

CHAPTER IX.



**The Aquatic Plants of Freshwater**

## AQUATIC PLANTS

A number of generally procurable aquatic plants thrive at all seasons under the unnatural conditions of the household aquarium, and not only add to its beauty by their graceful forms and fine colors but also fulfill the imperative requirement of properly aerating or oxygenating the water, whereby supplying to the animal inmates the air necessary to their existence. These plants are sought by the aquarist, and, as they belong to different genera, they will be described not in their botanical order but in the order in which they most effectually serve these purposes. Those which grow rapidly and for the greater part of the year have their foliage submerged, taking the required carbon and nitrogen from the soil and water, also liberate the greatest amount of oxygen to remain in available form in the water. Experiment has proven that the ribbon-leaved *Sagittarias* are in every way the best aquarium plants, with *Cabomba*, *Giant Anacharis* and *Vallisneria* next following, all hardy and easily propagated; while in further order of their utility, satisfactory growth and endurance are *Myriophyllum*, *Nitella* and *Anacharis*; *Ludwigia*, *Ceratophyllum*, *Hippuris*, *Fontinalis* and *Potamogeton*; *Callitriche*, *Utricularia*, *Proserpinaca*, *Heterenia* and *Hottonia*; and finally the Lilies, Water-poppies and other aquatic and semi-aquatic plants either not entirely submerged or floating.

The orders to which the aquarium plants belong are:—*Sagittaria* to the *Alismaceæ*; *Cabomba* to the *Nympheaceæ*; *Vallisneria* to the *Vallisneriaceæ*; *Myriophyllum* to the *Halorrhagidaceæ*; *Ludwigia* to the *Onagraceæ*; *Nitella* and *Chara* to the *Characeæ*; *Anacharis* to the *Vallisneriaceæ*; *Ceratophyllum* to the *Ceratophyllaceæ*; *Hippuris* to the *Halorrhagidaceæ*; *Fontinalis* to the *Musci*; *Potamogeton* to the *Naiadaceæ*; *Callitriche* to the *Callitrichaceæ*; *Utricularia* to the *Lentibulaceæ*; *Proserpinaca* to the *Halorrhagidaceæ*, and *Heterania* and *Hottonia* to the *Primulaceæ*.

It may be noted that when it is the habit of an aquatic plant to carry part of its foliage above the surface of the water, better results will be obtained by rooting it in soil instead of in the sand or pebbles and covering the surface with a layer of pebbles; for, though many will thrive either rooted in the pebbles or floating unattached, as they derive nearly all of their nourishment from the water, when set in shallow dishes with soil they are more likely to root, thrive and develop satisfactorily in the aquarium.

## SAGITTARIA

A small genus of very variable plants of which the number of species differs with different authorities, and, though there are quite 100 specific names, Micheli has reduced them to 13 species, 4 of which are doubtful. They are widely distributed in temperate and torrid regions, and in shallow water are effective foliage plants, most of which have the arrowshaped leaves from which the name is derived, with small buttercuplike flowers in successive whorls on an erect scape. They are perennials of easy culture, many propagating both by runners and seeds, grow on the muddy bottoms of shallow streams, ponds and lakes, raising their leaves above the water. In the beds of rapid streams, when exposed to a vigorous current, the leaf blades are almost entirely changed to the form of a spade, and not infrequently all traces of lamina are absent and the leaf is lengthened to form a limp, flat, pale-green ribbon much resembling *Vallisneria*. This is characteristic of *S. natans*, *S. pusilla* and *S. sinensis* or *S. gigantea*, which are grown in aquaria and successfully in shaded ponds in summer.

*Sagittaria natans* (Mul.) or Floating or Ribbon Arrowhead, Fig. 112, is a variety of *S. pusilla* and is the best of all aquarium plants, generally to be had of dealers in aquatics, who propagate it in tanks and aquaria. It originates in a tuft on the bottom of the water and spreads by runners usually in the direction of the strongest light. The clear-green linear leaves are nerved their entire length and



FIG. 112  
Floating Arrowhead,  
*Sagittaria natans*, with rhizoid, blossom, fruit, details of leaf  
and a floral leaf. Reduced one-third.

exhibit clearly veined and distinctly outlined cellular structure, grow to and float immediately below or on the surface of the water, and in midsummer develop lanceolate emersed and floating floral leaves resembling those of other species of the Arrowheads. The small, inconspicuous white flowers have three petals with yellow centres and are developed in 2 to 4 whorls about a long floating scape. These extend above the surface until the flowers are fertilized, but the fruit ripens on or below the surface of the water. *S. natans* is an exotic which may be obtained from dealers and is in such constant demand that its extensive propagation would be a profitable industry. In replanting it is advisable to take off the partly decaying outer leaves that the younger growth may become more active.

*Sagittaria pusilla* (Nutt.) or Slender or Subulate Arrowhead is similar to *S. natans* but a more slender-leaved plant, sometimes but a few inches high, with narrow linear submerged and lanceolate floating leaves, and the flowers in one whorl  $\frac{1}{2}$  to  $\frac{3}{4}$  inches across, with broad filaments. Grows from New York to Alabama along the coast line and may be had of dealers.

*Sagittaria sagittifolia* (Linn.), (var. *S. floreplena*), or Long-beaked Arrowhead is a slender species with double flowers. This is a very variable form and many species have been referred to it, among them *S. sinensis* (Sims.) and *S. gigantea* (Hort.), the cultivated broad-leaved or giant aquarium sagittaria, and also the semi-aquatic Arrowhead, known to florists as *S. chinensis*. *S. sagittifolia* develops the sagittate leaves above the water in the flowering season and grows in swamps and streams in New Jersey and Pennsylvania to Alabama. *S. sinensis* is native south of the Carolinas on the Atlantic slope, and is also propagated in tanks and aquaria. *S. mulertii* is probably a hybrid of *S. natans* and *S. sinensis*. These Sagittarias are generally to be had of dealers.

*Sagittaria graminea* (Michx.) or Grass-leaved Arrowhead is an erect glabrous and simple-leaved plant rarely over 2 feet high, with flat broadly-linear or lance-elliptical and pointed leaves which are purplish in the Spring. The small flowers are white and in 2 or 3 whorls. Grows in shallow water from Newfoundland to Ontario and South Dakota, and south to Florida and Texas.

*Sagittaria latifolia* (*S. variabilis*) (Willd.) or Common American Arrowhead is variable in stature and shape of leaves, and may be only a few inches or 3 feet in height. The leaves are mostly sagittate with long basal lobes, but run to very narrow forms. The flowers are clear white with slender filaments. Common everywhere in ponds and lakes and may be had of dealers. Will thrive in the aquarium.

*Sagittaria lancifolia* (Linn.) or Lance-leaved Arrowhead is an erect and slender plant with the scape sometimes 4 to 5 feet high. The leaves are variable and may be lanceolate or narrow oblong, nerved with a thick midrib, and the flowers white in several whorls. Native in the United States from Delaware to the tropics.

*Sagittaria montevidensis* (Cham. and Schlecht) or Giant Arrowhead is a very large plant which may grow to 6 feet in height with leaf blades 1 to 2 feet long and 3 to 5 inches across. It is native to South America but has been naturalized in the southern part of the United States on both the Atlantic and Pacific coasts. It will grow in pots and thrives fairly well in the house. May be had of dealers. Quite generally used in Aqua-terraria.

For aquarium culture *Sagittaria* should be planted in bunches or clusters of three to five plants with the lower tufts deeply set directly into the sand or pebbles, so that the runners will remain covered. The younger plants will be the most likely to thrive in transplanting, as the older leaves usually die down in the fall and winter season, and sometimes after transplanting, but the tufts continually develop new foliage. Those species of *Sagittaria* which bear linear leaves and remain submerged the greater part of the year are preferable for the house aquarium; those which grow above the surface are handsome foliage plants rather than efficient oxygenators.

### CABOMBA

Of the aquarium plants those most generally obtainable are the Cabombas, the botanical name taken by Linnæus from the aboriginal Guianese, but popularly known as the Watershield, Fanwort, Fish Grass, Washington Grass, etc. It is a genus of three species, native to the warmer parts of America, all of similar habit, rooting in the mud and sand of streams, ponds and lakes, and having slender branching stems which grow to a length of several feet. It is a submerged plant except in mid-summer, when the flowers are borne above the water accompanied by the floating floral leaves. The submerged fanshaped leaves are finely dissected, opposite or sometimes verticillated, and the floral leaves small and entire. The tiny flowers are white and yellow, and the fruit enclosed in a prickly pod or casing.

