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MONOGRAPH OF THE GENUS ELODEA: PART 4 AND SUMMARY.

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I. MONOGRAPH OF THE GENUS ELODEA, PART 4: THE SPECIES OF EASTERN AND CENTRAL NORTH AMERICA.

INTRODUCTION

A preliminary discussion was given in part one of this monograph and it does not need repetition here. Each of the four parts of this study covers the species of a large natural area. Since the species flower but briefly, and have delicate, largely evanescent flowers, they are poorly represented as dried herbarium specimens. Hence, for practical use, an artificial key, based mostly on foliage characters, is here included. With it, plants having well developed median and upper leaves can be identified with reasonable surety. Illustrations of typical leaves are here provided.

The other parts of this monograph have been printed elsewhere, so written that they can be assembled into a single whole. Part 1, The Species Found in the Great Plains, the Rocky Mountains, and the Pacific States and Provinces of North America, Res. Stud., Washington State Univ. 30 (1962) 19-44, fig. 1-5; Part 2, The species found in the Andes and western South America, Caldasia 9 (1964) 95-113, figs. 1-8, is in press in Mutisia; Part 3, The species found in northern and eastern South America, Darwiniana 12 (1963) 639-652, fig. 1-3, tab. 1. Also two species formerly

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placed in *Elodea* were treated in the author's monograph of the genus *Egeria* Planchon, *Darwiniana* 12 (1961) 293-307, figs. 1-2; 12 (1962) 523.

ARTIFICIAL KEY TO SPECIES OF NORTH AMERICA,
FROM THE ATLANTIC SLOPE TO THE GREAT PLAINS.

1. Middle and upper leaves in whorls of 4-5; staminate spathe 2-4-flowered; filaments glandular above, at least 3 times as long as the anthers; pistillate petals 8 mm. wide. This species of *Egeria* is here included because of its superficial similarity to *Elodea*, and because it was long considered a member of that genus. *Egeria densa*.
1. Middle and upper leaves in whorls of 2-3; staminate spathe 1-flowered; filaments non-glandular, shorter than the anthers; pistillate petals 0.5-1.5 mm. wide. Genus *Elodea*.
2. Middle and upper leaves opposite; pistillate spathe 3-7 cm. long. 21. *E. longivaginata*, p. 34.
2. Middle and upper leaves in whorls of 3 (-4); pistillate spathes shorter.
 3. Middle and upper leaves less than 1 mm. wide; stamens equal and equally attached on the hypanthium. 20. *E. linearis*, p. 29.
 3. Middle and upper leaves all, or some of them, more than 1 mm. wide.
 4. Middle and upper leaves 0.3-1.5 mm. wide, flaccid, divergent, not imbricate at tip of stem; pistillate sepals 1.1 mm. long; staminate flowers sessile, at anthesis detached and floating. 18. *E. Nuttallii*, p. 6.
 4. Middle and upper leaves 1-5 mm. wide, firm or subflaccid; all flowers long-stalked by the hypanthium base, not liberated.
 5. Upper leaves usually 2-5 mm. broad, firm, dark green, closely imbricate; flowers dioecious; pistillate sepals 2-2.2 mm. long. 19. *E. canadensis*, p. 12.
 5. Upper leaves 1-2 mm. broad, subflaccid, pale green, loosely imbricate; flowers perfect; sepals 2.7-3 mm. long. 17. *E. Schweinitzii*, p. 2.

DESCRIPTION OF SPECIES

17. *Elodea Schweinitzii* (Planch.) Casp., Monatsber. Kgl. Preuss. Akad. Wissensch. 1857 (1857) 46; also in Pringsheim's Jahrb. Wissensch. Bot. 1 (1858) 468; *Apalanthe Schweinitzii* Planch., Ann. Mag. Nat. Hist. II, 1 (1848) 87; Ann. Sci. Nat. Bot. III, 11 (1849) 76. Fig. 3 a-c, 4.

Description of all specimens examined: Submerged aquatic; stems slender, dichotomously branched; lower leaves opposite, ovate-lanceolate to lanceolate, smaller than the upper; medium and upper leaves 8-14 mm. long, 1-2 mm. broad, in whorls of 3, linear to lance-linear, finely serrulate, subflaccid and pale green; spathe 10-16 mm. long, narrowly urceolate, sharply bidentate at apex; flower perfect, exerted from the spathe by the thread-like elongating hypanthium 2-6 cm. long; sepals 2.7-3 mm. long, 1-1.2 mm. broad, elliptic, dark striate; petals 2.7 mm. long, 0.9 mm. broad, white, delicate, spatulate; stamens three, filaments 0.3 mm. long, stout; anthers 0.8-1.8 mm. long, elliptic; ovary narrowly cylindric; style slender, equaling the hypanthium; stigmas 3-4, linear-ob lanceolate, entire (or bifid), usually one of them shorter than the others which are twice the length of the sepals; capsule and seeds unknown.

Holotype: "in Americae septentrionalis provinciis confederatis [United States], loco proprio non indicato, *Schweinitz* in Herb. Hook." The holotypic specimen bears only the following data: North America, *Schwein.* (K)! Type examined! An apparent isotype lacks the locality and bears only the abbreviation *Schwein.* of the collector's name (K)!

UNITED STATES. NEW JERSEY: N. Caesar. 1834, *Torrey* (P); without locality, *Gray* (M); without locality or collector (K). PENNSYLVANIA: Bet. [hlehem], 1832, *Schweinitz* (K), sterile, but likely an isotype; Nazareth, [*Schweinitz*], (PH), from Schweinitz's own herbarium, doubtless an isotype; ubi, 1829, *Schweinitz* (BR), likely an isotype; Bethlehem, unio itiner, 1832, *Moser* (B, CAS, G, NY, P); in der Lecher bei Bethlehem, Juli 1832, *Princ Wiedensis* (BR); Bethlehem, *Wolle* (MO, PH). American Borealis: without data, (PH).

Elodea Schweinitzii is a member of the subgenus *Apalanthe*, a small group containing only two other species: *E. Brandegeae* St. John of California, and *E. granatensis* Humb. & Bonpl. of South America. Their distinctive feature is the possession of perfect flowers.

Elodea Schweinitzii is of very local occurrence. The holotype was collected by L. B. Schweinitz, but its label gave no locality data. There are, however, several other specimens collected by him, and doubtless some or all of them are isotypes. The one retained in his own herbarium was labeled Nazareth, while others are marked Bethlehem. Bethlehem, Pennsylvania was a small city and Nazareth an adjacent village. Schweinitz spent his life there, and made most of his collections in that immediate vicinity. It seems

that this *Elodea* with perfect flowers was then locally common there. It will be noted that the last collection of it was made in 1832. In 1940 the writer drove to eastern Pennsylvania and explored the region of Bethlehem and Nazareth. Unfortunately by this time Bethlehem had long been a center of steel mills and the streams of the vicinity were opaque and foul from the waste discharged by the mills. No aquatic flowering plants of any kind were to be seen in the despoiled streams.

The three collections recorded from New Jersey give no more precise locality. John Torrey certainly collected in New Jersey, but Asa Gray did so little if at all. No subsequent collections are known to confirm the New Jersey locality. The writer doubts it and thinks that the specimens probably came from Bethlehem, Pennsylvania and were labeled in the casual, inexact manner so often characteristic of botanists of that century.

The floras of eastern Pennsylvania and of New Jersey are very well known. For some 150 years these regions have been intensively botanized by numerous local, resident botanists. No one of them in the last 130 years has rediscovered *Elodea Schweinitzii*. It seems that this species is extinct in Pennsylvania, and that its report from New Jersey was erroneous.

In the other species of *Elodea* the morphology of the flowers is invariable. Not so in *E. Schweinitzii*, as the flowers show considerable variability. Planchon described in his Latin diagnosis that the flowers had: "three stamens; filaments slender, longer than the anthers; anthers obovate, compressed, . . . stigmas three, bipartite (?), the lobes recurved twice longer than the outer parianth lobes." The usual flowers have three stamens, three staminodia, and three or four undivided stigmas. Caspary described one specimen of Moser's 1832 collection as having 7 stamens and no stigmas. The writer has not found this specimen and cannot confirm the statement. Although Caspary maintained *Elodea Schweinitzii* (Planch.) Casp. he did so largely in confidence on the work of Planchon. Caspary studied the type specimen in Herb. Hooker, but found the only two

flowers partly destroyed. In one of these he could observe 2 petals and 3 stigmatic lobes, but he could not confirm the flowers as bisexual. He did see elsewhere several specimens of the bisexual plants from Bethlehem, collected by Schweinitz and by Moser, but he classified them as *E. canadensis*, a species as he interpreted it having either hermaphroditic or dioecious flowers. It is obvious now that these specimens with hermaphroditic flowers collected at Bethlehem were the genuine *E. Schweinitzii*.

One of the flowering specimens collected by Wolle (MO) has a loose staminate flower tangled in the leaves. On dissection this proved to have 9 stamens and to be a staminate flower of *Elodea canadensis*. The other specimen on this Wolle collection has an abnormal flower with a large, coriaceous, swollen hypanthium, probably due to insect injury. The "New Jersey" specimen, Gray (M) has 3 good flowers, one of which has one stigma deeply split, apparently accidentally so, down the median submembranous tissue. In the Delessert Herbarium (G) there are two sheets of the 1832 Moser collection. One has a flower with 3 good stamens, but the 3 stigmas are bifid $3/4$ way down. Their lobes are narrow, but flat, and more delicate in texture than those of *E. canadensis*. The duplicate of this (P) bears branches with one old and two good flowers. Of these one has 4 entire stigmas, while the other has 4 stigmas of which only one is bifid for 0.7 mm. On the Torrey specimen "N. Caesar." (P), of the three flowers one has 4 entire stigmas, and the other good flower has 4 stigmas, three entire and one shortly bifid. The 1829 Schweinitz (BR) specimen has the stigmas bifid $3/4$ way.

In sum it can be seen that this species is unusual in its variability in floral morphology. A possible explanation would be that the species was of recent origin by hybridization and that it was not fully homozygous. Opposed to that hypothesis is the fact that in the general area there are only two other species, *E. canadensis*, and *E. Nuttallii*. Both of these species have dioecious flowers and in their pistillate flowers have the male element represented by sterile staminodia. Obviously they were derived from ancestors with

perfect flowers. The species with perfect flowers represent the primitive state in the genus. Consequently it is not reasonable to look upon *E. Schweinitzii*, a species with perfect flowers, as a putative hybrid of two species with dioecious flowers.

18. (7. of part 1.) *Elodea Nuttallii* (Planch.) St. John, *Rhodora* 22 (1920) 27-28, as to basionym, non sensu St. John (1920); *E. occidentalis* (Pursh) St. John, *Rhodora* 22 (1920) 27-29, sensu St. John (1920), not as to basionym; *E. minor* Farw., Rept. Mich. Acad. Sci. 17 (1916) 181; *E. canadensis* Rich. in Michx. var. *angustifolia* (Britton ex Rybd.) Farw., Am. Midl. Nat. 10 (1927) 203; *Anacharis Nuttallii* Planch., Ann. & Mag. Nat. Hist. II, 1 (1848) 86, and Ann. Sci. Nat. Bot. III, 11 (1849) 74, *A. occidentalis* (Pursh) Victorin, Contrib. Lab. Bot., Univ. Montréal 18 (1931) 40; *Serpicula occidentalis* Pursh, Fl. Am. Sept. 1 (1814) 33, a superfluous epithet since Pursh should have adopted the epithet *canadensis*; *S. verticillata* L. f. β var. *angustifolia* Muhl., Cat. Pl. Amer. Sept. (1813) 84, *nomen nudum*; *Philotria minor* Small, Fl. S. E. U. S. (1903) 47; *P. Nuttallii* (Planch.) Rybd., Bull. Torrey Bot. Club 35 (1908) 461-462, 465, a provisional name; *P. Nuttallii* (Planch.) Rybd. ex Britton & Brown, Ill. Fl. N. E. U. S. ed. 2, 1 (1913) 105; *P. occidentalis* House, Bull. N. Y. State Mus. 243-244 (1923) 55. Fig. 2 e-i, 4.

Description of all specimens examined: Submerged aquatic; stems slender, dichotomously branched, often freely so; lower leaves opposite, lance-ovate, smaller than those above; median and upper leaves 6-13 mm. long, 0.3-1.5 mm. wide, whorled in threes or occasionally in fours, linear or narrowly lance-linear, pale green and flaccid, finely serrulate; staminate spathes borne at the median axils, sessile, ovoid, apiculate, 2-parted to well below the middle, the two acuminate teeth often twisted, forming the apiculate tip, the body 2 mm. long; staminate flower single in each spathe, sessile, at maturity breaking loose, floating to the surface and there opening; sepals 1.9-2.1 mm. long, 1.5-1.7 mm. wide, ovate, sometimes reddish-tinged; petals usually wanting, or when occasionally present 0.5 mm. long, ovate-lanceolate; stamens 9, and 1.2 mm. long, the 3 central ones slightly elevated on a common stalk, the 6 outer ones at a lower level and with separate filaments, the anthers 1 mm. long, 0.6 mm. wide, broadly ellipsoid; pistillate plants bearing in the upper axils spathes 9-25, but usually 10-15 mm. long, narrowly cylindric, somewhat ovoid at base, slightly enlarged at the bifid tip, the two acuminate teeth slightly spreading; pistillate flower stalked by a slender, thread-like, elongating hypanthium as much as 9 cm. in length; sepals 1.1 mm. long, 0.5 mm. wide, obovate, dark-striate; petals 1.3 mm. long, 1 mm. broad, white, delicate, broadly obovate; staminodia three, 0.5 mm. long, acicular; capsule 5-7 mm. long, 1.5-2 mm. in diameter, ses-

sile, narrowly ovoid to fusiform; seeds 3.5-4.5 mm. long, 0.5-0.8 mm. in diameter, cylindric, short beaked, pilose; style slender, equaling the hypanthium; stigmas 3, slender, bifid, somewhat exceeding the sepals.

