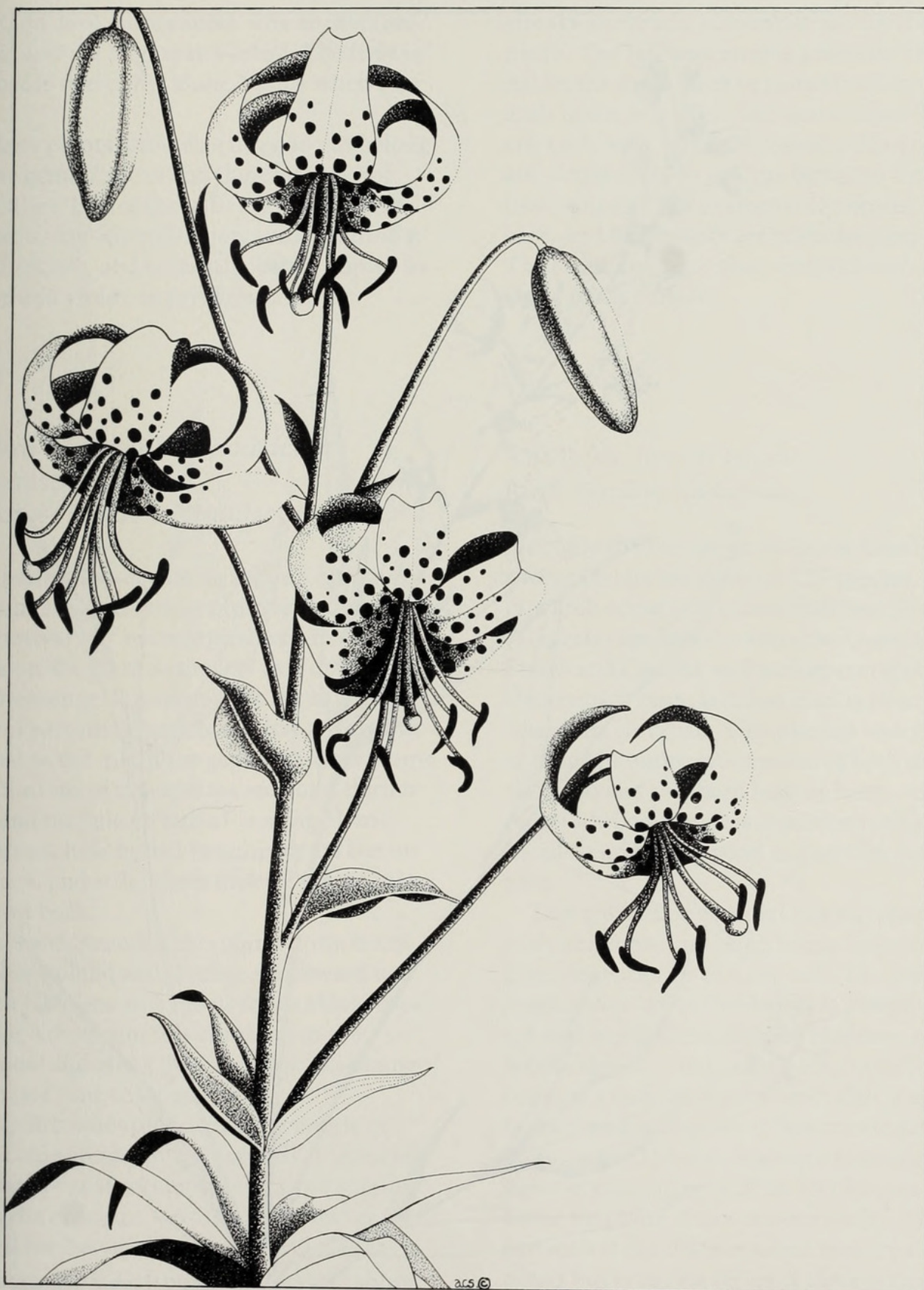
Superbum, which means magnificent in Latin, is an appropriate name for the turk's cap, the tallest and most spectacular of our native lilies. This species also has more flowers than any other native lily. The flower droops gracefully from the tip of the petioles, revealing deep reddish orange petals and sepals splashed with many shades of purple and rust-colored anthers. The stems sometimes reach 9 feet tall.

