A SYNOPSIS OF THE LEMNACEAE

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SUMMARY

The family *Lemnaceae* is divided into 2 subfamilies, *Lemnoideae* with the genera *Spirodela* and *Lemna* — the latter with 2 subgenera, *Lemna* and *Staurogeton* — and *Wolffioideae* with the genera *Wolffia*, *Wolffiella*, *Wolffiopsis*, and *Pseudowolffia*, the last two being new and based on former infrageneric taxa. All these taxa are described, and their types indicated; keys are provided for their distinction.

Recognized species names are listed with their synonyms, a few being newly reduced. There are 5 new specific combinations. A list of invalid and dubious names is added. The excluded names are listed separately.

An explanatory glossary is given of the terminology used in the descriptions, and is illustrated by some diagrams (fig. 1).

INTRODUCTION

The *Lemnaceae* is a well-defined family and its delineation has never given any difficulty. The systematic arrangement of the genera within the family has been elaborated by Schleiden (Linnaea 13, 1839, p. 385—392; Beitr. Bot. 1, 1844, p. 229—235) and later by Hegelmaier (Lemnac., 1868, p. 1—169; Bot. Jahrb. 21, 1895, p. 268—305). In his last work Hegelmaier recognized 4 genera: *Spirodela*, *Lemna*, *Wolffia*, and *Wolffiella*. Hegelmaier's work has been accepted almost generally, except for the fact that most British authors, following Bentham & Hooker (Gen. Pl. 3, 1881, p. 1000—1001) have not recognized *Spirodela* as an independent genus. In the years since the publication of Hegelmaier's work knowledge of the *Lemnaceae* has increased considerably. Several new species have been described and flowering and fruiting material has become available of quite a number of species.

The need for a new critical revision of the family has been felt for some time, not in the least by physiologists who use these small, readily multiplying plants more and more for their experiments (Hillman, Bot. Rev. 27, 1961, p. 221—287). Recently Daubs (Monogr. Lemnac., 1965, p. 1—118) published a monograph of the *Lemnaceae*, in order to give 'a critical review of the family in the light of this later knowledge'. Unfortunately this work does not meet the requirements which can be reasonably demanded from a monograph, and consequently it was not very well received (reviews by Howard, American Scientist 54, 1966, p. 242A—243A; Clark & Thieret, Sida 2, 1966, p. 437—438, and den Hartog, Blumea 15, 1967, p. 575—576). However, it certainly inspired us to examine critically the status of the various genera within the family, and not to take anything for granted.

The results of our taxonomic studies are only partly in agreement with those of the earlier authors. We agree with the division of the *Lemnaceae* into 2 subfamilies, the *Lemnoideae* and the *Wolffioideae*. Within the *Lemnoideae* we recognize 2 genera, viz. *Lemna* and *Spirodela*, as most other authors have done before. In the subfamily *Wolffioideae*, however, we recognize 4 genera, viz. *Wolffia*, *Wolffiella*, *Pseudowolffia*, and *Wolffiopsis*. The 2 last-mentioned genera are newly described; in the original system of Hegelmaier

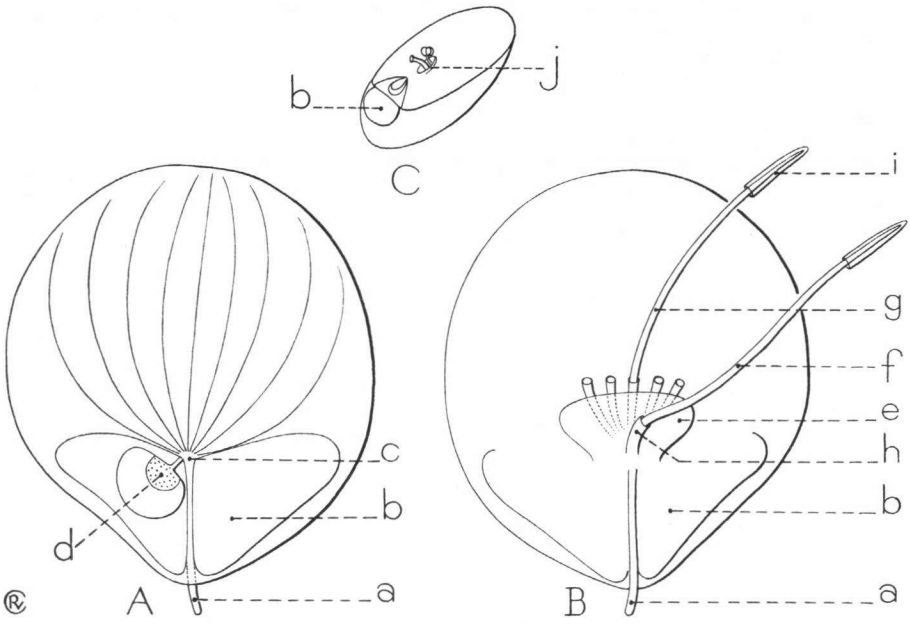

Fig. 1. Diagrams showing the external morphology of *Lemnaceae*. — A-B. *Spirodela polyrhiza* (L.) Schleiden; A. dorsal side of the frond, B. ventral side of the frond. — C. *Wolffia* sp. (a. stipe; b. budding pouch; c. node; d. young frond showing the dorsal scale; e. ventral scale; f. primary root; g. secondary root; h. root sheath; i. root cap; j. flowering cavity with male and female flower).

they figure as sections or subsections. In our opinion they are sufficiently distinct to be regarded as separate genera.

In this paper only the taxa above the rank of species are described. Under each genus or subgenus description an annotated list of the species with their full synonymy is given.

TERMINOLOGY

The *Lemnaceae* are morphologically very reduced plants, and consequently the terms used in the descriptions of the various taxa are, at least partly, rather different from those generally used for the description of more familiar looking angiosperms. Therefore, for the sake of convenience we have added a list of terms generally used for the description of *Lemnaceae*, and some diagrams (fig. 1). In this paper these terms are used exclusively for descriptive purposes.

Air spaces. Large lacunous spaces under the epidermis, filled with gas (or water).

Budding pouch. The basal cavity in the *Wolffioideae* and the two lateral pockets in the *Lemnoideae* are called budding pouches, as here the young fronds are produced. In the *Lemnoideae* one of the two pouches can also give rise to an inflorescence and is then often called a reproductive pouch. The budding pouch of the *Wolffioideae* never produces an inflorescence.