Holotype: "in America septentrionali." The type specimen is Herb. Thomas Nuttall, *Udora canadensis*, Phil.[adelphia], (BM). Specimen examined! It has the narrow leaves and the small pistillate flower of the species formerly called *E. occidentalis* (Pursh) St. John.

Range: In fresh (or rarely brackish) waters, Quebec to North Carolina, westward to Minnesota, Kansas, and Colorado, then in northern Idaho.

NORTH AMERICA: 1825, *Barrett* (W); *Brendel* (B); en 1868, *Durand* (P); *Engelmann* (G, K, P, W), with staminate flowers, labelled *Udora verticillata minor*, and probably isotypes of it; ditto, but with pistillate flowers, *Engelmann* (BR, K, S); *Leconte* (P); *Wolz* (ZT).

CANADA. QUEBEC: cult., Jard. Bot. Montréal, ex l'île Ste-Thérèse, Richelieu, *Rolland-Germain* 7498 (FSU, S); Saint-Jerome, *Laurérentides*, *Victorin* 20322 (GH).

UNITED STATES. *J. Blake* (BM). MAINE: Cobossee Contee L., *Battey* (NEBC); Unity Pond, Burnham, *Bean* (NEBC); Messalonskee R., Waterville, *Chamberlain* 774, *Fernald* 2750 (BRU, GH, NEBC); Cathance R., Bowdoinham, *Fassett* 14 (F), 94, (NY), *Fernald & Long* 12748 (NEBC, PH); S. Poland, *Furbish* (NEBC); E. Livermore, *Furbish* (NEBC); Androscoggin L., N. Leeds, *Furbish* (NEBC); Haley Pond, Rangeley, *Furbish* (NEBC); L. Auburn, *Merrill* 508 (NEBC), 963 (US), s.n. (NY). NEW HAMPSHIRE: Connecticut R., West Moreland, Cheshire Co., *Krochmal* 1227 (NHA); Beard's Brook, Durham, Strafford Co., *Hodgdon* 5889 (NEBC, NHA); tidewater, Durham, *Hodgdon* 5893 (NHA); Beard's Brook, Durham, *Hodgdon & Hooghkirk* 5890 (NHA); Ashuelot R., Hinsdale, Cheshire Co., *Hodgdon & F. Steele* 10048 (NHA); Province L., Wakefield, Carroll Co., *Pease* 29912 (NEBC); Pontook Res., Dummer, *Pease* 36781 (NEBC, NHA); Crescent L., Wolfboro, Carroll Co., *Seymour* 4824 (NEBC); S. Charlestown, Sullivan Co., *Seymour* 21058 (NEBC); Conway L., Conway, Carroll Co., *F. L. Steele* 3374 (NEBC). VERMONT: without locality, *Chapman* (UC); Windsor, *Eggleston* 2085 (GH). MASSACHUSETTS: Somerville, *Bailey* (NEBC); Congamond L., Congamond, *Blewett & Harger* 6631 (PH); Alewife Brook, Medford, *Boott* (GH); Harwich, *F. S. Collins* 2445 (NEBC); Back Bay Fens, Boston, *Collins* 3639 (NEBC), s.n. (NEBC); Fresh Pond, Cambridge, *Deane* (NEBC), *Deane and E. & C. E. Faxon* (GH, NEBC); Great S. Pond, Plymouth, *Fernald, Hunnewell & Long* (NY); Agawam R., Wareham, *Fernald & Svenson* 758 (NY); Muddy R., Brookline, *Forbes* (NEBC); Great S. Pond, Plymouth, *Glück* (NEBC); Heard's Pond, Wayland, *Kennedy* (GH); Beaver Brook, Middlesex Co., *Kidder* (NY); Spot

Pond, Stoneham, *Kingman* (GH); Fresh Pond, Cambridge, *Morong* (NY), *Pease* 2063 (NEBC); L. Cochichewick, N. Andover, *Pease* 2638 (NEBC); W. Cambridge, *St. John* 679 (NEBC, PH); Beaver Brook, Waverley, Belmont, *Seymour* 3620 (S); Agawam R., Wareham, *L. B. Smith & H. K. Svenson* 825 (NY); Fresh Pond, Cambridge, *Young* (NEBC). RHODE ISLAND: Olney Pond, Lincoln, *J. F. Collins* (NY); Mill Pond, Lonsdale, *Greene* (BRU). CONNECTICUT: Waterbury, *Blewitt* 573 (NEBC); Farmington R., New Hartford, *Blewitt* 586 (NEBC); Connecticut R., Hartford, *Blewitt* 609 (NEBC); Pistapaug Pond, Durham, *Blewitt* 1680 (NEBC); Stony Brook, E. Haven, *Blewitt* 1980 (NEBC); Congamond L., Suffield, *Castle & Dann* 114 (CU); Kensington, *Cowles* (GH); Beaver Cr., Milford, *E. H. Eames* (NEBC); Bantam L., Litchfield, *Eaton* (GH); without locality, *Gray* 4606 (BM), s.n. (CP, O); Housatonic R., Orford, *Harger* (UC); Simsbury, *Holcomb* (GH); without locality, *M. Mitchell* (G); Norwich, *Setchell* (UC); Middletown, *Ware* 3472 (NEBC); Boardman's Pond, E. Hartford, *Weatherby* 367 (NCSC); Pistapaug Pond, Wallingford, *Weatherby* 3373 (NEBC); E. Haven, *Weatherby* 3591 (NCSC); Putnam, *Weatherby* 3777 (NEBC); Old Lyme, *Woodward* (GH); Hartford, *Wright* (GH); Wethersfield, *Wright* (GH); without locality, *Wright*, in part (MO); without locality, Herb. *D. Don*, Herb. *Martii* (BR). NEW YORK: Jamaica Reservoir, *Bicknell* 176 (NY); Hudson R., Hastings, *Bicknell* (NY); S. Pond, Bedford, *Cushman & Wood* (NY); Fall Cr., Ithaca, *A. J. Eames & K. M. Wiegand* 13351 (CU); Woodside, *Ferguson* 4147 (NY); Cold Spring Hbr., *Ferguson* 4414 (NY); Oyster Bay, *Ferguson* 4832 (NY); Millneck, *Ferguson* 7843 (NY); Great S. Pond, Babylon, *Ferguson* 8027 (NY); Baldwin, *Ferguson* 8154 (NY); Millneck, *Ferguson* (NY); Salmon R., Selkirk, *Fernald, Wiegand & Eames* 14123, 14124 (CU, GH); Wading R., *Glück* (Glück Herb.); Watertown, *Gray*, in part (NY); Troy, *J. Hall* (F); Clove L., Staten I., *Hollick* (NY), *Heuser* (B); Long I., *Hennecart* (P); Black R. Bay, *Keyes* (UC); Quogue, *Knight* (NY); Mohegan L., *Leggett* (F); Peekskill, *Leggett* (NY); Ithaca, *Muenschner* 13352 (CU); Hudson R., Catskill, *Muenschner & Curtis* 5570 (CU); Great Pond, Riverhead, *St. John* 2548a (CU, GH); Pocantico Hills, W. Chester Co., *N. Taylor* 847 (NY); Hotaling I., Hudson R., New Baltimore, *Taylor* 1372 (NY); 3rd. Ave., (New York), *Torrey & Gilman* (NY); Ontario See, Charlotte, *Weinland* (B); N. Fairhaven, *Wiegand* 13358, in part (CU). NEW JERSEY: Oldmans Cr., Woodstown, *Adams* 263, 264 (GH, PH); Newton Cr., Collingswood, *Adams* 294 (PH); Camden, *Boice* (PH); Bayhead, *Cannon* (CAS); without locality, *Enneandr* (MO); Fishhouse Sta., (Delaware R.), *Glück* (Glück Herb.); Brindletown, *Grove* 490 (PH); Silver L., Belmar, *Harshberger* (PH); Rahway, *Heuser* (B, M); Paulsboro, *Jahn* 167 (PH); Swedesboro, *Lippincott* (PH); Crosswicks Cr., *B. Long* 6036 (PH); Delaware R., Delair, *Long* 6293 (PH); Budd's L., Morris Co., *Mackenzie* 1505

(NY); Barnegat Bay, Bay Head, *Mackenzie* 4731, 5095 (NY); Delaware R., Bordentown, *Mackenzie* 6833 (NY); Delaware R., Delair, *Mackenzie* 7352 (NY); Hibernia, *Mackenzie* (NY); Swartswood L., Sussex Co., *Mackenzie* (NY); Camden, *Martindale* (L, PH); without locality, *Morong*, in part (MO); Delaware R., Delair, *Pennell* 6498 (NY); without locality, *Pursh*, in part (K); Sussex Co., *Rusby* (BRU); Princeton, *Schott* (F, US); without locality, *Torrey* (K); Budd's L., *Vail* (NY). PENNSYLVANIA: Lagrange, *Adams* 76 (PH); Neshaminy Falls, *Adams* 99 (PH); Darby Cr., Delaware Co., *Barker* (PH); Stroudsburgh, *Bicknell* (NY); York Furnace, *Brown* (PH); Falls of Schuylkill, *Carson* (PH); Fulton Twp., *Carter* (PH); York Furnace, *Crawford* (PH); Perkiomen Cr., Schwenkville, *Driesbach* 1598 (PH); Philadelphia, *Engelmann* (B); Darby Cr., Adele, *Fogg* (PH); Pt. Pleasant, *Fretz* (PH); Cobbs Cr., *Githens* (PH); Philadelphia, *Griffith* 260 (PH), *s.n.* (P), *James* (GH); York Furnace, *Keller* (PH); Neshaminy Cr., *Long* 4595 (PH); Wissahickon Cr., Penllyn, *Long* (PH); Cobbs Cr., *MacElwee* (PH); Fishing Cr., Columbia Co., *Meredith* (PH); Greenlane, *Mumbauer* 313 (PH); Philadelphia, Nutt(all), perhaps an isotype of *E. Nuttallii* (PH); Brinton's Bridge, Brandywine Cr., Chester Co., *Pennell* 2280 (NY), 5110 (PH); White Clay Cr., Avondale, *Pennell* 5014 (PH); Chester Cr., Darling, Middletown Twp., *Pennell* 5058 (PH); Unionville, *Porter* (PH); Allentown, *Pretz* 5175, 6227 (PH); Saucon Cr. Center Valley P. O., *Pretz* 7279 (PH); McCall's Ferry, *Small* (NY); river, Harrisburg, *Small* (NY); Collen Brook, *B. H. Smith* (PH); canal, Belmont, *C. E. Smith* (PH); Philadelphia, *Watson* (L); Dunning Cr., Cessna, *W. F. Westerfeld* 6357 (FSU); Steelton, *C. S. Williamson* (PH); Martins Cr., *Williamson* (PH); Del(aware) R., above Richmond, *Wister* (PH); Delaware R., Philadelphia, *Zantzinger* (MO). DELAWARE: Wilmington, Herb. *Canby* (GH); New Castle City, *Commons* (NY); Brandywine Mill Race, Wilmington, 1874, *Commons* (MO, NY), and in 1896 (PH); Red Clay Cr., Greenbank, *Commons* (PH); Wilmington, *Rhoads* 831 (PH); Middleton, *Van Pelt & Long* (PH). MARYLAND: Miles R., Easton, Talbot Co., *Earle* 4281 (DUKE); Plummers I., *Killip* 32656 (US); by Canal, *Maxon* 6329 (US); Annapolis, *Rothrock* (F); Havre de Grace Light, *Shull* 146 (GH, MO, US); Baltimore Co., *K. A. Taylor* (NY); Great Falls, *Ward* 126 (US), without collector (US). DISTRICT OF COLUMBIA: Eastern Branch, Potomac, *Boettcher* 2543 (CAS); Potomac pools, *Morris* (F); Georgetown, *Van Eseltine & Moseley* 203 (US); Potomac, Washington, *E. S. Steele* (US); Washington and vicinity, *Steele* (C, CP, DUKE, G); Great Falls, *Ward* (US); Washington, *Ward* (US). WEST VIRGINIA: Cacapon R., Hardy Co., *Moldenke* 6765 (NY). VIRGINIA: Appomatox R., Hopewell, *Fernald, Long & Smart* 5592 (GH); Suffolk, *Kearney* 1697 (US); Great Falls, *McAtee* 2311 (US); Hunting Cr., *McAtee* 2339 (US); Black Pond, Fairfax Co., *Muenschner* 3614 (CU); Mountain L., Salt Pond Mt.,