Lilium contains about 70 species widely distributed throughout the world, with their greatest concentration in warm temperate and subtropical regions. The turk's-cap grows in wet meadows and low grounds from New Brunswick to Minnesota and south to Florida, Tennessee, and Missouri and tends to exhibit a more colorful display in moist soil. It is common in the meadow at the Arboretum and blooms from June until August.

This perennial herb has a stout, erect stem up to 9 feet tall. The principal leaves are arranged in whorls up to the inflorescence. The smooth, narrow blades are parallel veined and taper at the ends. The spectacular red-orange flowers are produced in an umbel or terminal raceme, with as many as 25 flowers nodding from long pedicels. The perianth segments are strongly recurved, with the curvature beginning below the middle of the segment. Newly opened flowers may not show much curvature, but they do so eventually, exposing the pale green



Drooping Sedge (*Carex crinita*)



Turk's-Cap Lily (*Lilium superbum*)



Yellow Loosestrife (*Lysimachia terrestris*)

base and deep purple spots. The anthers are linear and the stigma is 3-lobed. The fruit is a capsule that splits along 3 lines when mature.

Many plants known as lilies do not belong to the genus *Lilium* and therefore are not true lilies. Lily of the valley belongs to *Convallaria*, day-lily to *Hemerocallis*, corn-lily to *Clintonia*, and trout-lily, better known as dog-tooth violet, to *Erythronium*.

Yellow Loosestrife: *Lysimachia terrestris*

Primrose Family: Primulaceae

The yellow loosestrife, or swamp candle (*Lysimachia terrestris*), often reproduces vegetatively by bulbels produced in such areas on the plant as the leaf axis or the inflorescence. Linnaeus took these bulbels to be a parasitic mistletoe species, which he placed in the mistletoe genus, *Viscum*. Some populations of this species are quite floriferous and include no bulbel-bearing plants; others include bulbel-bearing plants but no flowers; and still others include plants that exhibit both.

In North America this plant grows from Newfoundland and Quebec southward to South Carolina and westward to Minnesota. At the Arboretum it is common in the meadow and along Bussey Brook, blooming from late June to August.

The rhizomes produce erect, simple or branching stems up to 3 feet tall. The leaves on the lower stem are scalelike and smaller than the opposite, sessile narrow leaves produced further up the stem. The blades are punctate with dark purplish dots and short