*Cabomba caroliniana* (Gray.) *C. viridifolia* (Hort.) or Carolina Watershield, Fig. 113, is the species most usually to be obtained of dealers and is largely grown for the aquarium purposes in Maryland, District of

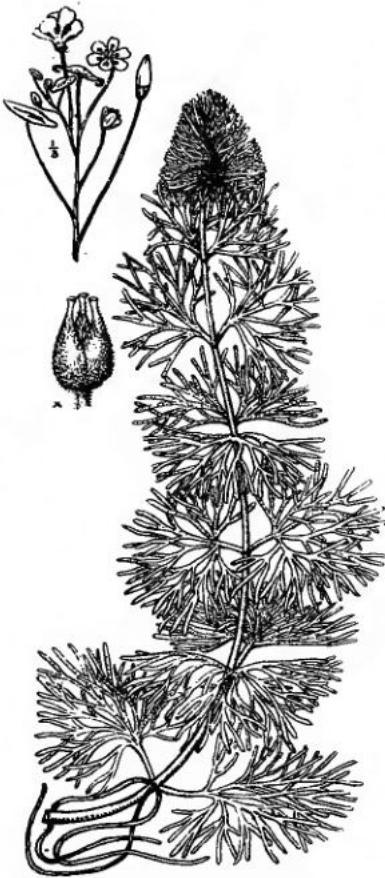


FIG. 113. Fanwort, *Cabomba caroliniana*, floral leaves, blossoms and fruit. Reduced one-third.

Columbia and North Carolina. It is a submerged creeping plant which develops rootlets on the lower part of the weak and flexible stems, having the bright-green submerged leaves opposite in pairs, finely dissected and fanlike in appearance, with small entire oblong-linear emersed leaves which appear when the plant blossoms. The small flowers are white with two yellow spots at the base of each of the 4 to 6 petals and with 4 to 6 stamens and 3 or 4 persistent sepals. The fruit is enclosed in a prickly pod with one seed in each cavity.

*Cabomba rosaeifolia* (Hort.) or Red-Stalked Watershield is a species similar to *C. caroliniana* but of a darker green color on the upper surface of the submerged leaves and the under surface a delicate pinkish-red. The stems are purplish-red and the flowers yellow with white stamens. It is a beautiful aquarium plant which retains its fine colors only in plentiful direct sunlight, and is not as hardy as the first-named species, thriving best when set into soil covered with pebbles.

*Cabomba aquatica* (Aubl.) or Tropical Watershield is a native tropical American species which has been introduced into the United States. It is of pale yellowish-green color, delicate and of handsome growth, as the fanshaped leaves are fuller and more spread and the joints closer to each other than in the other species. The floating floral leaves are nearly orbicular and the flowers yellow with pink stamens.

In the aquarium *Cabomba* will sometimes root but thrives as well when the stems are cleared of leaves a little distance at the ends and set into the sand or pebbles. Propagation is usually by pinching off pieces which will soon grow to considerable length, as at the joints along the stem rootlets will be projected which floating in the water sustain the plant. All the *Cabombas* are excellent oxygenators, and thrive in the household aquarium. They are offered by dealers bound in bundles with block-tin fastenings which serve as a weight to retain the plant in a natural upright position in the water, but it is advisable to separate them, planting

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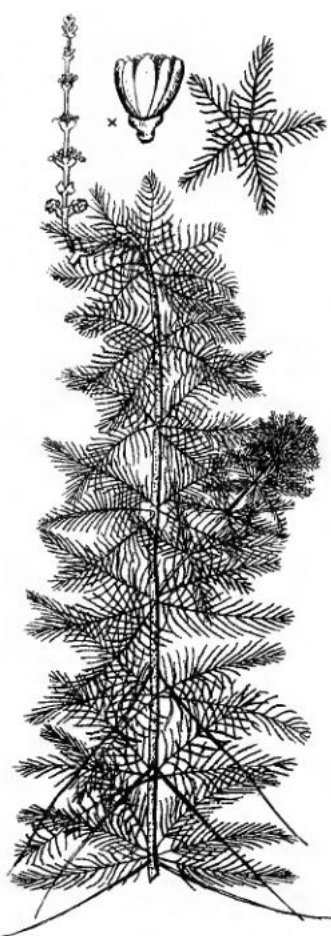


FIG. 115 Spiked Water-milfoil, *Myriophyllum spicatum*, whorled leaf, flower stalk and blossom. Reduced one-half.

are small and white, and the carpels rounded on the back with a deep and wide groove between; also thin, smooth and sometimes slightly rugose.

*Myriophyllum verticillatum* (Linn.) or Whorled Water-milfoil has the submerged leaves in more dense and crowded whorls of 3's and 4's, the capillary divisions very long and slender, usually finer than the above. The pectinate floral leaves are much longer than the purplish staminate flowers which have 8 stamens. May be found in both deep and shallow water from Quebec to Florida; west to Minnesota and in California.

*Myriophyllum alternifolia* (Gray) or Loose-flowered Water-milfoil has the submerged leaves in whorls of 3 to 5 or occasionally scattered; with finely pinnate capillary divisions and the spikes short, numerous or several on a branching stem. The floral leaves are ovate-linear, entire or minutely toothed and smaller than the 4-petaled, staminate pale rose-colored flowerets, with 8 stamens, and the carpels rounded on the back and deeply grooved. Found in Canada and the northern United States border and may be had of dealers.

*Myriophyllum nitschei* (Moenk) or Full-branching Water-milfoil, is a recently developed German aquarium variety having many-branched stems and beautiful long and slender leaves. It is named for the German fish-culturist, Nitsche and was developed by him from *M. verticillatum*. The slender leaf filaments are from 1½ to 3 inches long.

As previously stated, *Myriophyllum* will thrive in the aquarium but does not grow entirely satisfactory as it loses its fine appearance. The stems often become denuded of leaves, the plant assumes a dusky appearance and the younger growth is irregular and straggling. Its principal use is in the spawning of goldfishes and is introduced into the spawning-beds in loose bunches bound at the lower ends with metallic strips. For this purpose it is the best and most easily handled aquatic plant, though goldfishes sometimes prefer the roots of the Water Hyacinth for spawning.

*Proserpinaca*. This species is known botanically as *Myriophyllum proserpinacoides*, meaning forward creeping, and popularly as Parrot's feather



or Chilian Water-milfoil, Fig. 116. and emersed leaves are alike and grow in whorls of 4's and 5's about a creeping stem. The minute white auxillary and pistillate flowers have 4 stamens and develop 4 carpels. Small hairlike white bracts are borne at the base of the leaves and among the flowers. The finely pinnate, brilliantly green leaves and their graceful habit in growing above the water has made this a very desirable plant, but it is an indifferent oxygenator, as the submerged leaves soon slough off and the rapidly growing plant sends its green crown of leaves 4 to 6 inches above the surface of the water.

The pectinate-pinnatifid submerged

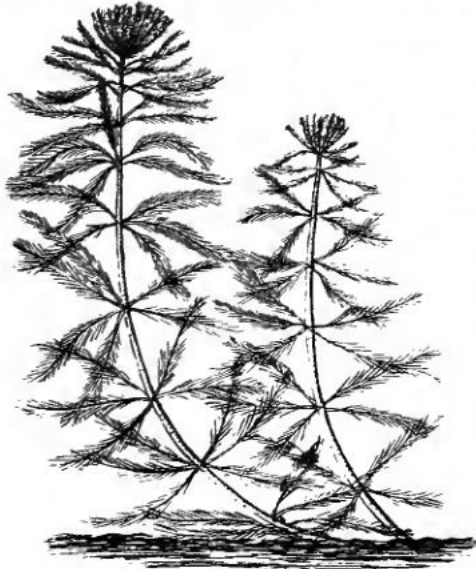


FIG. 116. Parrot's feather, *Myriophyllum proserpinacoides*. Emersed leaves. Reduced one-fourth.

The emersed leaves fold together at sundown to again open after sunrise. It is a beautiful semi-aquatic plant, and is extensively grown in watertight hanging baskets or jars where the fine single stems hang over the sides in handsome festoons.

In addition to the above described form there are two species of true *Proserpinaca* found in the United States, viz, *P. palustris* and *P. pectinata*, generally distributed in the Southern States.

*Proserpinaca palustris* (Linn.) or Common Mermaid-weed, Fig. 117, is not an indigenous plant but is now native to swamps from New Brunswick to Lake Huron and south to Florida, Iowa, Cuba and Central America. It is an aquatic herb with single stem and alternate dentate leaves about a weak stem. The perfect flowers are stigmatic above the middle with 3 or 4 styles, and the bony fruit has one seed in each

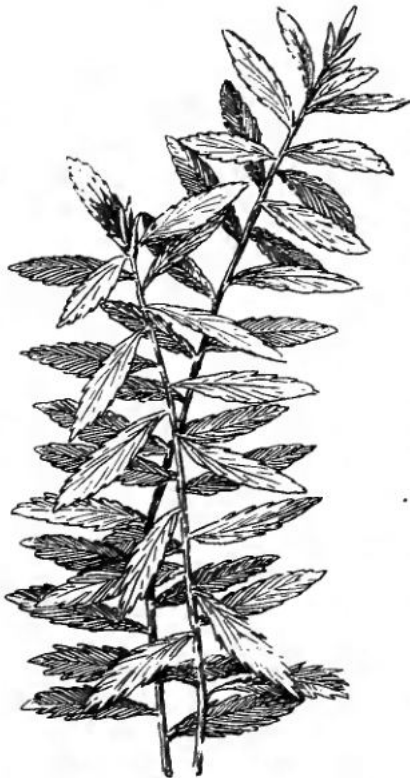


FIG. 117. Mermaid-weed, *Proserpinaca palustris*. Reduced one-third.

cavity. It is half-hardy plant introduced from Chili, of most delicate vivid green foliage composed of finely cut leaves. Flowers in July and August.