Giles Co., *Thorne* 11395 (FSU); Four Mile Run, Alexandria, *Tidestrom* 94 (S). NORTH CAROLINA: Jordans Mill Pond, Seaboard, *Beal* 3737 (NCSC); Garysburg, *Beal* 3816 (NCSC); Knotts I., Currituck Co., *Beal* 3956 (NCSC); Wiggins Rd., Wilson Co., *Beal* 4114 (NCSC); Moore's Pond, Youngsville, *Beal* 5690 (NCSC); L. Logan, Sunburst, Pisgah Natl. For., *Beal* 5835 (NCSC); Linville R., Pineola, *Beal* 6006 (NCSC); Alligator R., Fort Landing, Tyrrell Co., *Radford* 4616, 5409 (NCU); Perquimans R., Hertford, *Radford* 4686 (NCU); State Fish Hatchery, Marion, McDowell Co., *Radford* 4886 (NCU); Pensacola, Yancey Co., *Radford* 4956 (NCU); Currituck Sound, Duck, Dare Co., *Radford* 5436 (NCU); Boone's Mill Pond, Jackson, *Radford* 5739 (NCU); Island Cr., Trent R., Jones Co., *Radford*, *Haesloop & Miller* 7683 (NCU); Jack Smith Cr., New Bern, Craven Co., *Whitford* 231 (NCSC); Avery Co., *Whitford* (NCSC); L. Myra, Wake Co., *Whitford* (NCSC). ALABAMA: Little Bay Batte, Lower Mobile Bay Delta, *Lueth* 53 (DUKE). MICHIGAN: Jacobsville, *Herman* 7642 (K). OHIO: without locality, *Lx* (= *Lesquereux*), (BERN, G); Loraine, *Herb. Oberlin College* (US); Fox L., Wayne Co., *Selby & Duvel* 1321 (NY); Columbus, *W. T. S(ullivant)*, (G, M); Geauga L., Portage Co., *Webb* (GH). INDIANA: Blue R. Lake, Whitley Co., *Deam* 14458 (Deam Herb., UC); Wolf L., Noble Co., *Deam* 20721 (Deam Herb.); Wabash R., Fountain Co., *Deam* 22982 (Deam Herb.). KENTUCKY: Kentucky R., *Peter* (K, L, NY); Lexington, *Short* (K, P). MISSISSIPPI: Horseshoe L., Holmes Co., *F. A. Cook* (US). WISCONSIN: Wisconsin R., Merrill, *Fassett* 7376 (WIS); Mineral L., Mellen, *Fassett* 7377 (WIS); L. Superior, Oronto, *Gillman* (GH); Madison, *Hale* (F); Milwaukee, *Hase* (NY); Whitewater, *Kleeberger* (CAS); Milwaukee, *Lapham* (G); L. Mendota, Madison, *Mahoney* (WIS); Sullivan, *Shallert* (ZT); Whitney's Slough, Green Bay, *Shuette* (F); Point Sable, Green Bay, *Shuette* (F, K); St. Francis R., s. Wisc., *Widman* (MO). ILLINOIS: Cook Co., *Babcock* (MO); Indian L., *Eggert* (CAS, F, MO, UC, US); Keokuk Reservoir, Niota, *Eyles* 318 (NCSC); Chicago, *Gates* 632 (F); Chicago R., Bowmanvil, *Gates* 913a (F); Athens, *E. Hall* (F, G, P), 1079 (GH); without locality, *Hall* (GH); Oquawka, *Patterson* (F, NY); Murphys(boro), *Shuette* (F, UC); Pecatonica, *Swezey* (CAS). MINNESOTA: Winona, *Holzinger* (US); L. Winona, *Holzinger* (NY); without locality, *Holzinger* (CS); Swan L., Nicollet Co., *Metcalf* 6 (CU, US); L. Chisago, *Metcalf* 1232 (GH); Crystal L., Blue Earth Co., *Moore* 23682 (S); Center City, *B. C. Taylor* (B, BM, G, NY, RM, S, UC, US, WS). IOWA: Pike Cr., Muscatine Co., *Davidson* 4409 (NCSC); Harper's Ferry, *D. E. & M. S. Eyles* 338 (NCSC); Fayette, *Fink* (GH); Johnson Co., *Fitzpatrick* (MO); without locality, *Harvey* (GH); Swan L., Madison, *Thorne* 10472 (NCSC). MISSOURI: Kennett, *Bush* (MO); Carondelet, *Dewart* (MO), without collector (WU); Poplar Bluff, *Dewart*, in part (MO); Gascondy, *Emig* 218 (MO, US); American bottom, opposite St. Louis, *Engelmann* (MO); St. Louis,

Engelmann, holotype and isotypes of *Udora verticillata* Spreng. var. *minor* Engelm. (B, NY); St. Louis, *Gurney* (MO); Pink's slough, Allentown, *Kellogg* (MO); Jefferson City, *Krause* (MO); Ha-ha-tanka, Camden Co., *Metcalf* 924 (US); Rich Hill, Bates Co., *Metcalf* 992 (GH); Wayland, *Metcalf* 1089 (NY, US); Forest Mill, *E. J. Palmer* 3765 (MO, NY), 3766 (GH, US); Flat Cr., Barry Co., *Redfearn & T. Stombaugh* 4210 (FSU). NEBRASKA: Carter L., Omaha, *Kiener* 17601 (G); Enders L., *Thomson* 9 (US); Sweetwater Lakes, *Thomson* 177 (GH, NY, US). KANSAS: Linn Co., *Clothier* 1052 (GH, MO, NY, P, US, WU); Leavenworth, *Fendler* (GH). COLORADO: Larimer Co., *Cowen* (RM). IDAHO: L. Coeur d'Alene, *Epling & Houck* 10053 (LA); Fernan L., Coeur d'Alene, *Rust* 373 (US). WITHOUT LOCALITY: *Goldie* (K); *Torrey* (K).

The sterile specimens formerly listed for Oregon (*Rhodora* 22: 29, 1920) are now known to be *Elodea columbiana* St. John.

The record for Alabama, Mobile Bay Delta, Lueth 53, seems far out of range, and its occurrence there seems best explained as an escape from aquarium culture. Prof. J. Ewan agrees with this interpretation.

Again, the occurrence in northern Idaho, in and near Lake Coeur d'Alene, is remote from the rest of the range. The shores of the lake are a favorite hunting ground, and local sportsmen have imported and established duck food plants to attract the birds. They have successfully established *Zizania interior*, and it seems probable that *Elodea Nuttallii* was introduced in the same manner.

Cultivated specimens of the species are known from Germany, and the species is established in England, Holland, and probably in some other European countries.

Elodea Nuttallii is the type and only member of the section *Natator*. Its sessile staminate buds which are liberated to expand and float on the surface of the water are unique. They usually lack petals but have 9 stamens in two series, 6 outer, and 3 central.

Planchon's species was transferred and adopted by Rydberg as *Philotria Nuttallii* (Planch.) Rydb., but only as a provisional name. Later, in 1913, it was validly published, as *P. Nuttallii* (Planch.) Rydb. ex Britton & Brown. It is evident that Rydberg did not examine Planchon's holotype.

Rydberg cited six collections as this species, from New York, New Jersey, and Virginia. These specimens, in the New York Botanical Garden, have been reexamined. They differ in foliage and in flowers from the true *E. Nuttallii*. Instead, there is no basis of separation in the acuteness of their leaves or in the structure of the staminate flowers from the older *E. canadensis*. The writer positively refers these specimens, which represent the sense of *Philotria Nuttallii* Rydb. (but not of Planch.), to the synonymy of *E. canadensis*.

19. (3. of part 1.) ***Elodea canadensis*** Rich. in Michx., Fl. Bor.-Am. 1 (1803) 20; Richard, L. C., Mém. Inst. de France 12 (2), (1811-1812 = 1814) 3-4; *E. canadensis* var. *latifolia* (Casp.) Aschers. & Graebn., Syn. Mitteleur. Fl. 1 (1897) 403; *E. canadensis* var. *latifolia* var. *repens* Sanio, Verh. Bot. Verein Prof. Brandenburg 32 (1891) 121, an illegitimate epithet; *E. canadensis* var. *latifolia* subvar. *repens* Aschers. & Graebn., Syn. Mitteleur. Fl. 1 (1897) 404; *E. canadensis* var. *Planchonii* (Casp.) Farw., Am. Midl. Nat. 10 (1927) 203; *E. Planchonii* Casp., Monatsber. Kgl. Preuss. Akad. Wissensch, 1857 (1857) 47; also in Pringsheim's Jahrb. Wissensch. Bot. 1 (1858) 468-469, 500-501; *E. latifolia* Casp., Monatsber. Kg. Preuss Akad. Wissensch. 1857 (1857) 46, (and reprint p. 11, 1857); also in Pringsheim's Jahrb. Wissensch. Bot. 1 (1858) 467-468; *E. oblongifolia* Michx. ex Casp., Pringsheim's Jahrb. Wissensch. Bot. 1 (1858) 462; *E. iowensis* (as *Iowensis*) Wylie, Proc. Iowa Acad. Sci. 17 (1910) 82, a provisional name; and in Science n.s. 33 (1911) 263; *E. ioensis* Wylie, State Univ. Iowa, Nat. Hist. Bul. 6(4) (1913) 48, pl. 1-2; *Anacharis Alsinastrum* Babington, Ann. & Mag. Nat. Hist. II, 1 (1848) 83-84, 86; also in Ann. Sci. Nat. Bot. III, 11 (1849) 74; *A. canadensis* Planch., Ann. & Mag. Nat. Hist. II, 1 (1848) 86, and in Ann. Sci. Nat. Bot. III, 11 (1849) 75; *A. canadensis* Planch. var. *Planchonii* (Casp.) Victorin, Univ. Montréal, Contrib. Lab. Bot. 18 (1931) 40; *A. Planchonii* (Casp.) Rydb., Fl. Prairies & Plains Cent. N. Am. (1932) 57; *A. Planchonii* (Casp.) Peck, Man. Higher Pl. Ore. (1941) 76-77; *Philotria canadensis* (Rich. in Michx.) Britton, Science II, 2 (1895) 5; *P. Planchonii* (Casp.) Rydb., Bull. Torrey Bot. Club 35 (1908) 462-463; *P. iowensis* (as *Iowensis*) Wylie, Proc. Iowa Acad. Sci. 17 (1910) 82; and Science n.s. 33 (1911) 263; *Udora canadensis* (Rich. in Michx.) Nutt., Gen. N. Am. Pl. 2 (1818) 242, as to basionym, but excluding the linear-leaved Philadelphia specimen which is the holotype of *E. Nuttallii*; *Serpicula canadensis* (Rich. in Michx.) Eaton, Man. Bot. ed. 5, (1829) 390. Fig. 1, 2 a-d, 5.

Description of all specimens examined: Submerged aquatic, root-

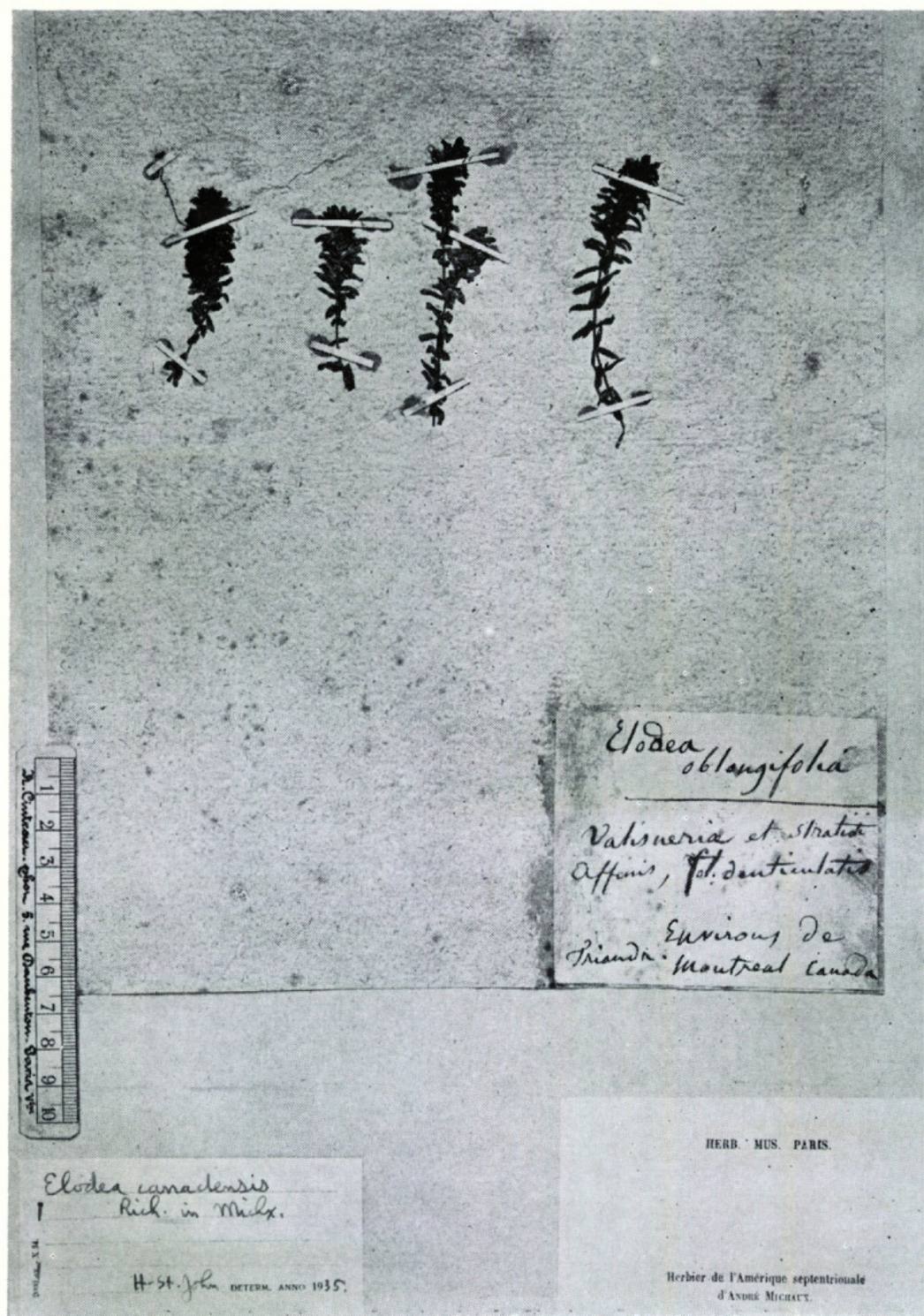


PLATE 1308

Fig. 1. *Elodea canadensis* Rich. in Michx. Holotypic sheet in the Museum National d'Histoire Naturelle, Paris.