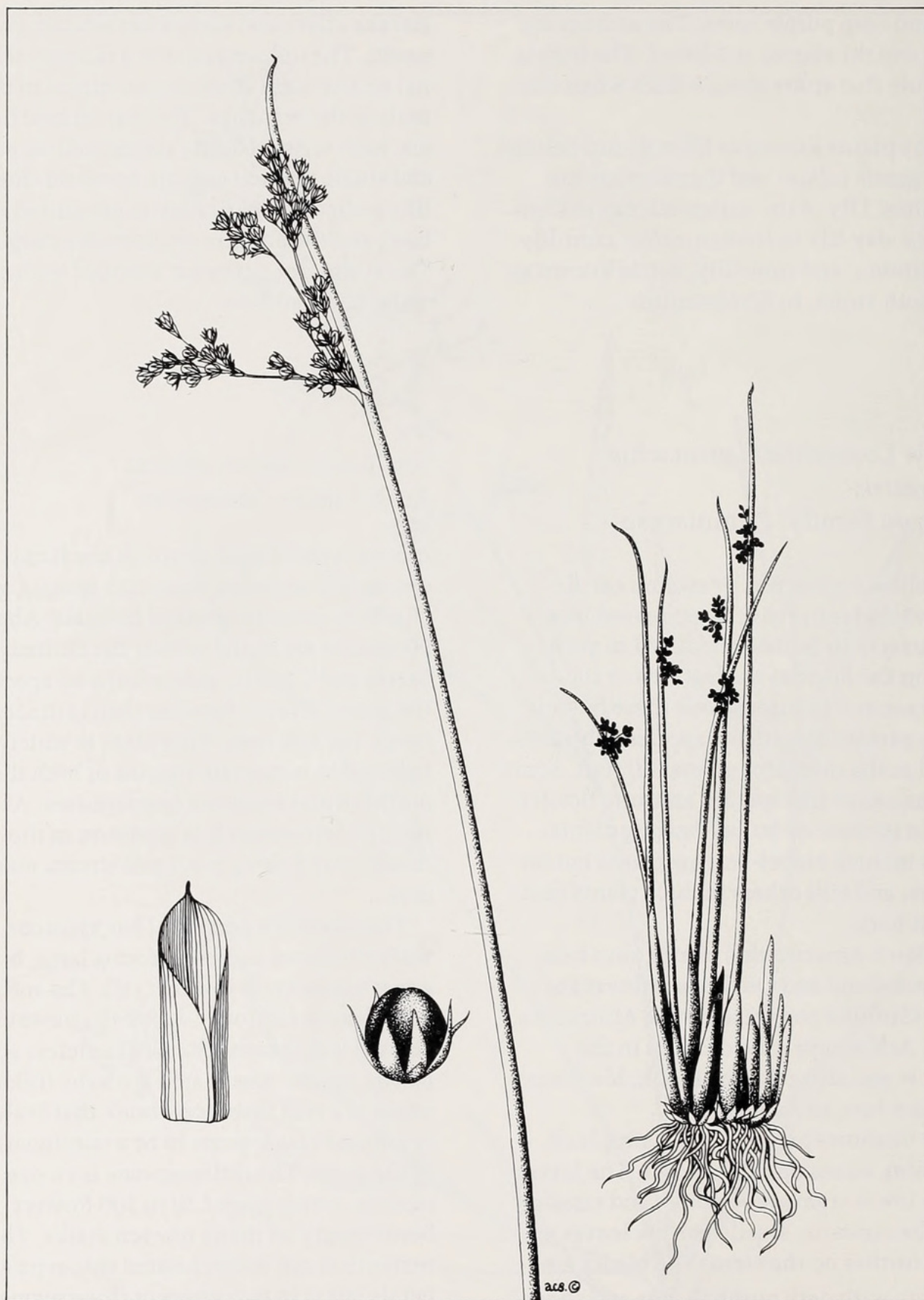
streaks above and somewhat whitish beneath. The inflorescence is a raceme, terminal on the main stem or sometimes in the axils of the branches. The star-shaped flowers, each with 5 basally united yellow petals and single maroon eye, are borne on thread-like pedicels. The filaments are united at the base, and the anthers are lavender-purple. The seeds are somewhat rounded with a shiny black surface.

Soft Rush: *Juncus effusus*

Rush Family: Juncaceae

Juncus is the largest genus in the family Juncaceae and includes about 225 species, most of which occur in wetland habitats. About 90 species are found within the United States and Canada, and perhaps no species of the genus is more familiar than is *Juncus effusus*, the soft rush. This plant is widely distributed in temperate regions of both the northern and southern hemispheres. At the Arnold Arboretum it is common in the meadow and along pond and stream margins.

This grasslike perennial has vigorous, scaly rhizomes and often forms large, bright green tussocks up to 4 feet tall. The soft, basal leaves are quill-like, with chestnut-colored leaf sheaths that are bladeless and bristle tipped. Associated with the inflorescence is a stiff involucre bract that is sharply pointed and appears to be a continuation of the stem. The inflorescence is an open panicle, consisting of 30 to 100 flowers borne singly on many uneven stalks. The perianth is not differentiated into sepals and petals but is in two series of three segments



Soft Rush (*Juncus effusus*)

each. The outer whorl is keeled and the inner whorl flat. The seed capsule, light brown and smooth, is 3-sided and rounded at the apices. The seeds are small with darker short-pointed extremities.