*Proserpinaca pectinata* (Lamm.) and *P. pectinacea* (T. and G.) or Cut-leaved Mermaid-weed may be found in sandy swamps near the coast from Massachusetts to Florida and west of Louisiana. Flowers June to September. Somewhat similar to the above. As will be seen by the illustration, these plants differ in appearance with Parrot's feather, the so-called *Proserpinaca* of the aquarium. They are tender-leaved plants and do not usually survive in household aquaria.

### LUDWIGIA

Of the so-called Swamp Loosestrife, named for the German naturalist Ludwig, there are about 25 aquatic or semi-aquatic species native to warm and temperate regions and abundant in the United States and North



FIG. 118. Marsh Purslain, *Ludwigia palustris*. Reduced one-third.

America; the most generally distributed being the following, of which the popular names indicate the character; and also several introduced species extensively cultivated for the aquarium. They are beautiful foliage plants of most attractive colorings. Those most generally to be obtained are:—*Isnardia palustris* or *Ludwigia palustris*, Marsh purslain or False Loosestrife; *L. polycarpa*, Many-leaved Ludwigia; *L. sphaerocarpa*, Globe-fruited Ludwigia; *L. glandulosa*, Cylindric-fruited Ludwigia; *L. linearis*, Linear-leaved Ludwigia; *L. alternifolia*, Alternate-leaved Ludwigia; *L. hirtella*, Hairy Ludwigia; *L. alta*, Wing-stemmed Ludwigia, and several Ludwigianthas and Isnardias, kindred species of similar habit and character; all fairly good oxygenators for aquarium and aqua-terrarium culture.

*Ludwigia palustris* (Linn.) or Marsh Purslain, Fig. 118, is a recumbent or floating aquatic, rooting in the mud of ditches and swamps, having opposite spatulate leaves, acute at the apex and narrowed into a slender petiole or stem; with axillary flowers having bractlets at the base of the calyx, triangular lobes and reddish petals. The branching and erect stems are of purplish-red color and the submerged leaves a golden-red and pale-green, and the emersed leaves a lustrous dark-green, all having distinct

red midribs and nerves. Grows abundantly in ditches, streams and ponds in the entire eastern and western sections of the United States. Flowers June to November.

*Ludwigia glandulosa* (Linn.) or Cylindric-fruited Ludwigia, Fig. 119, has larger, more acutely spatulate leaves than the foregoing, and is a very abundant form in still water along the Atlantic coast line. The seed carpels are either ovate or round in form. It is known to aquarists as Wild Ludwigia, and the sometimes crisped leaves somewhat resemble the cultivated *L. mulertii*.

*Ludwigia mulertii*, or Mulertt's Ludwigia, Fig. 120, is said to be a South American species, introduced as an aquarium plant by Mr. Hugo Mulertt. The leaves are more lance-oblong than *L. palustris* and the

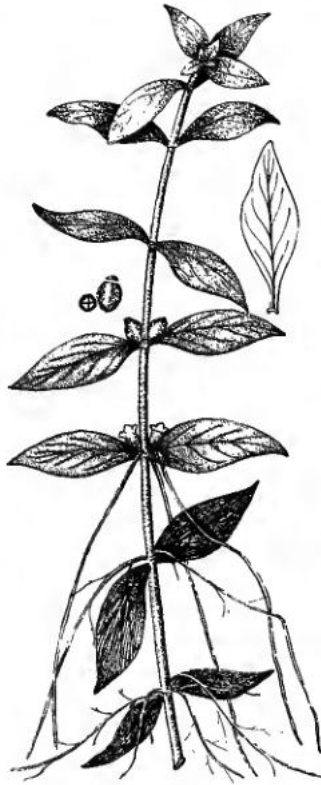


FIG. 119. Cylindric-fruited Ludwigia, *Ludwigia glandulosa*. Reduced one-third.



FIG. 120. Mulertt's Ludwigia, *Ludwigia mulertii*. Reduced one third.

brilliant coloring more permanent. The flowers are yellow. This plant has become widely distributed among growers of aquatic plants and is highly prized for its fine appearance and graceful habit in the aquarium. It is easily propagated from cuttings.

*Ludwigia alternifolia* (Linn.) or Alternate-leaved Ludwigia, is an erect semi-aquatic shrub and a fine foliage plant which grows to a height of 2 to

3 feet and bears yellow flowers  $\frac{1}{2}$  to  $\frac{3}{4}$  inch across, and alternate lanceolate entire or finely toothed leaves. Native to bogs in the Eastern and Middle States.

Ludwigia grows luxuriantly in ponds and basins and survives in the aquarium. It should be planted in shallow pots with sod soil or pond mud covered with pebbles. Its fine foliage and handsome colors make it a most desirable aquarium plant.

### NITELLA AND CHARA

These dainty aquatics, belong to the order of the Characeæ and are popularly known as Stoneworts. They are good oxygenators and beautiful aquarium plants but the more delicate of them should not be grown in the rearing tanks, as the young fishes may become entangled in their dense growth of hairlike stems and leaves. The generally distributed species are:—*Nitella flexilis*, *N. gracilis*, *N. tenuissima*, *Chara coronata*, *C. gymnopus* and *C. crinita*. Fig. 121.

*Nitella flexilis* (Ag.) or Flexible Nitella grows to a length of 20 to 30 inches in deep water and has a very slender erect and flexible stem with heavy and long threadlike node-bearing leaflets either single or divided into two abruptly pointed segments. The spores or fruitlets are formed in the middle of the branching leaves. Common in streams and still water.

*Nitella gracilis* (Sm.) or Slender Nitella, Fig. 122, is more hairlike than the above with the nodes more widely separated and the leaflets somewhat shorter. The spores are formed in the axils of the branching leaves. Usually to be found in ponds and streams. Morris Pond and Schuylkill River. A desirable aquarium plant.

*Nitella tenuissima* (Desv.) or Clustered Nitella has very slender 2 to 6 inch long sparingly branched stems and leaves in close verticils, three or four times divided, with the first segment the longer. Native in New York, New Jersey, Rhode Island and Michigan.

*Chara coronata* (Ziz.) or Crowned Chara, is a large Ceratophyllum-like aquatic, growing to 18



FIG. 121. Characeæ.  
Reduced one-third.  
1. *Chara coronata*.  
2. *Nitella flexilis*.  
3. *Chara gymnopus*.  
4. *Chara crinita*.  
5. *Nitella tenuissima*.  
6. *Nitella gracilis*.  
Reduced one-third.

and 20 inches in length, having a tufted stem from a single root. The jointed capillary leaves are often  $1\frac{1}{2}$  to 2 inches long and form in whorls of 8 to 11. Quite common throughout America on a sandy soil in shallow ponds and streams. This plant is sometimes mistaken for *Ceratophyllum*, but does not form the thick branching clusters of the latter plant.

*Chara gymnopus* (A. Br.) or Elegant Chara is a slender hairy-stemmed plant growing to a length of 2 feet in deep water and having the verticils of many-celled capillary leaves surrounded by a whorl of stipules. Each leaf usually bears three spores. This beautiful species is not uncommon, new localities coming constantly into notice.

*Chara crinita* (Wallr.) or Crumpled Chara somewhat resembles *N. tenuissima* and has rigid and erect stems and densely clustered, fascicled hairlike leaves. The tiny spores form in the axils of the leaves. Usually grows to a height of 6 to 12 inches. It occurs more usually in brackish water in the Eastern States, notably in Massachusetts and New York.

*Nitella gracilis* is a fine aquarium plant but thrives so abundantly that it forms dense masses impenetrable to fishes and snails. When introduced, it should be kept down by frequently removing the excess growth. It is a good oxygenator, as are all the vigorously growing submerged aquatics. The Charas do not grow as well in the aquarium as the Nitellas.

No other aquatics so plainly show the activity of plants in liberating oxygen as this group, particularly *Nitella*. When the growth is dense in strong sunlight, the oxygen bubbles form on the stems and leaves like suspended clusters of tiny pearls or slender strings of transparent glass beads; and when undisturbed, the plants appear as though hung with jewels. It has been observed that the Paradise-fish seems to prefer this oxygen to breathing the air and will occupy itself for hours in taking them into the mouth for gill absorption.

Together with the *Nitellas*, *Confervæ* and other large *Algæ* are usually introduced into the aquarium, the principal of these being the so-called Frog-spittle, *Nostocs* and *Zygnemæ*, hereafter more fully described. These seem rather to be associated with the *Characeæ* than parasitic, and



FIG. 122. Slender Nitella, *Nitella gracilis*, attached to a water soaked twig. Reduced one-third.

will develop even after the larger plants have been cleaned before introduction into the aquarium. The dense growth probably acts as a shelter for these film-like algæ or more secure anchors for their development.