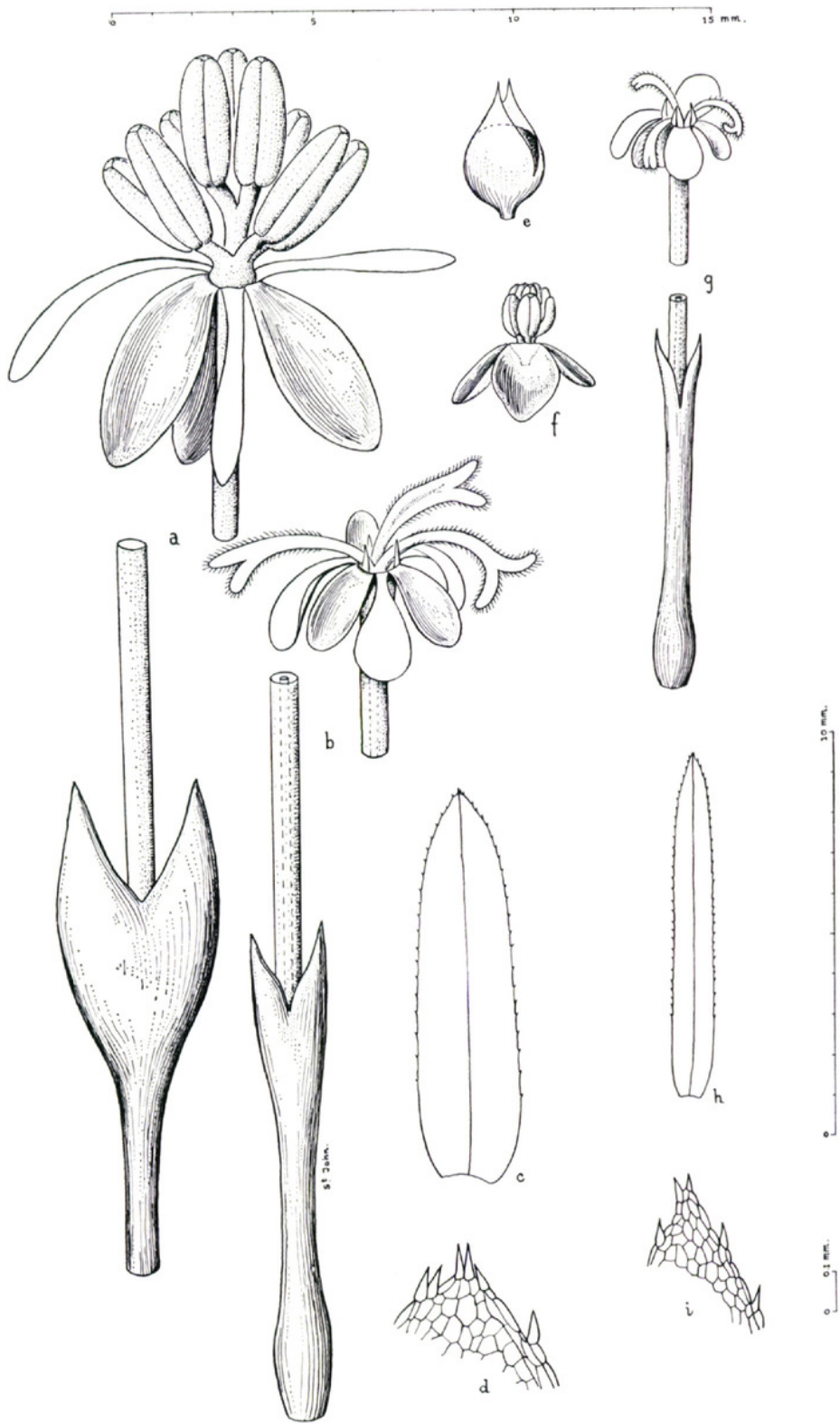


Fig. 2. *Elodea canadensis* Rich. in Michx., staminate flower, from L. N. Gooding 597, $\times 5$; b, pistillate flower, from Cayuga Lake, W. R. Dudley, $\times 5$; c, leaf from holotype, $\times 5$; d, leaf apex of same, $\times 50$; e, *Elodea Nuttallii* (Planch.) St. John, staminate spathe and bud, from Okuawka, Ill., H. N. Patterson, $\times 5$; f, expanded staminate flower, from Old Lyme, Conn., R. W. Woodward, $\times 5$; g, pistillate flower, from Center City, Minn., B. C. Taylor, $\times 5$; h, leaf, from H. St. John 1,827, $\times 5$; i, leaf apex of same, $\times 50$.

ing in the mud; plants dioecious; staminate plants rarely observed, their stems 2-10 dm. long; lower leaves opposite, small, lance-ovate; median and upper leaves in whorls of 3 and 7-17 mm. long, 1-4 mm. broad, linear, lance-linear, or lance-oblong, bright green, thin, firm or subflaccid, finely serrulate; staminate spathes borne in the upper axils, 15 mm. long, the lower half narrowed into a peduncle-like base, the upper half 6-8 mm. long, 4 mm. wide, inflated, ellipsoid or ovoid, the apex resembling a gaping mouth, due to the two acute, salient lobes; staminate flowers peduncled by the slender, thread-like, elongating base of the hypanthium which is 3-20 cm. long; sepals 3.5-5 mm. long, 2-2.5 mm. wide, elliptic, dark striate; petals 5 mm. long, 0.3-0.7 mm. wide, white, very delicate, the basal half a linear claw, the apical half linear lanceolate; stamens 9, the 3 inner raised on a common, fused stalk; anthers 2-3.5 mm. long, 1 mm. wide, oblong-ellipsoid; pistillate plants with stems slender, dichotomously branched; lower leaves opposite, ovate, much smaller than the upper ones; median and upper leaves in whorls of 3, and 6-13 mm. long, 1-5 mm. broad, oblong, ovate-oblong or lance-ovate, firm, dark green, serrulate, crowded and strongly imbricate at tip of the stem; pistillate spathe 10-20 mm. long, borne in upper axils, cylindric, the apex bidentate and with two broad teeth; pistillate flower exerted from the spathe by the thread-like, elongating base of the hypanthium which is 2-28 cm. long; sepals 2-2.2 mm. long, 1.1 mm. broad, oblong elliptic, dark striate; petals 2.6 mm. long, 1.3 mm. wide, broadly elliptic-spatulate, white, delicate; staminodia three, 0.7 mm. long, acicular; style equaling the hypanthium; stigmas three, 4 mm. long, broad, 2-cleft at apex; ovary 3 mm. long, lance-ovoid; ovules 3-4, erect; capsules 6 mm. long, 3.2 mm. in diameter, ovoid; seeds 4.5 mm. long, narrowly cylindric, glabrous.

Holotypus: "in rivulis Canadae." Environs de Montreal, *Elodea oblongifolia*, A. Michaux (P)! Type examined! Though the specimens bear the name *E. oblongifolia*, it was published as *E. canadensis*.

Range: In fresh ponds and streams, especially in calcareous areas, from Quebec, abundant southward to North Carolina, Alabama, and Arkansas, westward to Manitoba, British Columbia, Colorado, and central California, but absent in the higher Rocky Mountain region.

NORTH AMERICA, Herb. Durand (P); in 1823, Greville (K); Michaux (P); in 1827, Schweinitz (B); donné par W. Hooker (P).

CANADA: Cleghorn (K); Ny. He. [Norway House] to Canada, R. D. (K); Herb. Sprengel (B). QUEBEC: Corris Sta., Cleveland, Chamberlain & Knowlton (GH); L. Memphremagog, Churchill (GH, K), Aug. 18, 1906, Churchill (GH); L. Bernard, Farrellton, Hull Co., Rolland-Germain 6472 (S); flum. St. Laurent, Mont Real, Hennecart (P); Magog L., Orford, Knowlton (GH); R.-aux-Serpents, Deux-Montagnes Co., Pere Louis-Marie (S); Hull, Macoun 27001¹ (CAN);

Farm Pt., Gatineau R., *Macoun* 61033 (CAN); Ste. Anne de Beau-pré, *Macoun* 68806 (CAN, GH); Hull, *Macoun* 85553 (CAN); Pickanock R., *Macoun* (GH); Ottawa R., Hull, *Macoun* (F); St. Lawrence R., Caughnawaga, *Victorin* 8171 (BM, DEAM HB.); R. St.-Laurent, Montréal, *Victorin* 9910 (P); Longueuil, *Victorin* 11256 (DEAM HB., P, US); Montréal, *Victorin* 20318 (GH, P, S); Longueuil, *Victorin* 24725 (S); Montréal, *Victorin* 28388 (K, S); Pt. à Bison, Co. de Beauharnois, *Victorin* 28393 (K, S); rapides Richelieu, Chambly, *Victorin & Germain* 33905 (S); R. Richelieu, St.-Mathias, Chambly Co., *Victorin & Germain* 7310 (K, LD); R. Richelieu, St.-Mathias, Chambly Co., *Victorin & Germain* 7410 (FSU, S); R.-des-Prairies, Hochelaga Co., *Victorin & Germain* 33996 (S); Ile Ste.-Therese, St.-Jean Co., *Victorin & Germain* 45631 (C), 49140 (G), 49147 (W); Ste.-Rose, Laval Co., *Victorin & Germain* 49306 (C, W); Ile Ste.-Therese, Sainte-Jean Co., *Victorin & Germain* 49361 (G, M, W); Melocheville, Saint-Laurent R., *Victorin, Germain & Boivin* 4302 (S), Lac Olive, Reg. de l'Abitibi, *Victorin, Germain & Meilleur* 44974 (C); Ile Calumet, Ottawa R., *Victorin, Germain & Rouleau* 2017 (W); Ste.-Anne de Sorel, Richelieu Co., *Victorin, Germain & Rouleau* 6534 (C, S). ONTARIO: Kapuskasing R., Cochrane Dist., *Baldwin & Breitung* 3515 (K); Cochrane, Lillabelle L., *Baldwin & Breitung* 3898 (K); German Twp., Timmins, Cochrane Co., *Baldwin & Breitung* 4062 (S); Detroit R., Herb. *Boott* (GH); London, *Burgess* 2208 (BM); Frog L., Hardwick, *Garton* 1676 (G, W); Chelsea, *Harrington* (CAN); St.-Thomas, Elgin Co., *L. E. James* 1711 (C, G, L, W); Sparrow L., *Kirk* 679 (L); Stokes Bay, Bruce Penin., *Krotkov* 8649 (NY); St. Clair Flats, *McAtee* 3424 (US); Kaministiquia R., Neeling, Thunder B. Dist., *Mayall & Cormack* 24 (W); Lake Region, *Macoun* (K); Bay of Quinte, *Macoun* (CAN); Niagara Falls, *Macoun* 82331 (CAN); Kenora, Lake of the Woods, *Ostenfeld* 552 (C, CP); Coldwell, *Ostenfeld* 584a, 584c (C, CP); L. Superior, Coldwell, *Rendle & Good* (BM); Toronto, *Scott* (CAN); Jock R., Beckwith, Lanark Co., *Senn* 552 (S); Moose Factory, *Spreadborough* 62633 (CAN); Toronto, *Sturtevant* (MO); Pancake R., Algoma Dist., *Taylor, Hosie et al.* (S); L. Ontario, Belleville, Hastings Co., *Victorin, Germain & Jacques* 45855 (GB); Niagara, *C. S. Williamson* (PH). MANITOBA: R. des Marais, Otterburne, *Bernard* 58284 (S); Brandon, *Macoun* 13724 (B, CAN, F); Souris R., N. W. T., *Macoun* 27002 (CAN, GH); Wekusko L., *Scoggan* 6680 (C, K, S); Grassy R., Tramping L., *Scoggan* 6900 (C, K); Whiteshell For. Res., *Scoggan* 8723 (K); Minnedosa R., Elphinstone, *Scoggan* 10268 (C, S). SASKATCHEWAN: Carleton House without collector, (GH); without locality, *Drummond*, type of *E. Planchonii* Casp. (GH, K). BRITISH COLUMBIA: Mara L., Enderby to Sicamous, *Calder & Savile* 11838 (W).