Dorsal scale. A small, almost round, membranous scale at the base of the dorsal side of a young frond of *Spirodela*, disappearing with age.

Druses. Asteroid crystals of Ca-oxalate in the parenchyma of *Spirodela.*

Flowering cavity. A dorsal cavity in the frond of the *Wolffioideae* in which the inflorescence is formed. This cavity is formed just before the frond flowers.

Frond. A single plant of a *Lemnacea.*

Node. Point on the frond from which the roots descend. One vascular bundle connects the stipe with the node; from the node 1 or more nerves proceed towards the apex.

Petiole. See stipe.

Pigment cells. According to Solereder & Meyer (System. Anat. Monokot. 3, 1928, p. 170—175) the brown pigment cells are myriophyllin cells and the red pigment cells contain anthocyanin.

Primary roots. Roots which perforate the ventral scale and whose sheaths are grown together with that scale. These roots are appearing at an earlier stage in the development of the frond than the secondary roots, and are already visible in very young fronds *(Spirodela).*

Prophyllum. See ventral scale.

Raphides. Needle-like crystals of Ca-oxalate arranged in bundles *(Lemnoideae).*

Reproductive pouch. See budding pouch.

Resting bud. A frond consisting of a very compact tissue, filled with reserve food, sinking to the bottom in winter and rising to the surface in spring (winter bud!). In temporary waters the same kind of buds are formed, enabling the species to survive the dry period. The turion of *Spirodela* is a special form of a resting bud.

Root cap. A cylindrical membranous sheath surrounding the tip of the root, cohering with the root sheath at an early stage in the development of the root.

Root scale. See ventral scale.

Root sheath. A cylindrical membranous sheath surrounding the base of the root, cohering with the root cap at an early stage in the development of the root. As the root grows the two parts become separated.

Secondary roots. Roots which do not perforate the ventral scale, their sheaths are covered by this scale but are never connate with it. These roots appear at a later stage in the development of the frond than the primary roots *(Spirodela).*

Stalk. See stipe.

Stipe. A stolon-like structure by which the young plant is attached to the mother plant. It is often fugacious. Although it is certainly not homologous with the stalk of a leaf it is often referred to as a petiole.

Turion (in *Spirodela polyrhiza*). A young frond differing from normal fronds by its thicker habit and more compact tissue filled with reserve food. The dorsal as well as the ventral scale and some root primordia are present. In autumn it sinks to the bottom, and in spring it rises to the surface again.

Ventral scale. A scale at the ventral side of the frond of *Spirodela,* covering the bases of the secondary roots and/or grown together with the root sheaths of the primary roots.

Winter bud. See resting bud.

LEMNACEAE

Monoecious, very rarely dioecious, small to minute aquatic annuals, floating at the surface of the water, or floating just below the surface whereby only a very small part of the frond is exposed to the air, or completely submerged and then rising to the surface in the flowering period. *Fronds* either solitary or connected in small groups by short hyaline or rarely elongate green stipes, symmetric or asymmetric, flat or inflated, ranging in

shape from reniform, round, elliptic, lanceolate, and linear to globose, green, with or without red or brown pigment cells, sometimes with both types of pigment. *Roots* several, one, or none. *Budding pouches* 1 or 2; when there is one budding pouch there is one flowering cavity and in this a spatheless inflorescence is borne (an exception is *Wolffiopsis* which has 2 flowering cavities); when there are 2 budding pouches one of these gives rise to an inflorescence surrounded by a spathe. *Inflorescence* consisting of 1 female and 1 or 2 male flowers. *Perianth* none. *Male flower* consisting of a single stamen; anther uni- or bilocular. *Female flower* inserted above the male flower(s), consisting of 1 sessile, globular, unilocular ovary with a short style. *Ovula* 1—4. *Fruit* a 1—4 seeded utricle. *Seeds* ribbed or smooth.

KEY TO THE SUBFAMILIES

1. Roots present. Budding pouches 2, basal, lateral, one on either side of the axis. Inflorescence 1, developing from one of the budding pouches, consisting of 1 female and 2 male flowers enclosed by a membranous spathe. Anther bilocular, transversely dehiscent. Raphides present . . . . . **Lemnoideae**
1. Roots none. Budding pouch 1, basal, median, never giving rise to an inflorescence. Inflorescence 1 (rarely 2), dorsal, consisting of a cavity containing 1 female and 1 male flower, without a spathe. Anther unilocular, apically dehiscent. Raphides none. . . . . **Wolffioideae**

SUBFAMILY LEMNOIDEAE

Small water plants, floating at the surface or sometimes completely submerged in which case they come to the surface only in the flowering period. *Fronds* reniform, round, elliptic, obovate, or lanceolate; with or without red pigment cells in the epidermis; raphides and often brown pigment cells in the parenchyma; stomata on the dorsal side of the floating plants, absent in submerged plants; nerves 1—15. *Stipe* hyaline, fugacious, rarely green and persistent. *Dorsal and ventral scales* present *(Spirodela)* or absent *(Lemna)*. *Roots* 1—18 (rarely absent), with a root cap and usually with a root sheath. *Budding pouches* 2, basal, lateral, one on either side of the axis, dorso-ventrally flattened, in outline more or less triangular, opening by a transverse slit. *Inflorescence* 1, lateral, developing from one of the budding pouches, consisting of 1 female and 2 male flowers enclosed by a membranous spathe. *Male flower*: anther bilocular, transversely dehiscent. *Female flower* superior and lateral to the 2 male flowers; style partly persistent. *Ovula* 1—4, amphitropous, anatropous, or orthotropous. *Fruit* globular or more or less compressed, slightly or distinctly winged. *Seed* smooth or longitudinally ribbed.

KEY TO THE GENERA

1. Fronds with a dorsal and a ventral scale, 1—many roots and 3—15 nerves. Stipe ventrally attached. Brown pigment cells and druses in the parenchyma . . . . . **1. Spirodela**
1. Fronds without dorsal and ventral scales, with 1 root (rarely none) and 1—3, often indistinct nerves. Stipe marginally attached. Brown pigment cells and druses absent . . . . . **2. Lemna**

1. SPIRODELA

Schleid., Linnaea 13 (1839) 391 *(nom. gen. cons. prop.)*; den Hartog, Taxon 19 (1970) 647—648. — *Lenticularia* Séguier, Pl. Veron. 3 (1754) 129. — *Lemna* sect. *Spirodela* Coss. & Germ., Fl. Env. Paris 2 (1845) 577. — *Lemna* subgen. *Spirodela* Peterm., Deutschl. Fl. (1849) 540.