### ANACHARIS

This mosslike aquatic plant is variously known to botanists as Anacharis, Philotria or Elodea and commonly as Waterweed, Ditchmoss, Water Thyme, Water Pest and in the British Isles as Babington's Curse. There are 4 or 5 very similar American species which bloom from May to August, but are also propagated by a plentiful production of offshoots which, attached or separate, rooted or floating, grow with amazing rapidity in any ditch, stream or pond throughout the United States and North America except the extreme north. It is a slender wholly submerged plant with fragile jointed and branching stem, 4 inches to 3 feet long, dependent upon the depth of water, so weak that it mats together and decays when the water is withdrawn. The male and female flowers are borne on separate plants. The pistillate flowers are raised to the surface by their long calyx tubes and the minute staminate flowers break off and rise to the surface to shed their pollen. The fruit ripens below the surface of the water. The plant also forms heavy buds in the Fall, which drop to the bottom and develop in the following Spring. It is a veritable pest, as it chokes up canals and waterways.

*Anacharis canadensis* (Mich.) *A. alsinastrum* (Bab.), Fig. 123, is the species most generally to be found and has a weak jointed stem with the leaves in whorls of 4's to 8's or the lower leaves opposite, linear and minutely toothed. The white pistillate flowers develop on calyx tubes from 2 to 12 inches long.

The Common Anacharis *A. canadensis*, Fig. 123, thrives fairly well in the aquarium, is a good oxygenator, but is so weak and fragile that it will easily break into sections. It should be planted in the sand or pebbles in groups of 4 to 10 stalks. Freshwater fishes and goldfishes feed upon the leaves and in the aquarium frequently entirely destroy the plant. When found in cold water streams the plants are more robust and the leaves

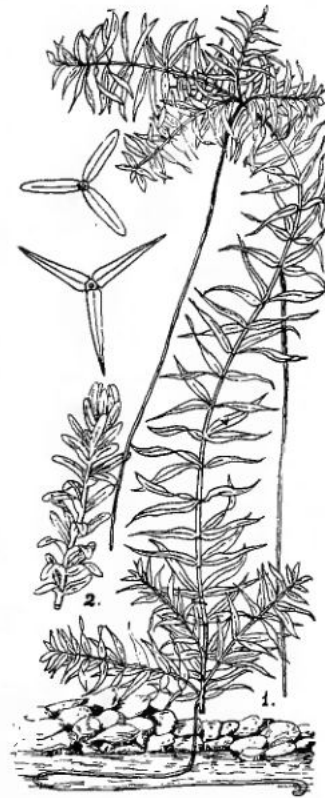


FIG. 123. Ditchmoss or Anacharis, *Anacharis canadensis*; also a modified form and leaves. Reduced one-fourth.

broader, fuller and more pointed than those of quiet or stagnant water, which probably caused it to be considered a different species. It is a very pretty aquarium plant but difficult to maintain in satisfactory condition, except with such fishes as will not molest it.

*Anacharis canadensis gigantea* or *Elodea canadensis gigantea* (Hort.)

Fig. 124, is a cultivated species derived from *A. canadensis*, the most generally distributed native form. It has a thick jointed stem and leaves

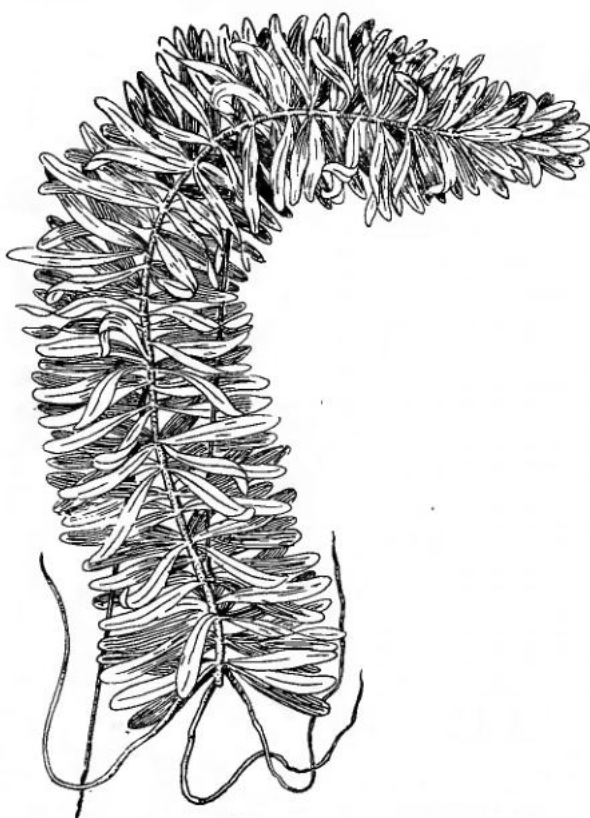


FIG. 124 Giant Anacharis, *Anacharis canadensis gigantea*, Hort.  
Reduced one-third.

1 to 1½ inches long, in whorls of 4 to 8, with a dense cluster of the long slender leaves at the ends of the stalks. It usually grows without much branching. In general appearance it considerably resembles *Hippuris* and is an attractive aquarium plant which grows to a length of 3 to 4 feet below and on the surface of the water. Its color is a delicate greyish-green, the younger growth usually a bright green, sometimes marked with white. Less fragile than *A. canadensis*, it is a good oxygenator, of most rapid growth, which thrives with or without roots, set directly in the pebbles or sand or in small pots with soil. May be

had of dealers in aquatic plants. In small aquaria, intended for the propagation of aquarium snails, it is preferable to most of the other aquatic plants. Together with *Cabomba* it is easiest to be obtained, and is a most satisfactory plant for the novice in aquarium study.

### CERATOPHYLLUM

This generally distributed aquatic weed, commonly known as Hornwort, is free-suspended in every stage of development and is shifted in position by every current, though the submerged species of this genus mostly occur in slow streams and still water. Absorption is carried on by

the epidermal cells of the foliage leaves and not by roots, though the lower leaves may assume a rootlike character. The Hornworts have weak and slender widely-branching and floating stems with verticulate leaves, which appear in thick clusters on the younger growth and branches. It is not a desirable aquarium plant as it is too fragile and requires careful attention, may decay in a brief period, contaminate the water, and cause the death of the fishes. Several species have been proposed, based on the spurs, spines or wings of the fruit but none of these distinctions are of value.

*Ceratophyllum demersum* (Gray), or Common Hornwort, Fig. 125, has long or short slender submerged floating stems, dependent upon the depth of the water, as it is characteristic of the plant to form thick mats immediately below the surface. The linear 2 to 3 times divided and forked leaves grow in verticils of 5's to 12's on a weak and fragile stem. The flowers are insignificant, either white or yellowish in color, of which the male and female are distinct. The former consists of about 15 sessile anthers and the latter of a small one-seeded ovary, but both surrounded by a whorl of very small bracts, while the fruit is oval with either a straight and spinelike beak, smooth or with a basal spur, or tubercular with narrow winglike spiny lower margin. Grows freely in ponds and slow streams throughout North America except in the extreme North. European authorities mention two other species, *C. submersum* and *C. platyacanthum*, not generally known in the United States. They are probably natural variants of *C. demersum* the universally distributed species.

*Podostemon ceratophyllum* (Linn.) is another aquatic bearing the name *Ceratophyllum*. It is popularly known as River Weed or Threadfoot, and is a dark green rather stiff plant, firmly attached to the stones in running streams. The densely tufted leaves are narrowly linear and sheathed at the base, but split above into filiform segments. It resembles *C. demersum* but is coarser and rougher in appearance. The white flowers are  $\frac{3}{4}$  to  $\frac{7}{8}$  inch broad, spreading from the spathes; and the oblong-oval capsules are borne on a

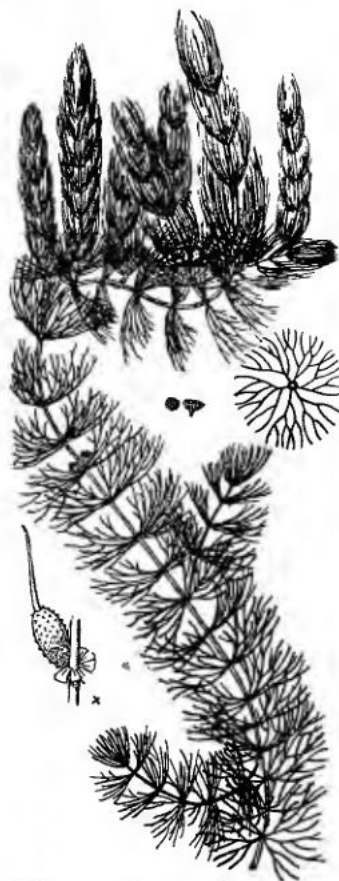


FIG. 125. Hornwort, *Ceratophyllum demersum*, whorled leaf, blossoms and enlarged seed carpel. Reduced one-third.



scape of about their own length, with recurved stigmas. Only one species is known in the United States, which occurs in shallow streams from Massachusetts to Northern New York, Ontario and Minnesota to Georgia, Alabama and Kentucky. Flowers July and August.