UNITED STATES. MAINE: L. Auburn, Auburn, 1953, *Bean* (NEBC); Benton Falls, Seabasticook R., 1959, *Bean* (NEBC); Lily Pond, Rockport, *C. A. E. Long* 906 (NEBC, NY); Rockport, *Long*

(NEBC, NY); calcareous water, Lily Pond, Rockport, *Rossbach* 96 (NEBC); Unity Pond, Unity, *Rossbach* 97 (NEBC). NEW HAMPSHIRE: Harris Pond, Pelham, Hillsborough Co., *Dupee* (NHA); Partridge Pond, Littleton, Grafton Co., *Sheehan & Krochmal* 53 (NHA). VERMONT: Winooski R., Essex Jct., *S. F. Blake* 2210 (NEBC, PH); N. Hero, *Brainerd* (P); Herb. *Chapman* (UC); Fern L., Leicester, *Dutton* (CU, MO); Catharine Wells, *Dutton & C. W. Dodge* (NY); L. Bomoseen, W. Ferrisburg, *Eggleston* (GH); Little Otter Cr., Ferrisburg, *Eggleston & Grout* (GH); Ferrisburg, *Eggleston* (F). MASSACHUSETTS: Andover, *J. Blake* 2210 (NEBC); Pontoosuc L., Lanesboro, *Churchill* (MO); Tyringham, *H. T. Clark* (BR); L. Garfield, Monterey, *Hoffman* (NEBC); Sheffield, *Hoffman* (NEBC); Fresh Pond, Cambridge, *Morong* (MO); Pontoosuc L., Pittsfield, *Kennedy* (GH); L. Quannapowitt, Wakefield, *Ripley* 16138 (GH), 17494 (GH, NEBC); Great Brook, Southwick, *Seymour* 257 (MO, NY). RHODE ISLAND: N. Providence, *Olney* (BRU, S), *Curtiss* (G), *Hope* (NY), *Olney* (BRU), *Olney* (S). CONNECTICUT: L. Saltonstall, *Blewitt* 1981 (NEBC); Norwalk, *E. H. Eames* 5265 (NY); L. Congamond, *Eames* 8457 (GH); Boardman's Pond, E. Hartford, *Weatherby* 367 (NCSC); Housatonic R., N. Canaan, *Weatherby* 2700 (NEBC); E. Haven, *Weatherby* 3591 (NCSC); Housatonic R., Huntington, *Harger & Weatherby* 3595 (NCSC); Huntington, *Weatherby* 3604 (NEBC), 3595 (WEATHERBY HERB.); Branford, *Setchell* (UC); E. Haven Pond, Herb. *Torrey* (NY); *Wright* in part (MO). NEW YORK: Fall Cr., Ithaca, *Bechtel* 13364 (CU); New York, *Bicknell* 174 (NY); Thousand Is., *Bicknell* 177 (NY); Chilton L., *Britton* (NY); New York, *Britton* (G); Kendall, *Burnett* (NY); Harris Bay, L. George, *Burnham* 53 (US); Fall Cr., Ithaca, *Clausen* 2386 (G); Buffalo, *Clinton* (F, MO, NY); Grand I., Niagara R., *Coville* (US); Cayuga L., *Dudley* (DS); Springport, *A. J. Eames* 13362 (CU); Renwick, *Eames & Wiegand* 13353, 13353a (CU); Cayuga L., *Eames & Wiegand* 13356 (CU); Mattituck, *Ferguson* 3405 (NY); Oakdale, *Ferguson* 7879 (NY); Cayuga L., *Fernald & Wiegand* 14548 (CU, GH); Watertown, *Fernald, Wiegand & Eames* 14125 (CU, GH); Ossawegatchee, *Fernald, Wiegand & Eames* 14126 (CU, GH); Clayton, *Fernald, Wiegand & Eames* 14127, in part (CU, GH); Selkirk, *Fernald, Wiegand & Eames* 14128 (CU, GH); Watertown, *Gray* (NY); w. N. Y., *Gray* (GH); *Gray* (K, M); Renwick, *R. Hitchcock & A. R. Bechtel* 11218 (CU); Pecksport, *House* 6561 in part (GH); Pierrepont Pond, Woodville, *House* 8223 (NY); Irondequoit Bay, *Killip* 1063 (MO); Oswego R., Oswego, *Killip* 12533 (US); Jennings Pond, Danby, *Lawrence* 831 (S); without locality, 1821, *Mitchell* (G); L. Ontario, *Morong* (MO, NY); Cayuga L., Ithaca, *Morong* (BM, NY); Danby Pond, Danby, *Muenschner* 19584 (S); Fall Cr., Ithaca, *Muenschner* 13354, 13363 (CU, GH); Oneida L., *Muenschner* 14547 (CU); Fall Cr., Ithaca, *Muenschner & Bechtel* 50 (O); Cayuga L., Ithaca, *Muenschner & Bechtel* 51 (O); Geneva, *Muenschner & Burkholder* 16366 (WS); Conesus L., *Muenschner & Burkholder* 16367, 16370 (WS); Silver L.,

Wyoming Co., *Muenschner & Burkholder* 16368 (WS), 16369 (GH, WS); Irondequoit Bay, *Muenschner, Wiegand & Wright* 15197 (CU); Sodus Center, *Wiegand & Wright* 15198 (CU); Thousand Is., *J. I. & G. R. Northrup* (NY); Junius marlbog, Seneca Co., *Ostenfeld* (C); Tioughnioga R., Cortland, *E. L. Palmer* 73 (CU); Seneca Falls, Cayuga L., *Palmer & Eames* 72 (CU); Grass R., Canton, *Phelps* 279 (CU, GH); P Y = (Penn Yan), *Sartwell* (F); Cayuga L., *H. von Schrenk* (MO); Fall Cr. Ithaca, *von Schrenk* (MO); Albany, Herb. *Schinz* (Z, ZT); Bainbridge, *Topping* (US); Oneida by New York, *Torrey* (P); Ithaca, *Trelease* (MO); Fish Cr., Oneida L., *Underwood* 3211 (NY); Lake View, L. Ontario, Jefferson Co., *Underwood* (NY); Charlotte am Ontario See, *Weinland* 49 (B); North Pond, Sandy Cr., Oswego Co., *Wiegand* 13355 (CU); N. Fairhaven, *Wiegand* 13358, in part (CU); McMullen Pond, *Wiegand* 13359 (CU); Renwick, *Wiegand* 13360 (CU); Fall Cr., Ithaca, *Wiegand* 13361, in part (CU); Spencer, *Wiegand & Fernald* 14546 (CU, GH); Cayuga L., Ithaca, *Wiegand & C. C. Thomas* 1533 (CU); Wellesley I., St. Lawrence R., *Ward* (US); L. Katrine, Ulster Co., *Wilson* (NY). NEW JERSEY: Foul Rift, Warren Co., *Bartram* (PH); Muscanetcong R., Asbury, Warren Co., *Godfrey* 62102 (FSU); Delaware R., Delaware Co., *Mackenzie* 7233 (NY); New Brunswick, *Mackenzie* 7258 (NY); Green Pond, Warren Co., *Mackenzie* 7732 (NY); Raritan R., New Brunswick, *Mackenzie* (NY); Rockaway, *Mackenzie* (NY, S); Stillwater, *Mackenzie* (NY); Clifton, *Nash* 1 (NY); Morris Co., *Rusby* (MO); Sussex Co., *Rusby* (BRU); Budd's L., Sussex Co., *Small* (C, F); Pensauken Cr., *Trudell* (NY); Foul Rift, *Van Pelt* (PH); Cooper's Ferry, opp. Kensington, without collector (PH). PENNSYLVANIA: Ingham Sprs., Bucks Co., *Bassett* (S); W. Chester, *W. D[arlington]* (K, LD); Peach Bottom, *Eby* (MO); Sellersville, *Fretz* (UC); without locality, Herb. *Guthnik* (BERN); Flinton, *Jennings* (CU, MO); Churchtown, *Long* (PH); Bloomsburg, *Meredith* (PH); Bethlehem, *Moser* (L, NY); Lancaster, *Mühlenberg* (M); without locality, *Mühlenberg* (S); Philadelphia, *Pickering* (PH); Erie, *Porter* 91 (PH); Pot Rock, Easton, *Porter* (PH); Saucon Cr., Friedensville, *Pretz* 4183 (PH); Allentown, *Pretz* 4784 (PH); Cedar Cr., Griesemersville, *Pretz* 6962 (PH); Centre Valley Sta., *Pretz* 11212 (PH, WS); Juniata R., *Rothrock* (F); without locality, *L. B. de Schweinitz*, in part (BR); Bethlehem, *Schweinitz*, in part (PH); Harrisburg, *Small* (F); Telford, *Strohm* (PH); Bethlehem, without collector, in part (BR). DELAWARE: Delaware City, *Commons* (GH, PH); Wilmington, *Tatnall* (MO). MARYLAND: Susquehannah, Herb. *Buckley* (MO); C. & P. Canal, near Lock 12, *Killip* 32129 (P); Ipesutic I., *J. D. Smith* (US). DISTRICT OF COLUMBIA: Rob's Pt., Potomac R., *Coville* 120 (US); Washington, *Vasey* (US), *Ward* (US). WEST VIRGINIA: Booth Cr., Uffington, Monongalia Co., *Davis* 205 (NCU); Kanawha Co., *Holton* (F); Wallace Switch, *Small* (NY). VIRGINIA: without locality, *Beyrich* (B); Big Walker Cr., Poplar Hill, Giles Co., *Kral* 13971

(FSU); V. P. I. grounds, Montgomery Co., *Massey* (NCU); Hunting Cr., *McAtee* 2281 (US); Waynesborough, *Murrill* (NY); Four-Mile Run, *Shull* 467 (US); New R., Goodwin Ferry, *Thorne* 17862 (FSU); Four Mile Run, near Alexandria, *Tidestrom* 94 (P); The Dyke, Potomac R., *Tidestrom* 7185 (US). NORTH CAROLINA: shallow pond, Perquimans Co., 1932, *Glasson* (DUKE); University L., Chapel Hill, *Hueske* (NCU); Snyder's L., Blowing Rock, Watauga Co., *Radford* 4950 (NCU); pools, State Fish Hatchery, Marion, McDowell Co., *Radford* 5279 (NCU). MICHIGAN: Detroit, *Bigelow* (MO); R. Rosin, Monroe, *Chandler* (US); Wolf L., *Chase* 1711 (US); Arenac Co., *Dodge* (US); Black R. near Black L., Cheboygan Co. *Ehlers* 5902 (S); Ocquecoc L., Presque Isle Co., *Ehlers* 6256 (S); Douglas L., Cheboygan Co., *Ehlers* 6280 (S); Hook Pt., Mich. Biol. Sta., Cheboygan Co., *Gates* 14143 (S); Douglas L., *F. C. & M. T. Gates* 10592 (F, MO); Sault St. Marie, *Gillman* (GH); Fort Gratiot, *Gillman* (GH); Sailor's Encampment, *E. T. & S. A. Harper* (B); Liver-Light Lakes, *Metcalf* 2222 (C, CP); Manistee, *Morong* (GH, NY); Kewenah Pt., L. Superior, *Robbins*; Whitmore L., *Stearns* 305 (C, CP, G, GH, K, LD, NCSC, NY, O, ZT); Reed's L., Grand Rapids, *C. F. Wheeler* 7663 (CS); Swan Cr., Old Fort, *Wight* 41 (US); Lower Scott L., Lee, *Wight* 73 (US); Ann Arbor, *Winchell* 7760 (MO); Sault Ste. Marie, no collector (PH). OHIO: Cincinnati, *J. Clark* (BM); unio itiner., *Frank* (G, K, P); Clear Cr., Hamilton Co., *J. F. James* (DS, US); Sandusky, *Moseley* (F), *R. C. O. & E. B. W.* (Deam Herb.); Put-in-Bay, *Pieters* (US); East Harbor, *Pieters* (US); Braceville, *A. N. Reed & Webb* 929 (GH); without locality, *J. L. R.* (P); Newark, *E. B. Williamson* (Deam Herb.). INDIANA: Wolf L., *Chase* 1711 (C, F, MO, O); L. Maxinkuckee, *H. W. Clark* 1 (US), 1593 (US); Rochester, *Deam* 11765 (Deam Herb.); L. James, Steuben Co., *Deam* 20245 (Deam Herb.); Princeton, *Deam* 25520 (Deam Herb.); Pendleton, *Deam* 25599 (Deam Herb.); Deshee R., Decker, *Deam* 29224 (Deam Herb.); Waldron, *Deam* 30087 (Deam Herb.); Knox, *Deam* 42177 (Deam Herb.); Harrison, *Deam* (Deam Herb.); L. Maxinkuckee, *Evermann* 1070 (US); 5-Mile Pond, Terre Haute, *Evermann* (F, US); Wolf L., *Greenman* (MO); Tippecanoe R., Talma, Fulton Co., *N. C. Henderson* 61-471 (FSU); Bedford, *Kriebel* 3479 (GH); E. Chicago, *Lansing* 1767 (F); L. Maxinkuckee, *Scovell & H. W. Clark* 1070 (DS, F); Mishawaka, *E. B. U.* (F); Whittings, no collector (PH). KENTUCKY: Reelfoot L., *Alexander* 323 (US); Kentucky R., *Peter* (PH); without locality, *Herb. C. W. Short*. ALABAMA: Lightsey's Pond, Centerville, *R. M. Harper* 3287 (NY, PH, US). WISCONSIN: Lauderdale, *R. Bebb* 1531 (F); Prairie du Chien, *Fassett* 5049 (Glück Herb., Heidelberg); Kawaquesagon, *Minocqua, Fassett* 5328 (Glück. Herb.); Beloit, *Fassett* 5691 (Glück Herb.); St. Croix Falls, *Fassett* 7378, 7379 (WIS); Nemakagon R., Cable, *Fassett* 7380 (WIS); L. Wiehe, *Eliot, Fassett* 7381 (WIS); Tomahawk R., *Fassett* (Glück Herb.); Trempealeau, *Fassett & Wilson* 5050, 5051