For more than a century the soft rush has been a wetland crop in Taiwan, China, Korea, and Japan, where the dried stems are used for floor matting.

white, pink, or purple, is provided by the cluster of stamens or pistils. (See inside front cover for illustration.)

Tall Meadow-Rue: *Thalictrum polygamum*

Buttercup Family: Ranunculaceae

Tall meadow-rue (*Thalictrum polygamum*) is one of the most easily located plants in the field, as its masses of soft, feathery white flowers rise above most other wetland plants. This perennial herb grows to 11 feet tall and can be found in wetlands, swamps, and low thickets from Newfoundland to Ontario, south to Nova Scotia, Georgia, and Tennessee. At the Arboretum it is common in the meadow and along Bussey Brook, blooming from June through September.

The stems of tall meadow-rue are light green at first but become tinged with magenta later in the season. The leaves are pinnate, with 3 or more leaflets. The large, graceful, terminal panicles can be rounded or flat at the top. Some plants display pure white flowers while others produce purplish flowers. Meadow-rue includes perfect (containing both stamens and pistils) and unisexual (containing only stamens or only pistils) flowers on single plants. Botanists have termed this condition *polygamous*, and the species name *polygamum* refers to this. The achenes (small, dry, one-seeded fruits) are short-stalked. This species has no petals, so the color of the flower, which can be

A Species List of Aquatic and Wetland Plants Observed in the Arboretum Since 1930

Monocotyledons (Monocotyledoneae)

Plants with all or some of the following characters: vascular bundles distinct and scattered in the internodes; cotyledon, or seed leaf, solitary; flowers with parts usually in 3s or multiples of 3; leaves parallel-veined; fibrous root system; plants usually herbaceous.