A few stalks of *Ceratophyllum* make a fine appearance in the aquarium, as the growth there developed is more delicate, brighter green and finer in appearance than that of the ditch, pond or stream.

### HIPPURIS

This genus consists of a small group of aquatic herbs with simple erect stems and verticillate entire leaves, small axillary flowers and a one-celled, one-seeded fruit. There are three known species native to north temperate and lower arctic regions and southern South America.

*Hippuris vulgaris* (Linn.) or Bottle Brush, Joint-weed, Mare's tail, etc., Fig 126, has a slender stem and linear or lanceolate acute leaves in crowned whorls or verticils. The flowers have stamens with a short thick filament, comparatively large two-celled anthers and ovoid seeds hollow in the interior. The plant is native to swamps and bogs in Labrador and Greenland to Alaska; south to Maine along the shore of Lake Superior, in the Rocky Mountains to New Mexico and along the Pacific Coast.

*Hippuris tetraphyllum* (Linn.) *H. maritima* (Hell.) or Four-leaved Mare's tail, is a smaller species with obovate or oblanceolate entire leaves in verticils of 4's and 6's at the base of the stem. Native to Labrador and Canada to the United States border and in Alaska.



FIG. 126. Mare's Tail, *Hippuris vulgaris*, and enlarged fruit. Reduced one-half.

*Hippuris* has the character of *Anacharis canadensis*, but is larger, stiffer and more erect, growing 12 to 15 inches above the water. It largely takes the place of *Anacharis* in northern waters and was introduced into the Middle States by aquarium fanciers in 1898, but has recently been superseded by *A. canadensis gigantea*.

### FONTINALIS

This genus of aquatic moss contains a quite considerable number of universally distributed freshwater species, two or three of which thrive in the aquarium. Ten species are recognized as native to the United States and

of these *F. antipyretica*, *F. gigantea* and *F. gracilis* are most easily obtained and best serve for aquarium purposes. The young foliage has a fine green color but changes to a dusky brown with age. A few sprigs, attached to the stone upon which they grew or in soil may be introduced if the aquarium is exposed to a good light.

*Fontinalis antipyretica* (Linn.) or Willowmoss, Watermoss, Fig. 127<sup>1</sup>, has broad ovate and acuminate entire sharply plicate leaves with the borders reflexed on the side towards the base, in two or three rows, more or less imbricated and sharply keeled. The bracts are also closely imbricated and the capsules ovate-oblong with a conical lid and bright coral-red peristome or cap. The plant adheres to rocks, submerged wood and stones in rivers and cold-water streams, and flowers in summer. Its name is in allusion to the use for which it is often applied, that of filling in between chimneys and walls to exclude the air and prevent the spread of fire. It is a fairly good oxygenator.

*Fontinalis gracilis* (Schp.) Fig. 127<sup>2</sup> is a generally distributed species very much more slender and mosslike than the above, with divided stems considerably denuded of leaves at the base. The tiny leaves are narrow and often split to the keel, the carpels smaller and usually contracted below the mouth. Common to most ponds, rivers and often rapid streams, sometimes associated with the above.

*Fontinalis gigantea* (Sull.) is a very robust Willowmoss, less branched than the above with wide leaves, less acute or curved at the base, of a coppery brown color, having small capsules and less perfect peristomes. Found attached to stones and stumps by the side of the water, but less generally distributed than the two above species, and in more southern latitudes.

There are a number of other varieties of the Watermosses which are more rare and not so often met with. Their purpose in the aquarium is more for their singular and interesting appearance than special utility.

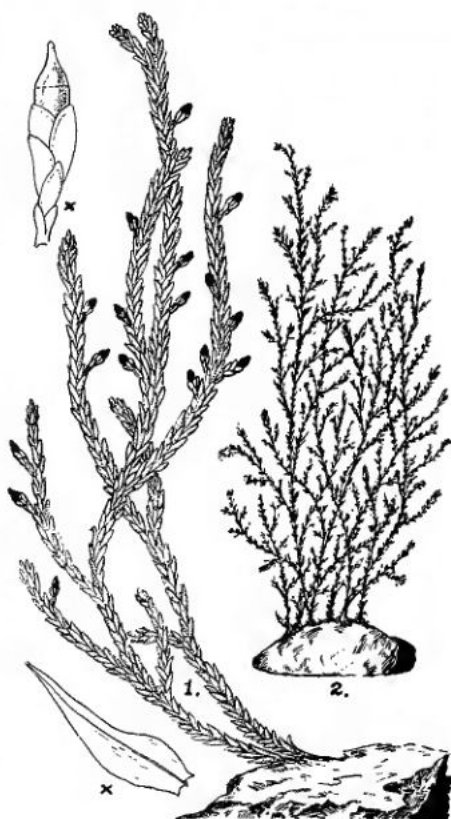


FIG. 127. Willowmoss. 1. *Fontinalis antipyretica* with enlarged leaf and fruit carpel. 2. *Fontinalis gracilis*. Reduced one-third.

## POTAMOGETON

About 40 species and sub-species of *Potamogeton*, also known as Channel, Pond or Riverweed, the latter from the Greek significance of the botanical name, are native of North America. They are all weedy plants which attach themselves to the bottom of ponds, shallow lakes, streams and canals and grow so luxuriantly as to choke the waterways. They are also known as Stink-grass on account of the rank fetid odor of the plant when exposed to the sun on the banks or shore. In many of the species there are two kinds of leaves, the narrow submerged and the broader floating leaves, which surround the small green flowers consisting of 4 stamens and usually 4 one-ovuled ovaries. The fruit is a small nutlet containing a coiled or hooked embryo. Four species have come into slight notice in American water gardens.

*Potamogeton crispus* (Linn.) or Curled-leaved Pondweed, Fig. 128, has a dark green stem and beautiful dark olive-green, two-ranked serrulate and crisped linear leaves with a compound midrib and the outer nerves near the margins. The ovoid fruit has a small embryo with its apex pointed directly towards the base, and the peduncle or stem recurved on the fruit. It occurs generally in fresh, brackish and salt water from Massachusetts to Pennsylvania and in Virginia, and flowers in August.

*Potamogeton lanceolata* (Linn.) or Spear-leaved Channelweed or Pondweed, Fig. 129, is generally distributed in all running and stagnant waters, forming thick almost impenetrable mats that obstruct the streams; and, as it is one of the fragile species, it often occasions the stoppage of turbines and water-wheels, especially in the late fall when it sheds its foliage. In this species the winter buds may be readily recognized. The flowers appear in July and August and consist of a cluster of tiny green pedals about a thick scape and the fruit is a hard nutlet with one or sometimes two grooves on the back; the embryo forming a spiral of one and a half turns. Native in almost all parts of the United States and North America.

*Potamogeton natans* (Linn.) or Common Spade-leaved Floating Channelweed or Pondweed, Fig. 129, has long and almost leafless stems with short narrow pointed submerged leaves, rounded



FIG. 128. Curled-leaved Pondweed, *Potamogeton crispus*; and Spear-leaved Pondweed, *Potamogeton lanceolata*, with winter bud. Reduced one-third.

at the base, and larger simple sparingly branched ovate floating leaves. The peduncles of the fruit are as thick as the stems and the nutlets are hard, pitted and with two grooves on the back; the embryo forming an incomplete circlet with its apex pointed to the base. Native in canals and streams throughout North America, and flowers in July and August.

*Potamogeton densus* (Linn.) or Close or Broad-leaved Pondweed, Fig. 129, has single or branching stems, broad olive-green submerged and floating leaves fitted closely to the stem and overlaying each other, having sharply defined midribs. The fruit is obvoid rounded and indistinctly three-keeled and the embryo recurved or spiral. This is a European species which has become naturalized in the United States.

Other frequently occurring species are:—*P. fluitans* or Long-leaved Pondweed; *P. heterophyllum* or Varied-leaved Pondweed; *P. perfoliatum* or Perfoliate (clasping-leaved) Pondweed; *P. compressus* or Flat-stalked Pondweed; *P. pectinatus* or Fennel-leaved Pondweed; *P. lucens* or Shining-leaved Pondweed; and *P. gramineæ* or Grass-leaved Pondweed.

The Potamogetons are easily grown in basins and ponds and may thrive in the Aquarium, *P. densus* and *P. perfoliatum* being especially desirable, the handsome deep olive-green leaves of the former and the clear pea-green leaves of the latter forming a fine contrast with other aquarium plants. They should be planted in soil or pond mud in shallow pots covered with pebbles in the corners of the aquarium. They are mainly propagated by cuttings, and in nature by rhizomes and the peculiar winter buds which remain dormant in cold weather and form new plants in the spring. Botanists are at variance in naming two species of this plant; some designating *C. crispus* as *C. lanceolata* and others classing the shorter-leaved of the latter species *C. crispus* and



FIG. 129. Floating Pondweed, *Potamogeton natans* with blossom; and Broad-leaved Pondweed, *Potamogeton densus*. Reduced one-third.

assigning the long-leaved varieties of *C. lanceolata* with less crinkled leaves to *C. graminea*. This is not essential to the aquarist. The author illustrates the species as he recognizes them. It is a variable genus sometimes difficult of identification.