Type species: *Spirodela polyrhiza* (L.) Schleid.

Small water plants, floating at the surface. *Fronds* either solitary or connected in groups

of 2—5 (sometimes even more), symmetric or asymmetric, reniform to obovate, flat or distinctly inflated, underside often red due to pigment cells in the epidermis; brown pigment cells, raphides, and druses in the parenchyma; stomata on the dorsal side; margin entire; nerves 3—15. *Stipe* hyaline, fugacious, short or relatively long, attached to the underside of the frond. *Dorsal scale* present, fugacious in older plants. *Ventral scale* broad, often pigmented. *Roots* 1—18, more or less vascularized; root sheaths short, clustered together and covered by the ventral scale with which some of them are adnate, one or more roots perforating this scale; root cap straight or slightly curved, acute or rarely obtuse. Slit of *budding pouch* ventral to the margin of the frond. *Ovary* with 1 amphitropous ovulum or 2—4 anatropous ovula. *Fruit* asymmetric.

Notes: Schleiden, *l.c.*, separated the genus *Spirodela* from *Lemna* on the grounds of the occurrence of a dorsal and a ventral scale, the conspicuous development of spiral vascula, and the clearly recognizable nodes with many roots. In his opinion these characters were '*in dieser Gruppe der allereinfachsten Pflanzen gewiss Momente, bedeutsam genug um die Aufstellung eines eignen Genus zu rechtfertigen*'. Hegelmaier maintained the genus on the same grounds, as he found no differences between the inflorescences of *Lemna* and *Spirodela* (Hegelmaier, Bot. Zeit. 29, 1871, p. 621—629, 645—666). In practice botanists have only used the character of the number of roots to distinguish the two genera, and according to Daubs (Monogr. Lemnac., 1965, p. 8) 'no one has seriously questioned the generic status of *Spirodela* since its establishment by Schleiden'. Daubs stated that 'the greater size and complexity of the plant body of *Spirodela*, including its increased vascularization, larger number of roots, tendency toward a plural number of ovules, and the monosporic development of the embryo sac (in *S. polyrhiza*) are sufficient to regard *Spirodela* as distinct from *Lemna*'.We disagree with respect to the taxonomic value of the new characters put forward by Daubs. The size of the frond is certainly not a generic character: *S. punctata* is exactly the same size as *Lemna minor* and *L. perpusilla*, and is considerably smaller than *L. trisulca*. Although it can be observed, a tendency towards an increasing number of ovula can never be a generic character. Not all the *Spirodela* species have more than one ovulum, and in *Lemna gibba* and *L. disperma* there is generally more than one ovulum. Finally the monosporic development of the embryo sac, which has been observed in *S. polyrhiza* by Maheswari (Nature 181, 1958, p. 1745—1746) cannot be used as a taxonomic character before similar observations have been made in other *Spirodela* species, in particular in *S. punctata*.

The genus *Spirodela* can be subdivided into 2 species groups; Hegelmaier (Lemnac., 1868, p. 147—152; Bot. Jahrb. 21, 1895, p. 283—288) distinguished these as '*Typus der S. polyrhiza*' and '*Typus der S. oligorrhiza*'. The first mentioned '*Typus*' has 5—12 mm long fronds and primary as well as secondary roots. The other '*Typus*' has 2—5 mm long fronds and primary roots only; its habit is very similar to that of *Lemna*. The differences between these two species groups are in our opinion too insignificant to regard them as separate sections.

Nomenclature: Farwell (Amer. Midl. Natur. 12, 1931, p. 239, in foot note) questioned the correctness of the name *Spirodela* for the genus. According to him *Lenticula* Hill (1757) is the correct name. Indeed Hill's work contains a rather extensive description of *Lenticula major* (= *Spirodela polyrhiza*), and the two other species *L. vulgaris* (= *Lemna minor*) and *L. aquatica trisulca* (= *Lemna trisulca*) are classified in the genus without much comment. According to Mansfeld (Fedde Repert. 45, 1938, p. 58), however, it is quite clear that Hill's conception of *Lenticula* and Linné's conception of *Lemna* are the same, as the species composition of the two genera was almost identical.

As Hill did not accept binary nomenclature his specific names are invalid, and no

nomenclatural type can be indicated. The first valid combinations in the genus, *Lenticula minor* and *L. trisulca*, were published by Scopoli in 1772. If the first of these is accepted as the type species of the genus *Lenticula*, the genus can be reduced as a nomenclatural synonym of *Lemna* L.

This reasoning cannot be applied to the generic name *Lenticularia* Séguier (1754). Séguier's diagnosis matches *Spirodela*, and, therefore, *Lenticularia* has to be regarded as an earlier name for this genus. This has nomenclatural consequences and, therefore, it has been proposed that the name *Spirodela* should be conserved in preference to *Lenticularia* (den Hartog, Taxon, 19, 1970, p. 647—648).

Distribution: The genus is widely distributed in the temperate and tropical zones of both hemispheres.

1. **Spirodela polyrhiza** (L.) Schleid., Linnaea 13 (1839) 392. — *Lemna polyrhiza* L., Sp. Pl. ed. 1 (1753) 970 — [*Lenticula major* Hill, Brit. Herb. (1757) 531, *nomen invalidum.*] — *Lenticula polyrhiza* Lamk., Fl. Fr. 2 (1778) 189. — *Lemna orbicularis* Kitaibel *ex* Schultes, Oesterr. Fl. ed. 2, 1 (1814) 64, *nomen seminudum.* — *Lemna thermalis* Beauv., J. Phys. Chim. Hist. Nat. 82 (1816) 102, 113, f. 23; Nuttall, Gen. Amer. 1 (1818) 19. — *Lemna orbiculata* Roxb., [Hort. Beng. (1814) 66, *nomen*] Fl. Ind. 3 (1832) 565. — *Telmatophace polyrhiza* Godr., Fl. Lorr. ed. 1, 3 (1843) 18; ibid. ed. 2, 2 (1857) 327. — *Lemna major* [C. A. Meyer, Ind. Cauc. (1831) 11, *nomen*] Griff., Not. 3 (1851) 216; Ic. Pl. As. 3 (1851): pl. 264. — *Telmatophace orbicularis* Schur, Enum. Pl. Transs. (1866) 635. — *Spirodela atropurpurea* Montand., Guide Bot. (1868) 309. — *Lemna maxima* Blatter & Hallb., J. Ind. Bot. 2 (1921) 49. — *Spirodela maxima* McCann, J. Bombay Nat. Hist. Soc. 43 (1942) 158. — *Spirodela polyrhiza* var. *masonii* Daubs, Monogr. Lemnac. 34 (1965) 13.