Alismataceae — Water-Plantain Family

Alisma subcordatum Raf. — water-plantain *p m s*

Alisma triviale Pursh — water-plantain *p m s*

Sagittaria latifolia Willd. — duck-potato *p m s*

Araceae — Arum Family

Acorus calamus L. — sweetflag *p s*

Peltandra virginica (L.) Schott & Endl. — arrow-arum *p*

Symplocarpus foetidus (L.) Nutt. — skunk cabbage *m*

Callitrichaceae — Water-Starwort Family

Callitriche heterophylla Pursh — water-starwort *p s*

Cyperaceae — Sedge Family

Carex annectens Bickn. — yellow fox sedge *p s*

Carex blanda Dew. *m*

Carex canescens L. *m s*

Carex conoidea Schkuhr — silvery sedge *m s*

Carex crinita Lam. — drooping sedge *m s*

Carex debilis Michx. *p m s*

Carex echinata Murr. *m*

Carex hirta L. *m*

Carex hystricina Muhl. — porcupine sedge *m s*

Carex lanuginosa Michx. *m*

Carex lupulina Muhl. *p*

Carex lurida Wahlenb. — sallow sedge *m*

Carex pallescens L. — pale sedge *m s*

Carex panicea L. *m*

Carex scoparia Schkuhr *m*

Carex stricta Lam. — tussock sedge *m*

Carex stipata Muhl. — awl-fruited sedge *m*

Carex tribuloides Wahlenb. *p m s*

Carex vulpinoidea Michx. *m*

Cyperus strigosus L. — straw-colored sedge *p m*

Eleocharis acicularis (L.) R. & S. — least spike-rush *m*

Eleocharis calva Torr. *p*

Eleocharis geniculata (L.) R. & S. *p*

Eleocharis obtusa (Willd.) Schultes — blunt spike-rush
p m s

p pond

m meadow

s stream

Eleocharis ovata (Roth) R. & S. *p*

Eleocharis palustris (L.) R. & S. *p m*

Rynchospora capitellata (Michx.) Vahl — beak rush
p m

Scirpus atrocinctus Fern. *m*

Scirpus atrovirens Willd. — dusky bulrush *m s*

Scirpus cyperinus (L.) Kunth — wool-grass *m s*

Scirpus expansus Fern. *p m s*

Scirpus polyphyllus Vahl *m*

Gramineae — Grass Family

Alopecurus geniculatus L. *m*

Alopecurus pratensis L. — meadow-foxtail *m s*

Anthoxanthum odoratum L. — sweet vernal grass *m*

Calamagrostis canadensis (Michx.) Nutt. — blue-joint
grass *p m s*

Cinna arundinacea L. — wood reedgrass *p m s*

Dactylis glomerata L. — orchard grass *m*

Glyceria acutiflora Torr. *p*

Glyceria canadensis (Michx.) Trin. — rattlesnake-
grass *s*

Glyceria grandis S. Wats. — reed-meadow grass *p m*

Glyceria laxa Scribn. — northern manna-grass *p m*

Glyceria pallida (Torr.) Trin. — pale manna-grass *p*

Glyceria striata (Lam.) Hitchc. — fowl-meadow grass
p m s

Leersia oryzoides (L.) Sw. — rice-cutgrass *p m s*

Leersia virginica Willd. — whitegrass *p s*

Muhlenbergia schreberi J. F. Gmel — drop-seed grass *m*

Phalaris arundinacea L. — reed-canary grass *m s*

Phleum pratense L. — timothy *m*

Poa compressa L. — Canada bluegrass *m*

Poa palustris L. *m s*

Poa pratensis L. — Kentucky bluegrass *m*

Spartina pectinata Link — cord-grass *s*

Iridaceae — Iris Family

Iris pseudacorus L. — yellow iris *p m s*

Iris versicolor L. — common blue flag *p m s*

Sisyrinchium atlanticum Bickn. *m*

Juncaceae — Rush Family

Juncus bufonius L. — toad-rush *m*

Juncus canadensis J. Gay *m*

Juncus dichotomus Ell. *m*

Juncus effusus L. *p m s*

Juncus marginatus Rostk. *m*

Juncus tenuis Willd. — tufted rush *m*

Lemnaceae — Duckweed Family

Lemna minor L. — duckweed *p s*

Liliaceae — Lily Family

Lilium canadense L. — Canada lily *m*

Lilium philadelphicum L. — wood-lily *m*

Lilium superbum L. — turk's-cap lily *m*

Uvularia sessilifolia L. — wild-oats *s*

Orchidaceae — Orchid Family

Habenaria lacera (Michx.) Lodd. — ragged orchis *m**Habenaria psycodes* (L.) Spreng. — purple-fringed orchis *s**Spiranthes cernua* (L.) Richard — nodding ladies-tresses *m s**Spiranthes gracilis* (Bigel.) Beck — southern slender ladies-tresses *m**Spiranthes tuberosa* Raf. — little ladies-tresses *m*

Potamogetonaceae — Pondweed Family

Potamogeton epihydrus Raf. — pondweed *p**Potamogeton foliosus* Raf. — pondweed *p*

Sparganiaceae — Bur-Reed Family

Sparganium eurycarpum Engelm. — bur-reed *p*

Typhaceae — Cat-tail Family

Typha latifolia L. — broad-leaved cat-tail *p m s*

Dicotyledons (Dicotyledoneae)

Plants with all or some of the following characters: vascular bundles of stem usually in a ring (sometimes scattered in a few aquatics); cotyledons usually 2 or rarely 1 in a few aquatics; flowers with parts usually in multiples of 2, 5, or more; leaves pinnately or palmately veined; roots usually fibrous; plants herbaceous or woody.