### WATERCRESSES

The Family of *Roripa* or Watercresses contain about 25 species, most abundant in the North temperate zone, of which eleven are native to North America. Of these the species generally distributed in the Eastern and Middle States are:—

*Roripa palustris* (Linn.) *Nasturtium terrestre* (A. Br.) or Marsh or Yellow Watercress, an erect, branching, glabrous plant having the lower leaves petioled and the upper leaves nearly sessile, with yellow flowers and linear-oblong fruit pods. Flowers May to August. Found in swampy localities throughout entire North America, except the extreme north.

*Roripa sylvestris* (Linn.) *N. sylvestris* (A. Br.) or Creeping Yellow Watercress has a creeping stem rooting at the nodules, with ascending branches, pinnately divided and toothed leaves and yellow flowers. Found in low ground and wet places from Massachusetts to Virginia and Ohio.

*Roripa nasturtium* (Linn.) *N. officinale* (A. Br.) or Watercress, Fountaincress, the edible Watercress, has branched floating and creeping stems rooting from the nodules, with odd-pinnate, ovate leaves, and white flowers, and may be found in almost every coldwater brook of North America. Many cultivated varieties have been produced from this species.

Another species is *Roripa hispida*, or Bristly Yellow Watercress which is more seldom met with. It grows on the borders of sluggish streams and ponds.

Of these, Fountaincress and the creeping Yellow Watercress thrive fairly well submerged in the aquarium and all the species make ornate plants for the aqua-terrarium.

Closely related to the cresses is another very desirable plant which thrives in the aquarium, the generally introduced Moneywort.

*Lysimachia nummularia* (Linn.) or Moneywort, Creeping Loosestrife, also known as Creeping Jenny and Herb-twopence, is a border plant that overhangs the water and develops roots which take their sustenance from the water. It has a glabrous, creeping stem, rooting at the nodules, with opposite, broadly ovate leaves, obtuse at both ends and solitary yellow flowers. This plant thrives satisfactorily in the aquarium, either rooted in soil or in pebbles; and may be found in moist and wet places from Newfoundland to New Jersey, west to Indiana; and to be had of florists. It is a fairly good oxygenator and a fine foliage plant in the aquarium where

it has taken the place of Watercress. It should be introduced in loose bunches as it requires strong light to grow submerged and makes a good screen for the fishes. The dark-green, almost circular leaves with their straight stalks strive to reach the surface and give a vigorous thriving appearance to the plant, in fine contrast with the languid appearance of the usual aquatic plants in the aquarium.

### CALLITRICHE

The Water Starwort family contains a number of herbaceous aquatic and semi-aquatic species, with slender stems, opposite spatulate leaves and minute axillary flowers, of which the following are native American species:—*Callitriche verna* or *C. palustris*, Vernal or Spring Water-Starwort, Water Fennel; Fig. 130, *C. bifida*, Autumnal or Northern Water-starwort; *C. heterophyllum*, Larger Water-starwort and *C. austenii*, Terrestrial Water-starwort. They are pond or basin plants but generally will not thrive in the aquarium.



FIG. 130. Spring Water-starwort, *Callitriche verna*.  
Reduced one-third.

*Callitriche verna* (Lindl.) is probably the hardiest, from the aquarist's point of view, and is the most common and generally distributed species in cold or running water throughout the United States and Canada. It grows in the mud with elongated one-nerved spatulate submerged leaves and most peculiar floating leaves; which, though a moderate distance from each other are arranged to form a rosette, as the stalks of the lower leaves are longer than those near the apex and bring the floating leaves into clusters of 4's, 6's and 8's. The small axillary flowers reach above the surface of the water and bloom from July to September. Native or wherever introduced, it spreads so rapidly as to become a nuisance, and should not be used in lily-ponds. Water Starwort is introduced into the aquarium in small bunches, but either so or floating on the surface is eagerly eaten by goldfishes.

### UTRICULARIA

The Bladderworts are divided into aquatic and marsh species, floating free or rooted in the mud. The aquatic species have finely divided leaves covered with minute bladders, the marsh species rootlets under ground and bladder-bearing leaves. There are about 150 widely distributed



FIG. 131. Greater Bladderwort, *Utricularia vulgaris*; and Lesser Bladderwort, *Utricularia minor*. Reduced one-third.

species of which 14 occur generally in the United States and 3 only in the Southern States.

*Utricularia vulgaris* (Linn.) or Greater Bladderwort, Hooded Water-milfoil, Pop Weed, etc. Fig. 131, occurs in ponds and brooks throughout nearly the whole of North America. The delicate 2 to 3 pinnately divided and much crowded floating leaves have numerous bladders, racemose yellow flowers and long recurved fruit. Flowers June to August and also propagates by winter buds.

*Utricularia minor* (Linn.) or Lesser Bladderwort, Fig. 131, occurs in bogs and shallow ponds from Greenland, Labrador and British Columbia south to New Jersey, Arkansas, Utah and California. The floating leaves are short, much scattered, with fewer divisions and not as many bladders borne among the leaves. The flowers are pale yellow and the fruit has the peduncle reflexed. Flowers June to September in different altitudes.

*Utricularia biflora* (Lam.) or Two-flowered Bladderwort, Fig. 132, occurs on the mar-

gins of ponds in New Jersey and New York, Massachusetts and Rhode Island to Illinois, south to Louisiana and Texas. The leaves are finely divided with few divisions and are copiously provided with bladders. The flowers are yellow. Blossoms during warm weather, later in the season the farther north it occurs.

Other generally distributed species are *U. gibba*, Humped Bladderwort; *U. intermedia*, Flat-leaved Bladderwort; *U. clandestina*, Hidden-fruited Bladderwort; *U. purpurea*, Purple Bladderwort; and *U. subulata*, Tiny or Zigzag Bladderwort.

The Bladderworts are beautiful floating aquarium plants which thrive satisfactorily indoors. Any of the three described species, and occasionally some of the



FIG. 132. Two-flowered Bladderwort, *Utricularia biflora*. Reduced one-third.

others, are generally to be had and may be planted with the lower ends embedded in the sand or pebbles or loosely floating on the surface of the water. They require a strong light and grow very rapidly. Goldfishes destroy them but with Paradise fishes or for snail culture, they form handsome aquatic gardens.

A peculiar characteristic of the Bladderworts is that they are aquatic insectivorous plants. The bladders are provided with a valvelike trap on their lower sides and when filled with water also probably contain secretions which attract infusoria and small crustaceans, who upon entering are entrapped and absorbed by the plant. Of some species it is reported that they will capture the tiny fry of fishes, though in these latitudes there is no species with bladders sufficiently large to serve this purpose.

### HOTTONIA

This pretty marsh herb is commonly known as Featherfoil, Water-feather, Water or Marsh-violet and Water-yarrow. Two species are native to North America.

*Hottonia inflata* (Ell.) or Water-feather having an entirely submerged spongy close cluster of thick and soft stems with pinnate crowded leaves in verticils and clustered at the ends and joints of the stems. An interesting pond plant but does not usually survive in the aquarium.

*H. palustris* (Ell.) the second species is more rarely met with, but in Europe is considerably cultivated as an aquarium plant.

### FRESHWATER ALGÆ

The Algæ constitute one of the grand divisions of the Cryptogams or flowerless plants, embracing the sea weeds and lower water plants, the Fucas, Ulva and Confervæ. The most of the Fuca and Ulva are marine forms; but in counterdistinction to Algæ in general, the Confervæ are an extensive section of the order of Algæ, consisting of slender, often scum-like vegetation, the best known being the so-called "Frog-spittle." The simpler forms of Algæ, the Nostocæ, consist only of a cell wall containing a colored protoplasmic substance; but in the higher forms the cells are combined into a tissue, and the forms which they assume are more varied than in any other class of plants. Some appear as strings or linear masses, globules, laminæ, etc. In others, the Fucaceæ, a distinct stem, branches, leaflike structures and rhizoids or rootlike structures are formed, but these have none of the characteristics of true plants and consist entirely of cellular tissue.

Each season of the year, every climate, every moist spot, has its species of Algæ. Some may be found in healthy condition frozen into an icicle



or in the heated water of a boiling spring. They are the last vestige of life in the region of perpetual snow or in the heated basin of the geyser. The numerous forms are to be found in every stagnant pool and ditch, rivulets, springs and in all other bodies of water. In pools and ponds the most conspicuous forms are *Oscillatoria* and *Zygnemaciæ*; the former forming dense floating or attached slimy strata, having fine rays extending from the mass, of dark green, purplish or bluish-black color. The *Zygnemæ* are bright green filamentous masses, usually entangled among the water plants, twigs, etc. When in fruit they become dingy, yellowish, or dirty looking. Late in the season *Rivulareæ* and *Nostocs* are often met with. These adhere to larger plants and floating matter and form fine fringes around the stems and edges of the leaves, or little green and brownish globules and small protuberances. Of the river *Algæ*, the *Desmids* are abundant in the spring and summer months, adhering to rocks and water plants; and *Chætophora*, *Scytonema* and *Palmela* are also numerous, often free but sometimes attached to objects in the water.