(Glück Herb.); Bear L., Barron Co., *Goessl* 6907 (B); Nobleton, Washburn Co., *Goessl* 7471 (B); Cameron, Barron Co., *Goessl* 8785 (B); Milwaukee, *Hasse* 2531 (PH); Whitewater, *Kleeberger* (CAS); without locality, *Lapham* (MO); Prairie du Chien, *H. H. Smith* 7422 (B). ILLINOIS: Mound Cr., Ogle Co., *M. S. Bebb* (PH); Ogle Co., *Bebb* (F); Peoria, *Brendel* (P); "Canes," *De Selm* 717 (F); Grass L., Lake Co., *Gates* 1758.4 (Deam Herb.); Oregon, *Waite* (US). MINNESOTA: Prior's L., Scott Co., *Ballard* (NY); Clearwater Co., *Buell* 1650 (NCSC); E. Twin Pond, Itasca Park, Clearwater Co., *Buell* 1651 (NCSC); Ft. Snelling, *Campbell* (F, MO); L. Winona, *Holzinger* (NY, US); L. of the Woods, *MacMillan & Sheldon* 572 (CU, GH), 3334 (NY); Ft. Snelling, *Mearns* 804 (US); Squaw L., Cass Co., *Metcalf* 2364 (GH); N. W. Territory, *Nicollet* 415 (PH); Thompson, *Sandberg* 563 (WS); Hennepin Co., *Sandberg* (F, UC, US); Center City, *B. C. Taylor* (O). IOWA: Fayette Co., *Fink* 552 (US); Spirit L., Dickinson Co., *Anderson* (C, G, GH, L, LD, NCSC, S, W); Clinton Co., *Butler* 27 (MO, P); Des Moines R., Emmet Co., *Cratty* (NY); L. Okoboji, *Wolden* (GB); Pilot Knob State Park, Hancock Co., *Thorne* 14595 (NCSC); Cheever L., Estherville, Emmet Co., *Thorne* (NCSC); E. Okoboji L., Dickinson Co., *Wylie*, type of *E. iowensis* Wylie (GH, NY). MISSOURI: Neosho, *Bush* (MO); St. Louis, *Engelmann* (NY); Phillips Spr., Van Buren Co., *Redfearn* 5742 (FSU); Mill Spr., Wayne Co., *Russell: Trelease* (MO). ARKANSAS: Mammoth Spr., *Trelease* (MO). NORTH DAKOTA: L. Metigoshe, (*C. E.*) *Lee* (RM); Minot, *Lunell* (Deam Herb., DS, NY, RM, US); Jim L., Pingree, *Mabbott* 321 (US); Fargo, *Waldron* (MO). NEBRASKA: Loup Fork, *Hayden* 1553, 1554 (MO); without locality, *Hayden* (NY); Jackson L., N. Platte, *Kiener* 17514 (G); Kingsley Dam, Keith Co., *Kiener* 15537 (G); Fremont, *Williams* 373 (US). MONTANA: Lindberg L., Swan R., Missoula Co., *C. L. Hitchcock & Muhlick* 13712 (S); S. Pablo Reservoir, Lake Co., *Hotchkiss* 6349 (US). IDAHO: L. Pend d'Oreille, *Leiberg* 9 (C). WYOMING: Fish Hatchery, *Nelson* 1429 (RM), 5374 (BM, GH, MO, NY, RM, US). COLORADO: Alamosa, *Biltmore Herb.* 105a, Colo. Exped. 1-897 (US); Rio Grande, Alamosa, *Shear* 3746 (NY). UTAH: Panguitch L., *Jones* 6018 (US); Fish L., *Locke* 4 (US). NEVADA: (formerly in Utah), Carson R., Ragtown, *Remy* (B, P). WASHINGTON: Seattle, *Bardell* (MO); Green L., Seattle, *Congdon* (MO); Seattle, *Eyerdam* (G); Clover Cr., Pierce Co., *Eyerdam* 1221 (G, S); 98th st., (Seattle), *Eyerdam* 6627 (G); Lake Chelan, *Gorman* (US, WS); Green L., Seattle, *Piper* (WS); Fish L., Spokane Co., *Preston* 860 (WS); Little Spokane R., Davenport, *St. John* 3438 (DS, K, WS), *St. John & Warren* 3423 (WS); Falcon Valley, *Suksdorf* 87 (O); Calispell L., Pend Oreille Co., *Yocom* (W); Seattle, *Zeller* (MO). OREGON: Harriman Lodge Sta., *Abrams* 9719 (DS, MO); Crater L., *Coombs* (CAS); Sprague R., Bly, *Coville & Leiberg* 318 (US); DesChutes R., Bend, *Peck* 4250 in part (W, WS). CALIFORNIA: Big Meadows, *Austin* 573 (MO, US); Feather R., *Austin* 1179 (US); Plumas Co., *Austin* (NY);

Egg L., *Baker* (UC); Sisson, *Eastwood 1268* (CAS); Folsom, Sacramento Co., *Johannsen 652* (FSU); Mt. Eady, *Krautter* (BM); Sisson, *Krautter* (K); Walker Cr., Klamath R., Siskiyou Co., *Lee 1239* (G, K); San Dimas Canyon, San Gabriel Mts., "of very doubtful indigeniety," *L. Wheeler 2325* (DS, CAS, LD); Mendocino Co., *Vasey* (US).

Discussion: Caspary in his treatment of the Hydrilleen (1858) included a detailed monograph of *Elodea*, in which he accepted 10 species. He treated *E. canadensis* Rich. in Michx. in great detail. It is noted that he describes plants with a floral morphology quite different from those of the present concept. In *E. canadensis* he included plants that were hermaphroditic, others dioecious, others polygamous (fide Torrey, and fide Gray). His "hermaphroditic" plants were Michaux's type specimens of *E. canadensis* (hermaphroditic fide Rich. in Michx.); and Moser's and Schweinitz's collections from Bethlehem, Pa. which are the true *E. Schweinitzii* and are genuinely hermaphroditic. His dioecious plants were *E. Nuttallii*, and *Anacharis Alsinastrum* which was based on pistillate plants of *E. canadensis* when established in England, and *Udora occidentalis* (Pursh) Koch, in part, which is a synonym of *E. canadensis*. In addition Caspary accepted as a species *E. Planchonii* Casp. which is merely the staminate plant of *E. canadensis*. He also made and accepted *E. latifolia*, based on broad leaved, sterile material of *E. canadensis*. He accepted *E. Schweinitzii* (Planch.) Casp., though he had some doubt about it. He had seen the holotype but its flowers were mutilated and he could not confirm its characters, so he accepted it, with confidence in the description by Planchon. However, he cited four good specimens of this species as hermaphroditic specimens of *E. canadensis*. In sum, Caspary did not have a good understanding of *E. canadensis*, as he made three species out of it, while reducing to the synonymy of *E. canadensis* itself two other excellent species. *E. guyanensis* Rich. was maintained by Caspary, though there are no actual differences to separate it from the earlier *E. granatensis* Humb. & Bonpl.

The floral morphology of *Elodea canadensis* is in need of

discussion, as it has often been misinterpreted. In the original diagnosis of the monotypic genus Richard in Michaux included among other details, the following: that the three stamens, with thick filaments, bore terminal, cordate anthers. In part 1 of this monograph (1962: 34-36) it is shown that of the existing 8 good, open flowers on the holotypic sheets in Paris and the isotypic sheet in Geneva, all are pistillate, with 3 acicular staminodia, all without anthers. The type locality was "in rivulis Canadae," and the label adds, "environs de Montreal." The species still grows commonly there, and the pistillate plants from the type locality have subsequently been described in detail by Victorin (1931: 15-19). Their pistillate flowers are identical in structure with those of the holotype collection, and with all other normal flowers of all other collections of wild, indigenous specimens from Canada and the United States. Their flowers are dioecious, as the functionally pistillate ones have 3 bifid stigmas and 3 acicular staminodia, but no anthers. These pistillate plants were the kind that in 1836 escaped from cultivation in Ireland, and with remarkable rapidity spread to aquatic habitats of most of Europe.

Rydberg (1908: 458-459) stated that "Caspary, who saw the original Michauxian material at Paris, stated that the two flowers found there were hermaphrodite as described." The present writer in 1935 found Michaux's holotype in Paris to consist of five sheets, and in Geneva one isotypic sheet, the holotype with a total of eight good flowers, but none of them with anthers. Caspary (1858: 462) stated that he examined two of Michaux's specimens. For one he quoted from the label, "Triandr.;" for the other he said, "mit schlechter blüthe." So, Rydberg notwithstanding, Caspary did not say that he saw two flowers of the type material and that they were hermaphrodite. It is clear that the existing abundant holotypic material has only pistillate flowers with 3 staminodia.

The staminate plants and flowers of this species were not at first recognized as of the species *Elodea canadensis*. They were described as *E. Planchonii* Casp. (1857: 47),

based upon "Suskatschawan, *Drummondio*; Canada, *Cleg-hornio*." The former specimen, Saskatchewan, *Drummond* (K), which has good staminate flowers, is here chosen as lectotype. These staminate flowers are strikingly different from the pistillate flowers, but are produced from the same sort of spathe which has a peduncle-like base and a bidentate ellipsoid apex. The sepals are larger, 3.5-5 mm. long; so also are the petals, being 5 mm. long. The 9 stamens consist of 6 lower outer ones and 3 inner ones raised on a common stalk. On the holotype and on most of the staminate plants the leaves of successive nodes are more widely spaced, narrower, and thinner, than on the pistillate plants of *E. canadensis*. Since their description as *E. Planchonii* in 1857, these staminate plants have by most botanists been accepted as a distinct species, but by a few as a variety, *Anacharis canadensis* var. *Planchonii* (Casp.) Victorin.

The first good evidence that *Elodea Planchonii* really represented only the staminate plants of *E. canadensis* came from the studies of Wiegand and Eames (1926: 55). They reported that these staminate plants grew together with the pistillate *E. canadensis* and they classed them as the two sexes of a single species. Several of their collections of flowering staminate plants had broad, firm, imbricate leaves, indistinguishable from those of genuine, pistillate *E. canadensis*.

The collection from New Jersey, Morris Co., July 1879, H. H. Rusby, has the leaves as narrow as in *Elodea linearis*, but the staminate flowers as in *E. Planchonii*. The specimen from Quebec, Longueuil, Aout 1920, *Marie-Victorin* 11256 (US); and that from North Dakota, Jim Lake, Pingree, Aug. 14, 1917, *D. C. Mabbott* 321 (US) have the typical staminate flowers but the leaves as short and broad and imbricate as in the pistillate *E. canadensis*.

In 1926 to confirm the observations of Wiegand and Eames, the writer followed Dr. W. C. Muenscher, and at Ithaca, New York, waded in the estuary of a stream flowing into the south end of Cayuga Lake. There, flowering pistillate *E. canadensis* and flowering staminate *E. Planchonii* were growing in 3-4 feet of water in both adjacent

and intermingling luxuriant colonies. At first glance they seemed different in herbage. That is, of course, to be expected between plants of different species, but it is also possible between the two sexes of a dioecious species. An extended survey in this large colony showed that besides the different looking plants, there were also plants with intermediate and ones with identical foliage characters. We agreed that there were no constant differences or usable distinctions in the foliage of the male and the female plants.

Though the male flowers are much the more conspicuous, they have seldom been collected. However, their total range in North America falls within that of *Elodea canadensis*, and at almost every locality for the staminate, the pistillate is also known to occur. From these considerations it seems clear that the staminate *E. Planchonii* is not a distinct taxon, but is merely the staminate sex of the wide ranging *E. canadensis*.

Staminate plants of *Elodea canadensis* have rarely been found in Europe. A second botanical collector with the famous name D. Douglas found and published (1880: 227-229) on the occurrence of these plants at the Braid Hills, Edinburgh, Scotland. In the Kew herbarium there are three of his sheets from the above locality, collected in Aug. 1881. They are vigorous shoots with oblong leaves 4-5 mm. wide, and with normal, 9-anthered staminate flowers. No later collections of this plant have been seen or reported. It did not rapidly spread over Europe, instead it apparently died out. There seems to be no documentary evidence of its advent in Scotland. It may have been privately imported from North America by some individual for aquarium culture. Then it may have been wholly or in part discarded by a stream or pond, where it then became established.

The other possible origin of these staminate plants in Scotland is that a flowering pistillate plant may have set some parthenogenetic seed. Some of these seeds could have grown into staminate plants. If this happened, it has been a rare occurrence. The other possible method of advent, the direct importation of staminate plants, seems the more probable explanation of its occurrence in Scotland.

The description of the fruit given by Victorin (1931: 19) is rather different from the writer's. His description when translated is, "capsules 10-15 mm. long, ovoid, acuminate and with a persistent style; seeds 1-2, rarely more, lance-ovoid." It would seem that he included the style when measuring the capsule. The details and measurements here presented by the writer came from study of a specimen from North Dakota, Lake Metigoshe, July 9, 1891, *Lee* (RM).

In the southeastern states of the U. S. A., *Elodea canadensis* has been considered absent. Here is accepted as that species a sterile collection from Centerville, Alabama, *Harper* 3287. The leaves are broad and imbricate, and so typical that no hesitation is felt in accepting this record. In the Kew herbarium there is another specimen labeled Alabama, Schweinitz. He was a Pennsylvanian botanist who collected intensively around Bethlehem, Pa., but is not known to have collected in Alabama. The flowers are small and resemble those of *E. canadensis*, but the herbage looks like that of *E. Schweinitzii*, a species found only near Bethlehem, Pa. It seems best to leave this specimen undetermined and to question its locality.

Elodea canadensis has been recorded as occurring in Texas by Coulter (1894: 421); and as *Anacharis canadensis* by Cory and Parks (1937: 14). Having seen no specimens of this or other indigenous species from that state, inquiries were made. V. L. Cory replied on Dec. 16, 1940, "I regret to inform you that the inclusion of *Anacharis canadensis* in our Catalogue was apparently based on the report given in Coulter's Botany of Western Texas. As for myself, I have not seen this plant in Texas, nor have I seen any material of it collected by anyone else in this State." Prof. B. C. Tharp, curator of the herbarium of the University of Texas, replied on Jan. 14, 1941, that concerning, "specimens of *Elodea*, I regret to say that I do not find any specimens in the herbarium."

Recent collections in the herbarium of the Texas Agricultural and Mechanical College, from Brazos, Robertson, Hays, and Leon Counties prove to be not *Elodea*, but the

introduced *Egeria densa*. Thus, it appears that no indigenous species of *Elodea* occur in Texas, or in South Carolina, Georgia, Florida, or Louisiana.