It is not impossible that *Lemna thermalis* is an earlier name for *Spirodela biperforata* Koch. Although Beauvois mentioned several differences between *Lemna thermalis* and *L. polyrhiza* he gave no information about characters used nowadays for distinguishing between the species of *Spirodela*. The type of *L. thermalis* needs reinvestigation.

2. **Spirodela intermedia** W. Koch, Ber. Schweiz. Bot. Ges. 41 (1932) 114.

3. **Spirodela biperforata** W. Koch, Ber. Schweiz. Bot. Ges. 42 (1933) 188.

Spirodela intermedia and *S. biperforata* need further examination. Both species are closely related to *S. polyrhiza*.

4. **Spirodela punctata** (G. F. W. Meyer) Thompson, Rep. Mo. Bot. Gard. 9 (1897) 28. — *Lemna punctata* G. F. W. Meyer in Prim. Fl. Esseq. (1818) 262. — *Lemna oligorrhiza* Kurz, J. Linn. Soc. Lond. 9 (1866) 267. — *Lemna melanorrhiza* F. v. M. *ex* Kurz, J. Bot. 5 (1867) 115. — *Lemna pleiorrhiza* F. v. M. *ex* Kurz, ibid. 5 (1867) 115. — *Spirodela oligorrhiza* Hegelm., Lemnac. (1868) 147—150, incl. var. *β melanorrhiza* Hegelm., var. *γ pusilla* Hegelm., var. *δ pleiorrhiza* Hegelm., and var. *ε javanica* Hegelm. — *Spirodela melanorrhiza* Hegelm., Bot. Jahrb. 21 (1895) 287. — *Spirodela pusilla* Hegelm., ibid. 21 (1895) 287). — *Spirodela pleiorrhiza* Hegelm., ibid. 21 (1895) 288. — *Spirodela javanica* Hegelm., ibid. 21 (1895) 288.

2. LEMNA

L., Sp. Pl. ed. 1 (1753) 970; Gen. Pl. ed. 5 (1754) 417. — *Lenticula* [Hill, Brit. Herb. (1757) [530 Boehmer in Ludwig, Def. Gen. Pl. (1760) 499; Mich. *ex* Adans., Fam. 2 (1763) 471. — *Hydrophace* Hall., Hist. Stirp. Indig. Helv. 3 (1768) 68. — *Telmatophace* Schleid., Lin-

naea 13 (1839) 391. — *Staurogeton* Rchb., [Consp. (1828) 288, *nomen*] Nom. (1841) 33. — *Lenticularia* Montandon, Guide Bot. (1868) 308, *non* Séguier, Pl. Veron. 3 (1754) 129.

Type species: *Lemna minor* L.

Small water plants, floating at the surface or sometimes completely submerged in which case they come to the surface only in the flowering period. *Fronds* either solitary or connected in groups of 2—10 (sometimes even more), symmetric to slightly asymmetric, round, elliptic, oblong, obovate, or lanceolate, flat or slightly swollen, sometimes considerably inflated, often with a median row of papillae on the dorsal side; with or without red pigment cells in the epidermis; raphides in the parenchyma; brown pigment cells none; druses none; stomata on the dorsal side of floating plants, but absent in the submerged plants; margin entire, rarely denticulate; nerves 1—3(—5). *Stipe* hyaline and fugacious or green and persistent, attached to the margin. *Dorsal* as well as *ventral scale* absent. *Root* 1 (rarely absent), slightly vascularized, with or without a distinct root sheath; root cap straight or curved, obtuse, mucronate, or acute. Slit of *budding pouch* coinciding with the margin of the frond, rarely ventral or dorsal to the margin. Flowering proterandric, proterogynic, or simultaneous. *Ovary* with 1 orthotropous or amphitropous ovulum or with 2—4 anatropous ovula. *Fruit* symmetric or asymmetric. *Seeds* longitudinally ribbed, rarely smooth.

Note: In literature two species have been referred to as type of the genus *Lemna*. In the works of Britton & Brown (Ill. Fl. North. U.S. ed. 2, 1913, p. 447), Britton (Fl. Bermuda, 1918, p. 61), Britton & Millspaugh (Bahama Fl., 1920, p. 62), and Britton & Wilson (Sc. Surv. P. Rico & Virgin Isl. 5, 1923, p. 131) *Lemna trisulca* L. has been indicated as such without comment. Hitchcock & Green (Int. Bot. Congr. Cambridge, 1930. Nom. Prop., 1929, p. 187) proposed *L. minor* as the type species because it is 'one of the best known of the original species, and the only one of them placed by Engler in section *Eulemna*'. However, both proposals do not satisfy the directives for designating a lectotype as given in the International Code of Botanical Nomenclature (1966, p. 71). The reason for choosing *Lemna trisulca* as the type species has possibly been that it is the first species of *Lemna* mentioned by Linné, as it is in a rather isolated position within the genus. The Code warns against this procedure as being unscientific and a possible cause for confusion.

The arguments brought forward by Hitchcock & Green in favour of *Lemna minor* as type species of the genus are obviously based on the later application of the name. Fortunately the generic diagnosis of Linné (Gen. Pl. ed. 5, 1754, p. 417) contains the phrase '*monophyllus, subrotundus*', which can be applied to *Lemna minor*, but not to *L. trisulca*. For this reason we are in favour of *L. minor* being regarded as the type species of *Lemna*.