Asclepiadaceae — Milkweed Family

Asclepias incarnata L. — swamp-milkweed *p s*

Balsaminaceae — Touch-Me-Not Family

Impatiens capensis Meerb. — spotted touch-me-not *p m s*

Boraginaceae — Borage Family

Myosotis scorpioides L. — forget-me-not *s*

Caprifoliaceae — Honeysuckle Family

Sambucus canadensis L. — elderberry *m*

Chenopodiaceae — Goosefoot Family

Chenopodium glaucum L. — oak-leaved goosefoot *m*

Compositae — Composite Family

Aster laevis L. — smooth aster *m**Aster lateriflorus* (L.) Britt. *m s**Aster novi-belgii* L. — New England aster *p m s**Aster puniceus* L. — purple-stemmed aster *m s**Aster simplex* Willd. — tall white aster *p**Aster vimineus* Lam. — small white aster *m s**Bidens cernua* L. — stick-tight *p m s**Bidens connata* Muhl. — beggar-ticks *p m s**Bidens frondosa* L. — beggar-ticks *p m s**Bidens vulgata* Greene — beggar-ticks *p m s**Eupatorium dubium* Willd. — Joe-pye-weed *p**Eupatorium perfoliatum* L. — thoroughwort *m**Solidago canadensis* L. — Canadian goldenrod *m s**Tanacetum vulgare* L. — tansy *p m s*

Convolvulaceae — Convolvulus Family

Convolvulus sepium L. — hedge bindweed *m**Cuscuta gronovii* Willd. — common dodder *m s**Cuscuta pentagona* Engelm. *s*

Cruciferae — Mustard Family

Barbarea vulgaris R. Br. — yellow rocket *m s**Diplotaxis muralis* (L.) DC. — sand rocket *p**Rorippa nasturtium-aquaticum* (L.) Britten & Rendl.(*Nasturium officinale* R. Br.) *p s**Rorippa palustris* (L.) — Bess-marsh cress *p m*

Euphorbiaceae — Spurge Family

Acalypha virginica L. — three-seeded mercury *m*

Gentianaceae — Gentian Family

Gentiana crinita Froel. — fringed gentian *m**Hypericum boreale* (Britt.) Bickn. *p**Hypericum canadense* L. *m**Hypericum majus* (Gray) Britt. *m**Hypericum mutilum* L. — slender St. John's-wort *p m s*

Labiatae — Mint Family

Lycopus americanus Muhl. — cut-leaved water-horehound *p m s**Lycopus uniflorus* Michx. — water-horehound *p m s**Lycopus virginicus* L. — water-horehound *s**Mentha arvensis* L. — field mint *p m s**Prunella vulgaris* L. — selfheal *m**Scutellaria lateriflora* L. — mad-dog skullcap *m*

Lentibulariaceae — Bladderwort Family

Utricularia vulgaris L. — common bladderwort *p*

Lobeliaceae — Lobelia Family

Lobelia cardinalis L. — cardinal flower *p**Lobelia siphilitica* L. — great blue lobelia *m s*

Lythraceae — Loosestrife Family

Decodon verticillatus (L.) Ell. — swamp loosestrife *p**Lythrum salicaria* L. — purple loosestrife *p m s*

Malvaceae — Mallow Family

Malva moschata L. — musk-mallow *p*

Nymphaeaceae — Water-Lily Family

Nymphaea odorata Ait. — fragrant water-lily *p*

Onagraceae — Evening-Primrose Family

Epilobium coloratum Biehler — purple-stemmed willow-herb *m s**Ludwigia palustris* (L.) Ell. — water-purslane *p**Oenothera biennis* L. — common evening primrose *m**Oenothera perennis* L. — sundrops *p m*

Polygonaceae — Buckwheat Family

- Polygonum amphibium* L. — water-smartweed *p*
Polygonum arifolium L. — halberd-leaved tearthumb
p m
Polygonum aviculare L. — knotweed *m*
Polygonum coccineum Muhl. — swamp smartweed
p m s
Polygonum hydropiper L. — water-pepper *p m s*
Polygonum hydropiperoides Michx. — mild water-pepper *p m*
Polygonum lapathifolium L. *p*
Polygonum punctatum Ell. — water-smartweed *m*
Polygonum sagittatum L. — arrow-leaved tearthumb
p m
Rumex obtusifolius L. — bitter dock *m*