There is a collection of *Elodea canadensis* from Mexico. Its data is Morelia, Laguno, in aqua, 2,000 m. alt., 1.9.1911, Arsène (B). This locality is 130 miles slightly north of west of Mexico City, and is remote from the known range of the species. To an inquiry, Dr. F. Miranda of the Universidad Nacional Autónoma de México replied on 23 Nov. 1962, "No conazio ejemplares verdaderamente indígenas de ninguna especie de *Elodea* (o *Egeria*) en México. *Elodea densa* es frecuente en estanques de jardines públicos o cultivada en acuarios de esta ciudad." It can be safely concluded that the collection of *E. canadensis* from Morelia represents a plant cultivated or adventive in that area.

One other locality record needs discussion. In the Berlin herbarium there is a specimen of *E. canadensis* labeled as from Labrador. It was determined as *Anacharis Alsinastrum* which is a synonym of *E. canadensis*. It is marked "ex Mus. Parisiensis," but the bottom of the label is cut away so that the collector's name is shown only by the remaining tops of a few taller letters. Later the originals were found in the museum in Paris, three similar sheets of *E. canadensis*, and one of *E. Nuttallii*. They all have the printed label form: Amerique du Nord, M. Lamarre-Picquot, and on it in handwriting is the locality Labrador. He was sent in 1848 to North America to collect economic plants for the Ministère de l'Agriculture. From his report (1849) we learn his itinerary. He landed on the 24th of June 1848 at New York. He journeyed up the Hudson River to Lake Erie, Detroit, across Michigan, and Indiana to Chicago, Galena, Saint-Paul, Mendota at the junction of the R. Saint-Pierre with the R. Mississippi, to Lac-qui-Parle, Mendota, Saint-Paul, Buffalo, Erie Canal, Albany, and he sailed from New York on Oct. 3, 1848 to Europe. As edible plants he brought back to France *Psoralea esculenta* Pursh and *Apios americana* Medic. (*A. tuberosa*).

His specimens of *Elodea* are genuine, but his locality Labrador is incredible. On his voyage he nowhere ap-

proached Labrador. No species of *Elodea* is known within many hundreds of miles of Labrador. The present writer explored the full length of the southern coast of the Labrador Peninsula, and wrote his doctor's thesis on its flora. Others have explored the eastern and other sections of Labrador. This record of *Elodea* from that area is rejected as an undoubted error.

There is a specimen of *Elodea* from Nicolett's North-Western Expedition, ponds up Rivière aux Serpent near Oanus River, July 10, 1883, *Charles A. Geyer* (US), that was omitted in the enumeration of specimens. The plant is *E. canadensis*, but the locality is obscure to the writer and to the present staff of the Missouri Botanical Garden. However, Dr. J. M. Greenman noted on the sheet that it was "probably from Nebraska."

In the British Museum of Natural History is a specimen of *Elodea canadensis*, with the data: Hawaiian Ids., *Udora**, the asterisk indicating a new species, then follows a specific epithet meaning broad-leaved. The epithet is not quoted here, as this would constitute the publishing of a *nomen nudum*. The locality Wahoo is in T. Nuttall's writing, then in another hand is added, Herb. Nuttall. The label is like Nuttall's other labels for plants that he collected on Wahoo (Oahu I., Hawaiian Is.). A confusion is suspected here, since *Elodea* is not indigenous to the Hawaiian Islands, is not established there now, nor does it ever seem to have been. The sheet bears three small, but genuine, branches of *E. canadensis*, but the locality stated seems to be in error.

In 1836, *Elodea canadensis* was found introduced in Ireland, and in 1842 in Scotland, and in 1847 in England. It spread to continental Europe and soon became abundant and a pest in the watercourses of much of the continent. As the plants were pistillate only, its spread was due to vegetative fragmentation.

The species spreads rapidly by its own means, and man has doubtless been responsible for its arrival on distant continents or regions. It is now established in Europe, Asia, Africa, Australia, and New Zealand. From these

areas it is abundantly represented in herbaria, but there seems no good reason for listing these records in this monograph. There is also a very extensive literature reporting its occurrence as an exotic in the above named areas. Also, there are many articles on its anatomy, cytology, genetics, and physiology, but they are not pertinent here.

J. K. Santos (1923, and 1924) published two studies upon the genus *Elodea*, issued as Contributions 302 and 317 of the Hull Botanical Laboratory. They are both largely cytological studies on the cell division in the formation of the pollen grains. However, being studies of the sexuality of *Elodea* plants, they touch in several places on the characters used by taxonomists for the differentiation of the species of this genus. In the first article Santos deals particularly with *E. gigantea* which he inadvertently published as a new species, *Elodea gigantea* Santos. Evidently this is a synonym of the cultivated *Egeria densa* Planch. He states (1923: 44) that *E. canadensis* "is strictly dioecious." His second paper deals principally with what he calls *E. canadensis*. His material came from Wolf Lake, Indiana. He again describes it as dioecious, saying (1924: 353), "both male and female plants are abundant." His papers do not record his means of determination of the species. By correspondence it is clear that Gray's Manual was the only source consulted. On page 85 of the 7th edition, this gives *Elodea canadensis* as the only species in northeastern North America. As synonymy it gives *Anacharis* Planch., and *Philotria* Britton. Britton & Brown's Illustrated Flora (ed. 1913) gives four species for the same area, and in the key leading to *Philotria* (*Elodea*) *canadensis* says "staminate flowers unknown." Also there are given references to the monographs by Planchon, Caspary, and Rydberg. Santos gives a bibliography of 36 titles in his first paper, and one of 53 in his second. In neither does he include any of these four monographs dealing with the classification of *Elodea*, or give any indication that he had consulted them. If he had, he could not have determined his plants all as *E. canadensis*.

No voucher specimens of the *Elodea* studied by Santos were preserved, which makes it more difficult to verify his determinations, but both *E. canadensis* and *E. Nuttallii* are known to occur in Wolf Lake, Indiana, the source of the specimens investigated by Santos.

In his final discussion of the determination of sex, Santos says (1924: 368) any experimental studies should be accompanied with a critical cytological investigation. The effect of the environmental condition should not be looked upon from the external character of the individual only, but also in its effect upon the structure of the cell. One apparently may get some changes in form, but in reality the changes may be produced by changes in the chromatin." On this the writer would comment, any such experimental study should be preceded by a critical and accurate identification of the species studied.

20. *Elodea linearis* (Rydb.) comb. nov. *Philotria linearis* Rydb., Bull. Torrey Bot. Club 35 (1908) 464; *Anacharis linearis* (Rydb.) Victorin, Contrib. Lab. Bot., Univ. Montréal 18 (1931) 41. Fig. 3 d-f, 5.

Diagnosis of Holotype: Submerged aquatic; stems slender, dichotomously branched; middle and upper leaves 5-12 mm. long, less staminate spathes borne in the upper axils, about 1 cm. long, the lower half 3-5 mm. long, narrowed and peduncle-like, the upper inflated ovate or obovate, the apex like a gaping mouth, with 2 salient teeth 3-4 mm. long; staminate flowers peduncled by the slender, thread-like, elongating hypanthium; sepals 2.5-4 mm. long, 1.5-2 mm. broad, obovate, or oval, dark striate; petals 4.5 mm. long, 0.5 mm. broad, linear lanceolate, white and filmy; stamens 9 and equal, 2 mm. long, all attached at the summit of the hypanthium: anthers oblong; pistillate plants and flowers unknown.

Holotype: Tennessee, swamps bordering on Cumberland River, vicinity of Nashville, A. Gattinger (NY). Type examined! Isotypes (DS, MO, NY, US).

Discussion: Several of the characters mentioned by Dr. Rydberg in the original description do not hold after examination of the holotype and the isotypes. Instead of being entire, the leaves are finely serrulate as in the other species of this genus. The peduncle-like base of the spathe reaches 5 mm. in length. The inflated apex of the spathe is ovate

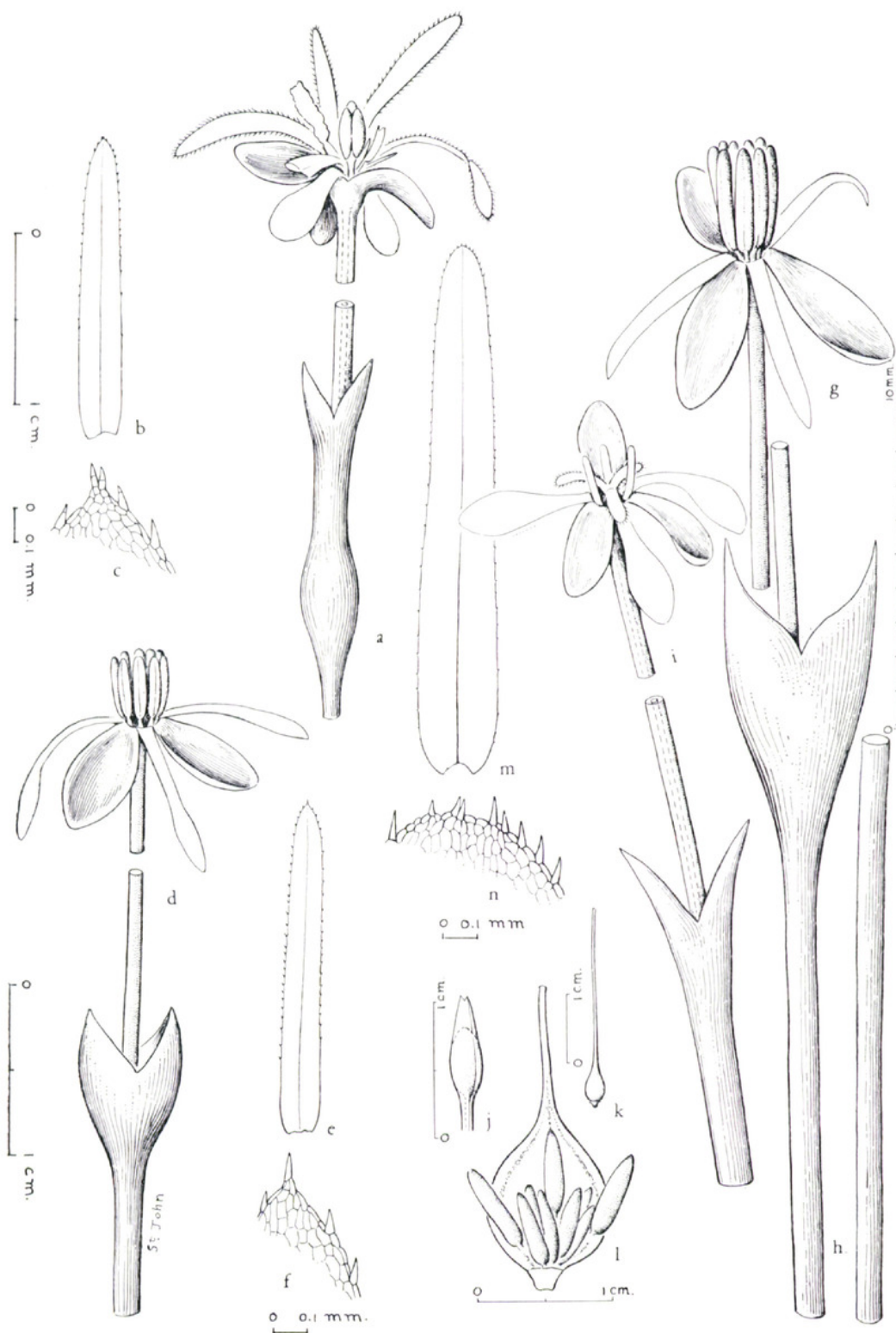


Fig. 3. *a*, *Elodea Schweinitzii* (Planch.) Casp., perfect flower, from holotype, $\times 5$; *b*, leaf, $\times 5$; *c*, leaf apex of same, $\times 50$; *d*, *Elodea linearis* (Rydb.) St. John, staminate flower, from holotype $\times 5$; *e*, leaf, $\times 5$; *f*, leaf apex of same, $\times 50$; *g*, *Elodea longivaginata* St. John, staminate flower, from C. S. Crandall 2,528, $\times 5$; *h*, staminate spathe of same, $\times 5$; *i*, pistillate flower of holotype, $\times 5$; *j*, staminate bud, from Crandall 2,528; *k*, fruit, from Crandall & Cowen 6,720, $\times 1$; *l*, opened capsule and seeds of same, $\times 2$; *m*, leaf, from C. S. Crandall, 2,423, $\times 5$; *n*, leaf apex of same, $\times 50$.

when young, but appears obovate when mature and opened. The sepals reach 3 or 4 mm. in length. The petals instead of being oblong, are clawed and narrowly linear lanceolate. The specimen from Center City, Minnesota, 1892, B. C. Taylor, the writer considers to be *E. Nuttallii*, and not the pistillate plant of *E. linearis*.

Elodea linearis is a member of the section *Elodea*. In many ways it closely resembles staminate *E. canadensis*, but it differs in having the leaves less than 1 mm. wide, and in having the stamens equal in length and equally attached on the hypanthium; while the latter species has the leaves 1-4 mm. broad, and the 3 inner stamens raised on a joint stalk.

Here is presented a copy of a note on the specimen, Tennessee, Nashville, Sept. 1875, A Gattinger (NY). This is apparently the same collection as that distributed with a printed label and made the type of *P. linearis* Rydb. It has several staminate flowers still in the spathes, but more mature than those described by Rydberg. The 3 central anthers are slightly the longer, but attached as shown in our illustration. The flower examined had only one petal, it being short and bearing a single anther sac containing pollen, attached along one edge of the petal.