Taxonomy: In 1868 Hegelmaier divided the genus *Lemna* into 2 subgenera, *Hydrophace* and *Telmatophace*, the latter subgenus containing only *L. gibba*. The subgenus *Hydrophace* was divided into 2 sections, *Staurogeton*, with the only species *L. trisulca*, and *Eulemna*. Within the latter section 3 species groups were recognized, viz. the *Lemna valdiviana* group, the *L. perpusilla* group, and the *L. minor* group. In 1895 Hegelmaier reduced *Telmatophace* to the rank of section, following Cosson & Germain (1845), and at the same time he raised the species groups to the same rank, thus recognizing 5 sections, viz. sect. *Telmatophace*, sect. *Lemna*, sect. *Staurogeton*, sect. *Alatae* (for the *L. perpusilla* group), and sect. *Uninerves* (for the *L. valdiviana* group). Later authors did not follow Hegelmaire's subdivision of the genus *Lemna*. We too do not see the need for such an excessive splitting of a small genus. However, in our opinion it seems fully justified on morphological grounds to recognize *Staurogeton* as a separate subgenus. The status of *Telmatophace* is still under investigation.

Distribution: The genus is almost cosmopolitan.

KEY TO THE SUBGENERA

1. Floating water plants. Fronds round, elliptic, oblong, or obovate, with 1 root. Slit of budding pouch coinciding with the margin of the frond or ventral to the margin. . . . . subgen. **Lemna**
1. Submerged water plants, only rising to the surface in the flowering period. Fronds oblong to linear-lanceolate, with or without a root. Slit of budding pouch just dorsal to the margin of the frond subgen. **Staurogeton**

Subgen. LEMNA

Hydrophace Hall., Hist. Stirp. Indig. Helv. 3 (1768) 68. — *Lemna* sect. *Hydrophace* Dumortier, Fl. Belg. (1827) 166. — *Lemna* subgen. *Wolfia auct., non* Horkel: Endl., Gen. Pl. (1837) 232, — *Telmatophace* Schleid., Linnaea 13 (1839) 391 — *Lemna* sect. *Telmatophace* Coss. & Germ. Fl. Env. Paris 2 (1845) 576. — *Lemna* subgen. *Telmatophace* Peterm., Deutschl. Fl. (1849) 540, *p.p.* — *Lemna* subgen. *Hydrophace* sect. *Eulemna* Hegelm., Lemnac. (1868) 135.

Small water plants, floating at the surface. *Fronds* symmetric or slightly asymmetric, round, elliptic, oblong, or obovate, flat to conspicuously swollen, with or without red pigment cells in the epidermis; stomata on the dorsal side; margin entire; nerves 1—3(—5), sometimes indistinct. *Stipe* hyaline and fugacious. *Root* 1, always present, with a distinct root sheath. Slit of *budding pouch* coinciding with the margin of the frond, rarely ventral to the margin. *Ovary* with 1 amphitropous or orthotropous ovulum or with 2—4 anatropous ovula.

1. **Lemna minor** L., Sp. Pl. ed. 1 (1753) 970. — [*Lenticula palustris* Garsault, Fig. Pl. Anim. Med. (1764) t. 336; Descr. Pl. Anim. (1767) 206, *nomen invalidum.*] — *Lenticula minor* Scop. Fl. Carn. ed. 2,2 (1772) 213. — *Lenticula vulgaris* [Hill, Brit. Herb. (1757) 531, *nomen invalidum*] Lamk, Fl. Fr. 2 (1778) 189. — *Lemna vulgaris* Lamk, Encycl. 3 (1792) 464. — *Lemna minima* Thuiller *ex* Beauvois, J. Phys. Chim. Hist. Nat. 82 (1816) 113. — *Lemna minor* var. *minima* Chev., Fl. Paris 2 (1827) 256. — *Lenticularia monorhiza* Montand., Guide Bot. (1868) 308. — *Hydrophace minor* Bubani, Fl. Pyren. 4 (1897) 23.

Nearly all records of *Lemna minor* from tropical and subtropical regions relate in fact to *L. perpusilla.*

2. **Lemna gibba** L., Sp. Pl. ed. 1 (1753) 970. — *Lenticula vulgaris* var. *β* Lamk, Fl. Fr. 2 (1778) 189. — *Lemna vulgaris* var. *α* Lamk, Encycl. 3 (1792) 464. — *Lenticula gibba* Moench, Meth. (1794) 319. — *Lenticula gibbosa* Renault, Fl. Dep. Orne (1804) 40. — *Telmatophace gibba* Schleid., Linnaea 13 (1839) 391. — *Telmatophace gibbosa* Montand., Guide Bot. (1868) 308. — *Lemna cordata* Sessé & Moc., Pl. N. Hispan. La Naturaleze ser. II, 1, App. (1890) 159; Pl. N. Hispan. ed. 2 (1893) 147.

In its typical form *Lemna gibba* is a very characteristic species; flat forms of this species, however, can be easily mistaken for *L. minor.* Further it is not at all certain that all flat '*L. gibba*' truly represent a form of this species. The species is still under investigation. For further data on this 'flat form' one is referred to De Sloover (Natur. Belg. 47, 1966, p. 443—456), Guppy (J. Linn. Soc. Lond. 30, 1894, p. 323—330), den Hartog (Gorteria 4, 1968, p. 90—92), de Lange & Segal (Gorteria 4, 1968, p. 5—12), and Mason (Fl. Marshes California, 1957, p. 331).

3. **Lemna disperma** Hegelm., Bot. Zeit. 29 (1871) 654. — *Lemna disperma* var. *fallax* Hegelm., Bot. Jahrb. 21 (1895) 291. — *Lemna parodiana* Giardella, Notas Mus. La Plata 2, 12 (1937) 97—100.

L. disperma is the name used for Australian material of this species, while *L. parodiana*

has been used for South American specimens. The taxonomic position of this species in relation to *L. minor* and *L. gibba* is not yet clear. In some respects it seems an intermediate between these.

4. Lemna obscura (Austin) Daubs, Monogr. Lemnac. (1965) 20. — *Lemna minor* var. *obscura* Austin in A. Gray, Man. Bot. ed. 5 (1867) 479. — *Lemna minor* var. *colorata* Hegelm., Lemnac. (1868) 144.

This species needs reinvestigation. It is possible that it is only a growth-form of *L. gibba*.