Diatoms are also classed in the family of *Algæ* and consist of minute silicious organisms which were formerly considered as belonging to the lowest forms of animal life. They are a higher form of *Algæ* and obtain firmness by depositions of silica. Another class, the *Acetabulariæ*, deposit carbonate of lime.

The mentioned *Algæ* and *Confervæ* are those with which the aquarist becomes familiar, the group being too complex in classification for further description in a work of this character. The common small aquarium species are mentioned elsewhere as they have more or less parasitic character.

*Algæ* have many useful purposes in the aquarium, as they form a screen on the glass to intense light, serve as a natural food for both the fishes and the scavengers, and have beneficial medicinal properties to fishes. When the growth is of a clear green color and not so thick as to be unsightly, it may be left undisturbed on the glass or removed only from the side through which the contents are viewed; but when the growth, both on the glass and in the water, assumes a brown color, it is indicative of a dead and decaying condition and it is advisable to thoroughly clean the aquarium and refill with fresh water, as the appearance of the *algæ* is a good indication of the water conditions. Excessive growth on the plants is injurious and they should be cleaned to prevent suffocation or the affected leaves removed, but usually the fishes and scavengers, when not overfed, keep them sufficiently clean. It is for this purpose that goldfishes are kept in tanks with aquatic plants by florists, to keep down both objectional plant and injurious insect life.

Should the growth become so excessive as to destroy the lower leaves

of the plant, they should be removed, the aquarium cleaned and new plants introduced; though this may only occur in large tanks or basins. Excessive growth of some of the larger varieties, especially the Confervæ, may also form such compact masses and mats that even large fishes become entangled and may die of suffocation. These larger algæ and confervæ are best removed with tweezers, the hand, or by entangling the growth about a stick. Aquatic plants taken directly from the pond, especially Myriophyllum and Nitella, are the usual sources of introducing these objectionable algæ. The microscopic green algæ are sometimes present in aquaria in such numbers as to obscure the contents; often the decomposition of their chlorophyll makes the water brown. A small quantity of a solution of permanganate of potassium in water diluted to a claret color and then added to the aquarium water, will cause their entire disappearance without injury to the animal life.

### FLOATING WATER PLANTS

Some of the native and tropical floating plants may be introduced into the aquarium with very pleasing effect. Of these the native species are Duckweed, Floating Pondmoss, and Crystalwort, and the more commonly known tropical species, Salvinia, Trianea, Frog-bit, Water Lettuce, and the Water Hyacinth.

### DUCKWEED

Lemnas or Duckweeds, Fig. 133, occur on every ditch and pool; the five most generally distributed in the United States being *L. minor* or Lesser Duckweed; *L. perpusilla* or Tiny Duckweed; *L. gibba* or Thick-leaved Duckweed; *L. polyrhiza* (*Spirodela polyrhiza*) or Greater Duckweed; and *L. trisulea* or Ivy-leaved Duckweed, the last two least often found in the Eastern and Middle States. They are small flowering plants having pendant roots, and grow by the extension of offshoots from the clusters; and in winter sink to the bottom when the growth of the leaves is checked by frost.

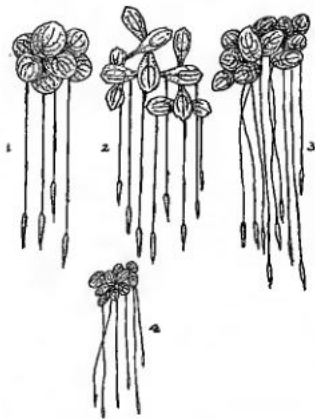


FIG. 133. Duckweed. Reduced one-third.  
 1. *Lemna minor*.  
 2. *Lemna trisulca*.  
 3. *Spirodela polyrhiza*.  
 4. *Lemna perpusilla*.

*L. minor* has nearly round leaves of even, small size and bright green color, with usually one rootlet attached to each leaf. It is very common and during the summer almost covers the surface of ditches and other slow flowing or stagnant water. *L. perpusilla* has a still

smaller elong-ovate leaf and grows in closely matted clusters of dull green color. *L. gibba* has a flat leaf, the larger about  $\frac{3}{8}$  inch diameter, of a bright green color, to each of which is attached a single root.

*L. polyrhiza* has the leaves of varying outline, densely clustered and overlapping each other, of varying shades, from pea-green to light olive-green. *L. trisulca* is a pond variety with the serrated  $\frac{3}{8}$  inch leaves of a light green color, which grow most oddly at right angles to each other. It is restricted to some few localities.

All the duckweeds have tiny white flowers but during warm weather increase rapidly by offshoots from the edges of the leaves. In the aquarium goldfishes feed on their roots and leaves and soon destroy them. They are to no purpose as oxygenators.

### FLOATING PONDMOSS

This beautiful many-branched mosslike floating plant, known botanically as *Azolla caroliniana*, Fig. 134, consists of clusters of tiny bright red or reddish-brown leaves usually bordered with dark green, and having short roots under the centre of the fronds. In warm weather it occurs on slow-flowing streams and ponds in the Eastern and Middle States, but is more generally distributed in Southern waters. It does not thrive indoors in the aquarium and is prized on account of its quaint appearance, having no merit as an oxygenator. Another very similar species is *A. filiculodes*, a northern variety.



FIG. 134. Floating Pondmoss, *Azolla caroliniana*.

### CRYSTALWORT

Two species of Crystalwort, *Riccia fluitans* and *R. natans*, Fig. 135, are sometimes introduced into the aquarium. They are bright-green mosslike plants growing on the surface of still water, of which the first is the most common form and may be found in many coldwater ponds and streams. It has repeatedly forked, threadlike leaves, of which the segmented branches grow about  $\frac{1}{2}$  to  $\frac{3}{4}$  inch in length; and the second has clusters of heart-shaped leaves with several pendant rootfibres. It is a native of Southern waters. *R. fluitans* thrives fairly well in the aquarium, but as it is brittle and the fishes break it, it soon floats on the surface in fragments or sinks to the bottom to clog the roots and stems of other plants. It has no merit as an oxygenator.

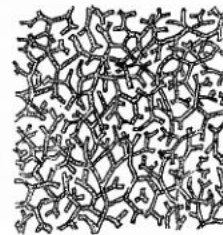


FIG. 135. Crystalwort, *Riccia fluitans*.

**SALVINIA**

This is the most beautiful of the smaller floating aquatic plants. Two species, *Salvinia natans*, native to the Southern and Southwestern States, and the larger tropical *S. brasiliensis*, are to be obtained of florists. Fig. 136.

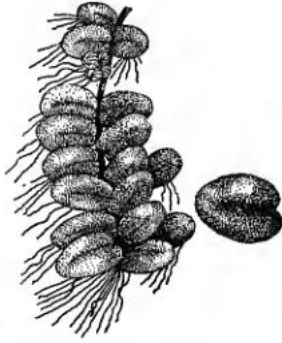


FIG. 136. *Salvinia*, *Salvinia natans*, and a leaf of *S. brasiliensis*. Reduced one-third.

The leaves of the native species are heartshaped, and of a bright, beautiful green color, and covered with hairlike bristles, the under side of the leaf being a purplish-red. The larger, more circular leaves of the exotic species are pale golden yellow with pea-green tints and a bright-green border; and are more rounded with a depressed centre which gives the leaf a heartshaped appearance. The leaves grow in rows along a fine threadlike stem, and in the moist atmosphere of the greenhouse develop and increase with incredible rapidity, but in the household aquarium soon diminish in size

and rarely survive the winter. Goldfishes eat the roots, which also tends to check the growth. It is the handsomest of the floating aquarium plants but does not serve as an oxygenator. Two new species have recently become known, *S. auriculata* from South America, and *S. elegans* from Mexico.

**TRIANEA**

This sub-tropical floating water plant, *Trianea bogotensis*, Fig. 137, with its heartshaped, slightly roughened and waxlike green leaves, is an attractive floating plant, which develops with remarkable rapidity in the moist atmosphere of the greenhouse, but dwindles in size of leaf and loses vigor in the household aquarium. The pendant roots harbor infusoria and entomostraca and are eaten by the fishes. It makes a fine appearance in the aquarium, but will not serve as an oxygenator. The leaves develop in the centre of the clusters and the blossom is small and yellow with a white centre.



As a shade plant in out-of-doors tanks, it is to be recommended and grows well during the warm summer months, if not exposed to too strong sunlight. May be had of florists.