Pontederiaceae — Pickerelweed Family

- Pontederia cordata* L. — pickerelweed *p*

Primulaceae — Primrose Family

- Hottonia inflata* Ell. — featherfoil *p*
Lysimachia quadrifolia L. — whorled loosestrife *m*
Lysimachia terrestris (L.) BSP. — yellow loosestrife *m*

Ranunculaceae — Buttercup Family

- Ranunculus acris* L. — tall buttercup *m*
Ranunculus repens L. — creeping buttercup *m s*
Thalictrum polygamum Muhl. — tall meadow-rue *m s*

Rosaceae — Rose Family

- Rubus hispidus* L. — dewberry *m*

Rubiaceae — Madder Family

- Galium palustre* L. — marsh bedstraw *m*
Galium tinctorium L. — marsh bedstraw *m*

Saxifragaceae — Saxifrage Family

- Penthorum sedoides* L. — ditch-stonecrop *m*

Scrophulariaceae — Figwort Family

- Agalinis paupercula* (Gray) Pennell — small gerardia
m s
Agalinis tenuifolia (Vahl.) Raf. — slender gerardia *m s*
Chelone glabra L. — turtlehead *p m s*
Lindernia dubia (L.) Pennell — false pimpernel *p m*
Mimulus ringens L. — monkey-flower *m s*
Veronica officinalis L. — common speedwell *m*
Veronica scutellata L. — marsh speedwell *p*

Solanaceae — Nightshade Family

- Solanum dulcamara* L. — bittersweet nightshade *s*

Trapaceae — Water-Chestnut Family

- Trapa natans* L. — water-chestnut *p*

Umbelliferae — Parsley Family

- Cicuta bulbifera* L. — water hemlock *p s*
Cicuta maculata L. — spotted cowbane *p m s*
Hydrocotyle americana L. — water pennywort *m*

- Sium suave* Walt. — water-parsnip *p m s*

Urticaceae — Nettle Family

- Pilea pumila* (L.) Gray — clearweed *m*

Verbenaceae — Vervain Family

- Verbena hastata* L. — blue vervain *m*

Violaceae — Violet Family

- Viola cucullata* Ait. — marsh blue violet *m*
Viola lanceolata L. — lance-leaved violet *p m s*
Viola pallens (Banks) — brainerd-sweet white violet
m s
Viola papilionacea Pursh — common blue violet *m*

Pteridophytes (Pteridophyta)

Plants that are fernlike, rushlike, mosslike, or quill-leaved and have no seeds or flowers but reproduce by spores.

Equisetaceae — Horsetail Family

- Equisetum arvense* L. — field horsetail *p*
Equisetum fluviatile L. — water horsetail *p*
Equisetum sylvaticum L. *m*

Lycopodiaceae — Club Moss Family

- Lycopodium complanatum* L. — trailing ground-pine
m s

Marsileaceae — Pepperwort Family

- Marsilea quadrifolia* L. — pepperwort *p*

Osmundaceae — Flowering Fern Family

- Osmunda cinnamomea* L. — cinnamon-fern *s*
Osmunda claytoniana L. — interrupted fern *m s*
Osmunda regalis L. — royal fern *m s*

Polypodiaceae — Fern Family

- Onoclea sensibilis* L. — sensitive fern *p m s*
Dryopteris thelypteris (L.) Gray — marsh shield fern *m*

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Patricia A. Dalton is the author of *Wildflowers of the Northeast in the Audubon Fairchild Garden (Audubon Center in Greenwich)*. She has been updating the records of the living collections at the Arnold Arboretum during the past two years.

Alejandro Novelo R. is a taxonomist specializing in aquatic plants at the Universidad Nacional Autonoma de Mexico in Mexico City.

Amy Storey is an artist and botanical illustrator living in Victoria, British Columbia.



Dalton, Patricia A. 1983. "Aquatic and Wetland Plants of the Arnold Arboretum." *Arnoldia* 43(2), 7-44.

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