5. Lemna perpusilla Torrey, Fl. N.Y. 2 (1843) 245. — *Lemna aequinoctialis* Welw., Apontam. phytogeogr. sobre a flora da prov. de Angola in Anñaes do Conselho Ultram. Dec. 1858, nr. 55 (1859) 578. — *Lemna angolensis* Welw. *ex* Hegelm., J. Bot. 3 (1865) 112. — *Lemna perpusilla* var. *trinervis* Austin in A. Gray, Man. Bot. ed. 5 (1867) 479. — *Lemna paucicostata* Hegelm., Lemnac. (1868) 139. — *Lemna paucicostata* var. *membranacea* Hegelm., Lemnac. (1868) 141. — *Lemna trinervis* Small, Fl. SE. U.S. (1903) 230. — *Hydrophace perpusilla* Lunell, Amer. Midl. Natur. 4 (1915) 237. — *Lemna minima* Blatt. & Hallb., J. Ind. Bot. 2 (1921) 50. — *Lemna blatteri* McCann, J. Bombay Nat. Hist. Soc. 43 (1942) 153. — *Lemna eleanorae* McCann, ibid. 43 (1942) 154.

6. Lemna valdiviana Phil., Linnaea 33 (1864) 239. — *Lemna minor* var. *cyclostasa* Elliott, Bot. S. Carol. and Georgia 2 (1824) 518. — *Lemna torreyi* Austin in A. Gray, Man. Bot. ed. 5 (1867) 479. — *Lemna valdiviana* var. *pellucida* Hegelm., Lemnac. (1868) 138. — *Lemna valdesiana* S. Watson in U.S. Geol. Expl. 40th parallel (cited in Ind. Kew. as Bot. King's Exp.) (1871) 336; obviously a mis-spelling of *L. valdiviana*. — *Lemna valdiviana* var. *abbreviata* Hegelm. in Mart., Fl. Bras. 3,2 (1878) 19. — *Lemna valdiviana* var. *platyclados* Hegelm. in Mart., Fl. Bras. 3,2 (1878) 19. — *Lemna valdiviana* var. *robusta* Hegelm., Bot. Jahrb. 21 (1895) 298. — *Lemna cyclostasa* Thompson, Rep. Mo. Bot. Gard. 9 (1897) 35.

7. Lemna minuscula Herter, Rev. Sudamer. Bot. 9 (1954) 185. — *Lemna minuta* H., B. & K., Nov. Gen. & Sp. 1 (1815) 372, *non* Rafin., Med. Repos. N. York 5 (1808) 353; Kunth, Syn. Pl. Aequin. 1 (1822) 136. — [*Lemna minima* Kunth, Enum. Pl. 3 (1841) 5 (*nomen in synon. sub L. minor*, obviously a mis-spelling of *L. minuta*), *non L. minima* Beauvois, J. Phys. Chim. Hist. Nat. 82 (1816) 113; Humb. *ex* Phil., Linnaea 29 (1857) 45, *nomen;* ibid. 33 (1864) 239, *nomen*]. — *Lemna valdiviana* var. *minima* Hegelm., Lemnac. (1868) 138.

According to Thompson (Rep. Mo. Bot. Gard. 9, 1897, p. 135) *Lemna valdiviana* var. *platyclados* Hegelm. is a form of *L. minuscula*.

Subgen. STAUROGETON

Rchb. Fl. Germ. 1 (1830) 10. — *Lemna* sect. *Hydrophylla* Dumortier, Fl. Belg. (1827) 165. — *Staurogeton* Rchb., Consp. (1828) 288, *nomen*. — *Lemna* sect. *Staurogeton* Endl., Gen. Pl. Suppl. (1840) 1369. — *Lemna* subgen. *Hydrophace* sect. *Staurogeton* Hegelm., Lemnac. (1868) 133.

Type species: *Lemna trisulca* L.

Small, submerged water plants, floating at the surface only when flowering. *Fronds* thin, more or less symmetric, oblong to linear-lanceolate, entire or denticulate towards the apex, green, without red pigment cells, nerves 1—3, sometimes indistinct; stomata on the dorsal side in the flowering period. *Stipe* persistent, hyaline and short or green

and distinctly elongate. *Root* 1, or absent; root sheath indistinct. Slit of *budding pouch* just dorsal to the margin of the frond. *Ovary* with 1 amphitropous ovulum; fruit broad, more or less symmetric. *Seed* ribbed.

8. Lemna trisulca L., Sp. Pl. ed. 1 (1753) 970. — [*Lenticula aquatica trisulca* Hill, Brit. Herb. (1757) 531, *nomen invalidum.*] — *Lenticula trisulca* Scop., Fl. Carn. ed. 2 (1772) 213. — *Lenticula ramosa* Lamk. Fl. Fr. 2 (1778) 189. — *Lemna cruciata* Roxb., [Hort Beng. (1814) 66, *nomen*] Fl. Ind. 3 (1832) 566. — *Lemna intermedia* Ruthe, Fl. Mark Brandenb. und Niederlausitz, ed. 2 (1834) 277. — *Lemna bisulca* C. A. Meyer in Beitr. Pfl. Russ. Reich 9 (1854) 104. — *Staurogeton trisulcus* Schur, En. Pl. Transs. (1866) 636. — *Staurogeton trisulcum* Montand., Guide Bot. (1868) 308. — *Hydrophace trisulca* Bubani, Fl. Pyren. 4 (1897) 23.

9. Lemna tenera Kurz, J. As. Soc. Bengal 40, II (1871) 78.

SUBFAMILY WOLFFIOIDEAE

Small to minute water plants, floating freely at the surface, sometimes floating just below the surface whereby only a very small part of the frond is exposed to the air, or completely submerged in which case they come to the surface only in the flowering period. *Fronds* ranging in shape from linear, oblong, strap-like, broad elliptic, disc-shaped to globular or ellipsoid; epidermis with or without brown pigment cells and always without raphides; nerves none; roots none. Vascular tissue absent except for an occasional trace in the stamen. Dorsal and ventral scales none. *Budding pouch* basal, median, either triangular, dorso-ventrally flattened, opening by a transverse slit and with a well-developed stipe, or funnel-shaped with a circular opening and with a stipe not visible to the naked eye. *Inflorescence* 1, rarely 2 (in *Wolffiopsis*), dorsal, consisting of a cavity containing 1 female and 1 male flower, without a spathe. *Male flower:* anther unilocular, dehiscent along an apical pigmented line. *Female flower* situated nearer to the budding pouch than the male flower; style persistent; ovulum 1, orthotropous. *Fruit* globular or slightly compressed. *Seed* smooth.