**FROG-BIT**

This floating plant, *Hydrocharis morsus-ranæ*, (Hort.) Fig. 138, a European species, never takes

FIG. 137. *Trianea*, *Trianea bogotensis*. Reduced one-third.

root and propagates both by seed and by summer runners, upon which buds are developed which become young plants. The kidneyshaped leaves grow on long stems, and the 1 1/2 inch in diameter flowers have three petals



FIG. 138. Frog-bit, *Hydrocharia morsus-ranae*. Reduced one-third.

upon an erect scape. It is fairly hardy and easy to propagate in ponds in a mild climate, but does not thrive well in the household aquarium. Many of the water insects and most of the pond snails attack its leaves. At the approach of cold weather the leaves decay and the winter buds sink to the bottom of the pond, to

rise to the surface with the advent of warm weather. The plant is subtropical and will not survive very cold weather. Of the floating plants it is one of the largest fancied by aquarist, and the fine white blossoms are attractive and of pretty form. In the greenhouse the plant survives for years. May be had of dealers. A similar plant, the American Frog-bit, *Limnobium spongia*, having dark-green heartshaped leaves, purplish on the under side, is a desirable greenhouse plant, but also will not thrive in the household aquarium.

### WATER HYACINTH

The Water hyacinth, *Eichhornia*, is steadily growing in favor with the breeder of the goldfish, as it one of the best spawning plants, in addition to its curious and handsome appearance. The thick floating leaf stalks and dark green, burnished leaves, the long trailing roots, and the beautiful flowers, give it a most ornate appearance. It propagates by seeds and buds which again develop young plants before separating from the parent plant, so that a single Water hyacinth may be developed into many hundreds in a single summer. It is native to a warm climate and difficult to keep over the winter in a cold one, even in the greenhouse. As a shade plant, in the open-air, it is to be recommended, and the easy facility for the removal of goldfish spawn to hatching dishes, which it affords, is a great advantage in its use as a spawning plant. In Florida it has become a plague, as it propagates in such numbers that it chokes the channels

and waterways. May be had of dealers and florists generally. In warmer climates great care must be exercised that it may not get into the streams. Two species are generally to be had in the Eastern and Middle states, *E. azuria*, bearing lavender-blue flowers, and *E. crassipes*, with lilac-rose flowers.

### WATER LETTUCE

This curious floating plant, *Pistia stratiotes* (Linn.), consists of a cluster of large, fine, yellowish-green velvety leaves, which in general form resembles garden lettuce, and is about the size of a teacup. It is very handsome in the moist hot atmosphere of the greenhouse, but will not thrive in the household aquarium or in the open air; as it is a shade plant and can not endure direct sunlight. May be had of dealers in aquatic plants.

### ORNAMENTAL AQUARIUM PLANTS

A number of beautiful plants, rooted on the bottom but having floating leaves and emersed flowers may be introduced into the aquarium, but in the household there are but few that will grow satisfactorily. The best of these are the so-called Water Poppy, *Limnocharis humboldtii*, a hardy, handsome plant with small oval floating leaves and yellow poppy-like flowers; the Water Clover, *Marsilea natans*, which develops clover-like floating leaves and a delicate white flower; and the Water Snowflake *Limnanthemum indicum*, having small lilylike leaves and a dainty fringed pure white flower, from which it derives its popular name.

Some of the dwarf lilies, *Nymphaea*, may also be grown under favorable conditions, but as they are strong feeders and require abundant rich soil, they are better adapted for large receptacles than the usual smaller freshwater aquaria.

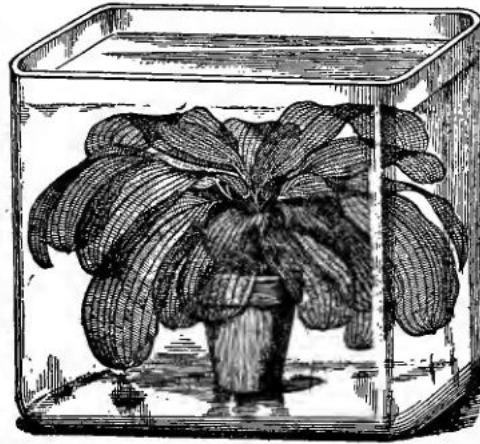
All the above ornamental plants are indifferent generators of oxygen and should be introduced only for their ornamental appearance.

**OUVIRANDRA.** This unique plant is known botanically by its Madagascar name, meaning Water-yam, and popularly as the Lattice-leaf or Lace-plant. The skeletonized, dark olive-green leaves spread just below the surface of the water from a single stalk or root stock and consist of a mere tracery of many nerves and crossveins, 6 to 18 inches long and 2 to 4 inches broad.

*Ouvirandra fenestralis*, (Poir.) or Madagascar Lace Plant, Fig. 139, is the finest form, having broad recumbent latticed leaves and 2 white petal-like bodies borne upon spikes about 2 inches long. The Lace Plant is grown in tubs or jars of freshwater, the frequent changing of which is

differed in by authorities. Fishes are not necessary to its growth, but a few snails or tadpoles are required to carbonate the water and to keep down the algæ and scum.

*Ouvirandra bernieriana*, (Decne.) or Bernier's Madagascar Lace Plant, is a sub-species having leaves with smaller open spaces and four-parted pinkish spikes. The plant is usually smaller than the foregoing. Both these species are grown in the Botanical Gardens



at Washington and at the University of Pennsylvania. May be had of dealers in aquatic plants.

The water in which these plants are grown should be clean and clear and should be kept at about 65° to 75° F. in a greenhouse. Despite the delicate and lacelike appearance of the plant, the leaves are tough and will stand rough handling.

### POND PLANTS

The beauty of lakes, ponds and basins largely depends upon a tasteful and picturesque arrangement of aquatic and semi-aquatic plants both in the water and along the borders. A selection of different species of the Nymphææ or Water Lilies, the Nelumbiæ or Lotuses, the Limnachiæ or Water Poppies, and occasional groups of Trapaceæ or Water-nuts, Marsilea or Water Clover, Aponogetonæ or Floating Cape Pond Weeds, Limnanthemæ or Floating Heart, and of Eichhornia or Water Hyacinths will beautify the surface; and clusters of Cabomba, Myriophyllum, Proserpinaca and Ludwigia the lower depths, except in the flowering season; but care must be taken that these latter will not spread too greatly and become a nuisance. Among all these there are hardy species which will thrive perennially when introduced, especially if the ponds and lakes are fed from natural springs that will not freeze solid in the winter.

For the margins and borders a natural grouping of any of the native hardy and readily obtainable Naiads, the semi-aquatic Sagittarias or Arrowheads, the Water Lobelias, the Acorus or Sweet Flags or Calamus, the Pontederia or Pickerel weeds, the Cypera and Papyrus or Umbrella Plants, the Juncaceæ and Cyperaceæ or Rushes and Sedges, the Isoetes or Quillworts, the Orontium or Golden Club, the Peltandra or Arrow arums, and the Ranunculaceæ, which include the Water Crowfoots

and Marsh Buttercups; also the Cætha or Marsh Marigolds, the Typha or Cat Tails, the Trollius or Globe Flowers, and many others enumerated in the Florists' catalogues, will produce most beautiful foliage and flower effects.

If the pond is a natural basin, the plants may be set into the mud at the borders, but in cement tanks they should be planted in pots and dishes and these screened or hidden with rockwork.

**TERRARIUM AND AQUA-TERRARIUM PLANTS.** In addition to most of the foregoing aquarium plants, Europeans collect or cultivate a considerable number of native and exotic aquatic and semi-aquatic plants for the terrarium and aqua-terrarium; of which, for brevity, only the botanical names will be given, as the most of them have no popular names. Many of the following may be obtained of florists or collected in bogs, along canals and other natural waterways.

**SUBMERGED AND PARTLY EMERSED PLANTS.** *Heteranthera reniformis* and *H. zosteræfolia*, *Najas major*, *N. minor* and *N. flexilis*, *Zanichella palustris*, *Hydrilla verticillata*, *Isoëtes lacustris*, *Pilularia globulifera*, *Sulularia aquatica*, *Saururus lucidus*, *Cyperus alternifolium*, *C. gracilis*, *C. papyrus*, *C. laxus* and *C. natalensis*; *Butomus umbellatus*, *Iris pseudacorus*, *Rumex aquaticus*, *Oryza sativa*, *Zizania aquatica*, *Sparganium ramosum*, *Typha latifolia*, *T. angustifolia* and *T. minima*; *Oenanthe fistulosa*, *Richardia albo-maculata* and *R. æthiopica*; *Pontederia cordata*, *Veronica beccabunga*, *Myosotis palustris*, *Acorus calamus*, *Cætha palustris*, *Berula aquatica*, *Triglochin palustris*, *Comarus palustris*, *Isolipis prolifera* and *I. gracilis*, *Scirpus radicans*, *Carex japonica-marginatis*, *Menyanthes trifoliata*, *Mentha aquatica*, *Nasturtium officinale*, and many others.

**PLANTS WITH FLOATING LEAVES.** Other than those already mentioned are *Alisma natans*, *Villarsia nymphæodes* and *V. humboldtiana*; *Polygonum natans*, *Aponogeton distachyus* and others.

**FLOATING PLANTS.** In addition to those heretofore mentioned are *Stratiotes aloides*, *Aldrovandia vesiculosa*; and the Mexican species, *Salvinia elegans*.

Of this wide range of plants selection may be made of those best adapted to grow entirely submerged, partly submerged, floating on the water, or together with many species of ferns, on the rocks or planted in pots.