The following note is in a pocket on the sheet. It is in T. Morong's handwriting, but is evidently a copy of field observations, probably Gattinger's. "*Anacharis Canadensis* Planch. Male flowers apt. in the spathe, undeveloped. There seem to be about 9 stamens (as Wood says) which are contained in a hyaline sack, and this in a spathe; the spathe on a pedicel $\frac{1}{4}$ ' or $\frac{1}{2}$ ' long, opening in a bifid mouth, and suffering the stamens with their sack to escape, when mature. These stamens rise to the surface, on which they float, and there fertilize the pistillate flowers, which rise to the surface on a long and very slender tube. The pistillate flowers are also furnished with stamens, and these in the time of maturity seem to have an abundance of pollen, as I have often seen when collecting the plant in August."

"Why Wood and Gray should both call these staminate flowers 'minute', I do not understand, as the sack is at least

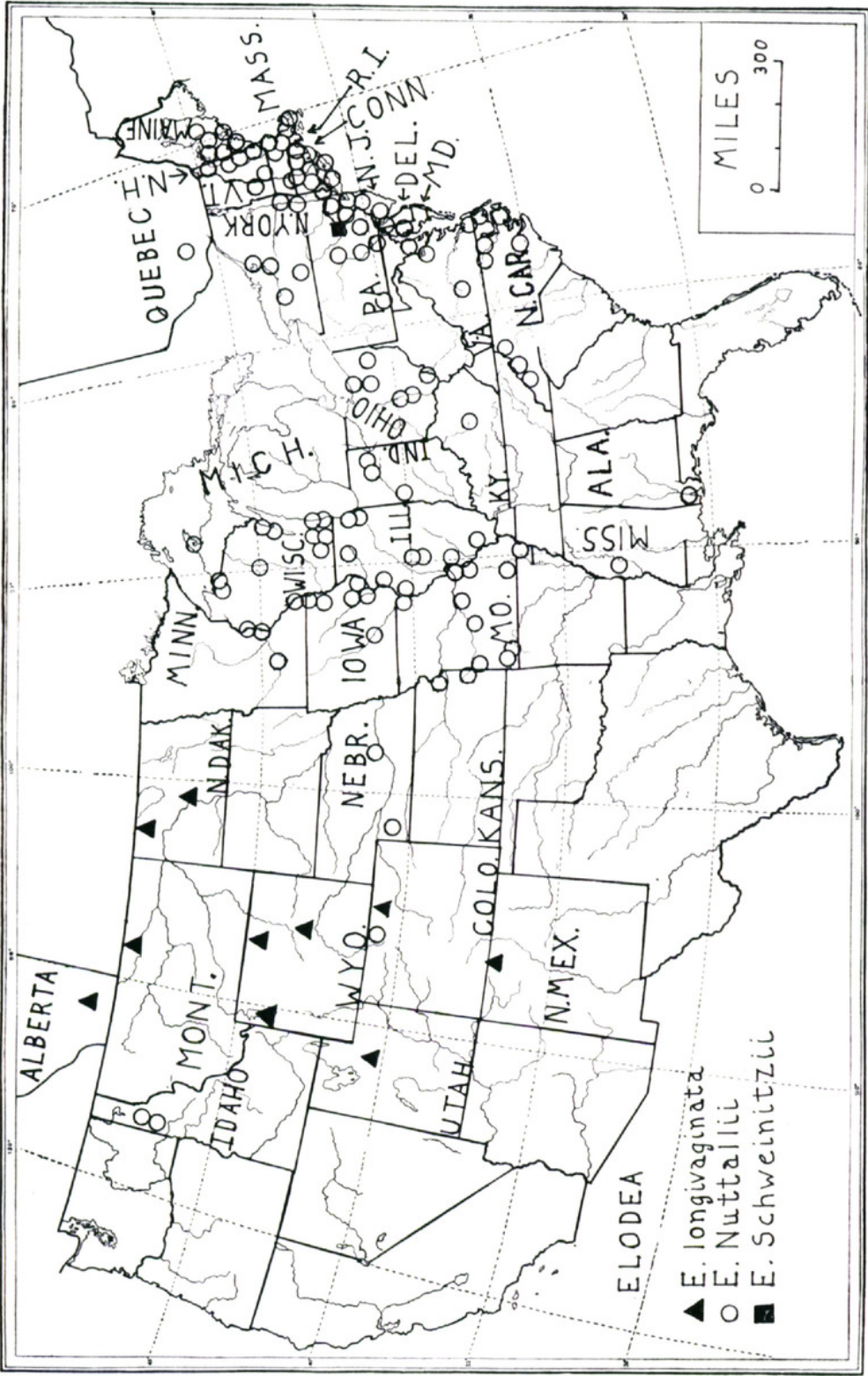


Fig. 4. Map of the distribution of *Elodea longivaginata* St. John; *E. Nuttallii* (Planch.) St. John; and *E. Schweinitzii* (Planch.) Casp.

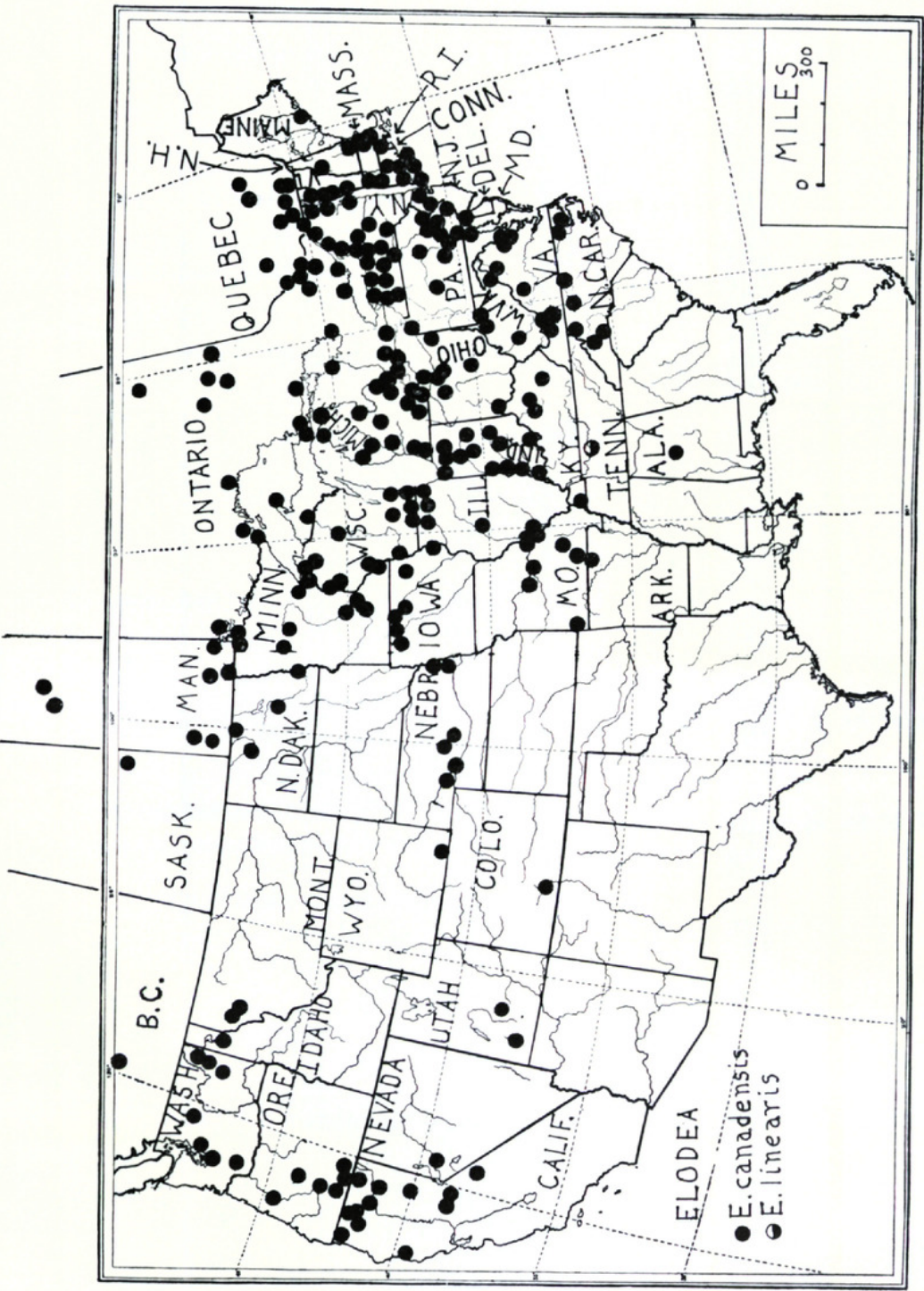


Fig. 5. Map of the distribution of *Elodea canadensis* Rich. in Michx.; and *E. linearis* (Rydb.) St. John.

1" long & 1" wide, & the spathe on a pedicel 3" or 4" lines long, fully as large as the fertile flowers."

"The staminate flowers seem to be without corolla, so far as I can make out. This does not appear to be the theory of the books, but from this specimen I judge it to be so."

These notes seem to contain partly material derived from the books by Wood, and by Gray, and partly actual field observations by Gattinger. Characteristics of more than one species are included. The sessile staminate flowers which are liberated and float to the surface are known only in *E. Nuttallii*. He recorded seeing perfect flowers, but none of his numerous specimens have any such, and no other species with bisexual flowers is known in the area.

21. (5 of part 1.) *Elodea longivaginata* St. John, Research Studies, Washington State Univ. 30 (1962) 38-40, fig. 2, e-j, 4, c-d, 5. Fig. 3 g-n, 4.

Description of all specimens examined: Submerged aquatic, rooting in the mud; stems elongate, slender, sparsely dichotomously branched; leaves opposite, linear, obtuse or acute, finely serrate near the tip, the middle and upper ones 5-24 mm. long, 0.5-2 mm. wide, bright green and flaccid, scarcely imbricate; apparently the lower leaves do not differ from the middle and upper ones, at least this is so down to the 21st. leafy node; staminate spathe 20-150 mm. long, ovoid, inflated near the tip, before opening with two small apical teeth, the inflated portion 8-10 mm. long, 2.5-4 mm. broad, finally with two large salient teeth at the open mouth-like apex; staminate flowers peduncled on the elongating, thread-like hypanthium which is up to 30 cm. in length; sepals 3.5-5 mm. long, 1.9-2.5 mm. wide, elliptic, dark-striate especially near the tip; petals 5 mm. long, 0.6 mm. wide, white, delicate, linear; stamens 9, all attached at the summit of the hypanthium, 3.1 mm. long, linear-cylindric; pistillate spathe 30-70 mm. long, linear-cylindric, slightly larger near the tip, the apex with 2 salient teeth, the base split by the ripening capsule; pistillate flowers stalked by the thread-like base of the hypanthium which elongates even to several decimeters, bearing the flower to the surface of the water; sepals 2.8 mm. long, 1.3 mm. wide, elliptic, dark-striate especially near the tip; petals 4 mm. long, 1.3 mm. wide, white, delicate, spatulate; staminodia 3, strap-shaped; style slender equaling the hypanthium; stigmas 3, oblong, undivided, only half the length of the sepals; ovary commonly setting fruit and becoming large and conspicuous, ovoid; capsule 10 mm. long, 3 mm. in diameter; seeds 6 mm. long, cylindric, surrounded by jelly, one attached on each parietal placenta, 6 attached basally.

CANADA. ALBERTA: in a lake at the northern edge of the Milk River Ridge, where the Lethbridge Trail leaves the summit, [holotype], July 20, 1895, *J. Macoun 13725* (CAN)!

UNITED STATES. NORTH DAKOTA: slough 7 miles e. of Bismarck, *Metcalf 358* (US); Ward L., Kenmare, Burke Co., *Metcalf 569* (CU). MONTANA: n. e. of Loring, Reservoir 158, Phillips Co., *Hotchkiss 6348* (US). WYOMING: Seven Mile L., Albany Co., *Gooding 597* (G, P); Teapot Dome, Reservoir, Casper, *Porter 6259* (UPS); L. De Smet, Johnson Co., *Porter 6285* (UPS); Two-Ocean L., Teton Co., *Porter 6365* (UPS). COLORADO: Lee's L., Fort Collins, 5,000 ft. alt., *Crandall & Cowen 6720* or *Crandall 6720* (CS); Lee's L., *Crandall 2528* in part (WS), *Crandall 2423* (B, CS, F, GH, LD, NY, P, PH, RM, US, WS); Fort Collins, *Cowen* (MO, UC); Lee's L., ex Herb. State Agric. Col. *2421* (NY, PH, US, WS). UTAH: drift, s. end, Strawberry Reservoir, Wasatch Co., *Hotchkiss 4933* (US). NEW MEXICO: L. La Jara, Jicarilla, Apache Reservation near Dulce, *Standley 8274* (US). Rocky Mts., 1868, *G. Vasey* (US).

(TO BE CONTINUED)

CORRECTION

In volume 65, p. 241 (1963) of *Rhodora* I reported *Habenaria conopsea* (L.) Benth. as having been collected by the late W. C. Coker in "Abisco," Labrador. Dr. A. E. Porsild has kindly called my attention to the geographical error of placing Abisko, Lapland in Labrador, and I have since learned from Dr. H. R. Totten that, in 1921, Dr. Coker was truly in Lapland. I must apologize for the bad labeling and my poor geography that resulted in this erroneous report. This species is now dubiously known from North America only in Connecticut.

D. S. CORRELL, TEXAS RESEARCH FOUNDATION, RENNER, TEXAS



St. John, Harold. 1965. "MONOGRAPH OF THE GENUS ELODEA: PART 4 AND SUMMARY. I. Monograph of the genus Elodea, part 4: The species of Eastern and Central North America." *Rhodora* 67, 1–35.

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