KEY TO THE GENERA

1. Plants flat. Budding pouch triangular, dorso-ventrally flattened, opening by a transverse slit. Stipe well-developed.
   2. Frond submerged, thin membranous, with brown pigment cells in the epidermis.
      3. Frond asymmetric, linear-oblong to almost strap-like, often falcate. Budding pouch asymmetric. Stipe lateral, short or elongate. Inflorescence 1. . . . . **3. Wolffiella**
      3. Frond symmetric, broad-elliptic to ovate, slightly curled. Budding pouch symmetric. Stipe median, short. Inflorescences 2. . . . . **5. Wolffiopsis**
   2. Frond floating at the surface, slightly swollen, symmetric, round or nearly so, without pigment cells in the epidermis. Budding pouch symmetric. Stipe median, long, membranous, more or less widened. Inflorescence 1 . . . . . **4. Pseudowolffia**
1. Plants globular or ellipsoid. Budding pouch funnel-shaped with a circular opening. Stipe not visible to the naked eye. . . . . **6. Wolffia**

3. WOLFFIELLA

Hegelm., Bot. Jahrb. 21 (1895) 303. — *Wolffia* subgen. *Wolffiella* Hegelm., Lemnac. (1868) 131.

Type species: *Wolffiella oblonga* (Phil.) Hegelm.

Small submerged water plants, only the basal parts of the plants emerged when flowering. *Fronds* asymmetric, flat, thin membranous, linear-oblong to almost strap-like, often falcate, with air spaces, with brown pigment cells in the epidermis; stomata only present in the emerged parts when flowering; margin entire or slightly toothed. *Budding pouch* more or less asymmetric, triangular, dorso-ventrally flattened, opening by a transverse slit, with a short or elongate lateral stipe. *Inflorescence* 1, lateral to the median line, proterogynic. *Fruit* slightly compressed.

Note: We propose to indicate *Wolffiella oblonga* (Phil.) Hegelm. as the type species of the genus. Of the 4 species placed by Hegelmaier in the genus *Wolffiella* it is the best known.

Distribution: The genus occurs with 4 species in the tropical, subtropical, and warm-temperate areas of America. A fifth species is known from South Africa.

1. **Wolffiella oblonga** (Phil.) Hegelm., Bot. Jahrb. 21 (1895) 303. — *Lemna oblonga* Phil., Linnaea 29 (1857) 45. — *Wolffia oblonga* Hegelm., Lemnac. (1868) 131. — *Wolffia lingulata* var. *minor* Hegelm. in Mart., Fl. Bras. 3,2 (1878) 10.

2. **Wolffiella lingulata** (Hegelm.) Hegelm., Bot. Jahrb. 21 (1895) 303. — *Wolffia lingulata* Hegelm., Lemnac. (1868) 132.

3. **Wolffiella gladiata** (Hegelm.) Hegelm., Bot. Jahrb. 21 (1895) 304. — *Wolffia gladiata* Hegelm., Lemnac. (1868) 133.

4. **Wolffiella floridana** (J. D. Smith) Thompson, Rep. Mo. Bot. Gard. 9 (1897) 37. — *Wolffia gladiata* var. *floridana* J. D. Smith, Bull. Torr. Bot. Cl. 7 (1880) 64. — [*Wolffia floridana* J. D. Smith *ex* Hegelm., Bot. Jahrb. 21 (1895) 305 (not validly published)].

5. **Wolffiella denticulata** (Hegelm.) Hegelm., Bot. Jahrb. 21 (1895) 305. — *Wolffia denticulata* Hegelm., Lemnac. (1868) 133.

4. PSEUDOWOLFFIA *nov. gen.*

Wolffia Horkel [*ex* Bartl., Ord. (1830) 76, *nomen ('Wolfia')*] *ex* Schleid., Linnaea 13 (1839) 389, *non* Horkel *ex* Schleid., Beitr. Bot. 1 (1844) 233; Kunth, Enum. Pl. 3 (1841) 4 *('Wolfia')*. — *Lemna* subgen. *Wolffia* Peterm., Deutschl. Fl. (1849) 540. — *Wolffia* sect. *Uniflorae* subsect. *Stipitatae* Hegelm., Lemnac. (1868) 122; Bot. Jahrb. 21 (1895) 300.

Type species: *Pseudowolffia hyalina* (Delile) den Hartog & van der Plas.

Small water plants, floating at the surface. *Fronds* symmetric, slightly swollen, round or nearly so, with air spaces, without pigment cells in the epidermis; numerous stomata on the dorsal side; margin entire or more or less denticulate. *Budding pouch* symmetric, triangular, dorso-ventrally flattened, opening by a transverse slit, with a long, membranous, more or less widened median stipe on the underside. *Inflorescence* 1, lateral or almost median, proterogynic. *Fruit* slightly compressed.

Nomenclature: The genus *Wolffia* was originally typified by W. *delilii* (= *W. hyalina*). This species and *W. repanda* are so different from the other species accomodated in *Wolffia* that the division of the genus into 2 separate genera is justified. As this would cause a number of name changes, — even such well-known species as *W. arrhiza* and *W. columbiana* would have to be renamed — a retypification of the genus *Wolffia* has been proposed (den Hartog, Taxon 18, 1969, p. 591—592). Although in this proposal

it is stated that we share Monod's opinion that *W. hyalina* and *W. repanda* have to be accomodated in *Wolffiella*, a further study of these species has shown that they have a number of characters in common which justifies the erection of a new genus, *Pseudowolffia*.

Distribution: The genus is restricted to northern and central Africa, and contains 3 species.

1. Pseudowolffia hyalina (Delile) den Hartog & van der Plas, *nov. comb.* — *Lemna hyalina* Delile, Fl. Egypt. (1813) 75. — *Wolffia delilii* Schleid., Linnaea 13 (1839) 390. — *Wolffia hyalina* Hegelm., Lemnac. (1868) 128. — *Wolffiella hyalina* Monod, Mém. Soc. Hist. Nat. Afr. Nord, hors sér. 2, Trav. Bot. dédiés à René Maire (1949) 242.

2. Pseudowolffia repanda (Hegelm.) den Hartog & van der Plas, *nov. comb.* — *Wolffia repanda* Hegelm., J. Bot. 3 (1865) 113. — *Wolffiella repanda* Monod, Mém. Soc. Hist. Nat. Afr. Nord, hors sér. 2, Trav. Bot. dédiés à René Maire (1949) 242.

3. Pseudowolffia monodii (Jovet-Ast) den Hartog & van der Plas, *nov. comb.* — *Wolffiella monodii* Jovet-Ast, Bull. Inst. Fond. Afr. Noire 30 (1968) 837—844, f. 3.

5. WOLFFIOPSIS *nov. gen.*

Wolffia sect. *Biflorae* Hegelm., Lemnac. (1868) 130; Bot. Jahrb. 21 (1895) 300.

Type species: *Wolffiopsis welwitschii* (Hegelm.) den Hartog & van der Plas.

Small submerged water plants with only a small part of the base at the water surface. *Fronds* symmetric, flat, thin membranous, broad-elliptic to ovate, with a very obtuse base and apex, entire, slightly curled, with air spaces in the basal part, with brown pigment cells in the epidermis; stomata very few or absent, only present in the emerged part. *Budding pouch* symmetric, triangular, dorso-ventrally flattened, opening by a transverse slit, with a short, median stipe on the underside. *Inflorescences* 2, one on either side of the median line, male and female flowers flowering simultaneously. *Fruit* slightly compressed.

Distribution: Monotypic genus, distributed in tropical Africa and tropical America.

1. Wolffiopsis welwitschii (Hegelm.) den Hartog & van der Plas, *nov. comb.* — *Wolffia welwitschii* Hegelm., J. Bot. 3 (1865) 114. — *Wolffia conguensis* Welw. *ex* Trimen, J. Bot. 4 (1866) 223. — *Wolffiella welwitschii* Monod, Mém. Soc. Hist. Nat. Afr. Nord, hors sér. 2, Trav. Bot. dédiés à René Maire (1949) 229, 242.

The problem whether the African and American material of this species are exactly identical needs further investigation.

6. WOLFFIA

Horkel [*ex* Bartl., Ord. (1830) 76, *nomen ('Wolfia')*] *ex* Schleid., Beitr. Bot. 1 (1844) 233 *(nom. gen. cons. prop.)*; den Hartog, Taxon 18 (1969) 591—592. — *Grantia* Griff. *ex* Voigt, Hort. Suburb. Calc. (1845) 692; Not. 3 (1851) 223. — *Bruniera* Franch., Billotia 1 (1864) 25, 30. — *Wolffia* sect. *Uniflorae* subsect. *Estipitatae* Hegelm., Lemnac. (1868) 122; Bot. Jahrb. 21 (1895) 301.

Lectotype species: *Wolffia michelii* Schleid. *(typ. cons. prop.)*

Small water plants, floating at the surface. *Fronds* symmetric, thick, more or less globular, ellipsoid or ovoid, sometimes dorsally flattened, with fleshy parenchyma without

air spaces, with or without brown pigment cells in the epidermis; stomata in the dorsal part of the frond; margin entire or with a few more or less prominent papillae. *Budding pouch* basal, funnel-shaped with circular opening and with a rudimentary stipe (only visible after dissection under the microscope). *Inflorescence* 1, proterogynic. *Fruit* globular. *Seed* globose or slightly compressed.

Distribution: The genus is widely distributed in the temperate and tropical zones of both hemispheres, with at least 7 species.

1. **Wolffia arrhiza** (L.) Horkel *ex* Wimmer, Fl. Schles. ed. 3 (1857) 140. — *Lemna arrhiza* L., Mant. 2 (1771) 294. — *Lenticula arrhiza* Lamk. Fl. Fr. 2 (1778) 190. — *Wolffia michelii* Schleid., Beitr. Bot. (1844) 233. — *Wolffia delilii auct. non* Schleid., 1839: Miq., Nederl. Kruidk. Arch. 3 (1855) 428; Fl. Ned. Ind. 3 (1855) 221; Kurz, J. Linn. Soc. Bot. 9 (1866) 265. — *Bruniera vivipara* Franch., Billotia 1 (1864) 25. — *Telmatophace arrhiza* Schur, Enum. Pl. Transs. (1866) 635. — *Horkelia arrhiza* Druce, Fl. Berks. (1898) 511.

Var. **australiana** Benth., Fl. Austr. 7 (1878) 162, represents probably a new species (see Eichler, Suppl. Fl. S. Austr., 1965, p. 78). This is still under investigation.

2. **Wolffia globosa** (Roxb.) den Hartog & van der Plas, *nov. comb.* — *Lemna globosa* Roxb., Fl. Ind. 3 (1832) 565. — *Grantia globosa* Griff. *ex* Voigt, Hort. Suburb. Calc. (1845) 692; Not. 3 (1851) 229. — *Wolffia schleideni* Miq., Nederl. Kruidk. Arch. 3 (1855) 428; Fl. Ned. Ind. 3 (1855) 221. — *Wolffia delilii* var. *schleideni* Kurz, J. Linn. Soc. Bot. 9 (1866) 265. — *Wolffia cylindracea* Hegelm., Lemnac. (1868) 123.

3. **Wolffia columbiana** Karsten, Bot. Unters. 1 (1865) 103. — *Grantia columbiana* Mac Mill., Metasp. Minn. (1892) 135. — *Bruniera columbiana* Nieuwland, Amer. Midl. Natur. 2 (1912) 306.

4. **Wolffia brasiliensis** Weddell, Ann. Sci. Nat. III, 12 (1849) 170. — *Grantia brasiliensis* Mac Mill., Metasp. Minn. (1892) 134.

5. **Wolffia punctata** Griseb., Fl. Br. W. Ind. (1864) 512. — *W. brasiliensis* var. *borealis* Engelm. *ex* Hegelm., Lemnac. (1868) 127. — *Bruniera punctata* Nieuwland, Amer. Midl. Natur. 2 (1912) 306.

6. **Wolffia papulifera** Thompson, Rep. Mo. Bot. Gard. 9 (1897) 40.

7. **Wolffia microscopica** (Griff.) Kurz, J. Linn. Soc. Bot. 9 (1866) 265. — *Grantia microscopica* Griff. *ex* Voigt, Hort. Suburb. Calc. (1845) 692; Not. 3 (1851) 226.

INVALID AND DUBIOUS NAMES

Horkelia Rchb., Consp. (1828) 44, *nomen* = *Wolffia* Horkel *ex* Schleid. See Bartl., Ord. (1830) 76.

Hydrophace monorrhiza Hall. *ex* Scop., Fl. Carn. ed. 2 (1772) 213, *nomen in synon. sub Lenticula minor* Scop. = *Lemna minor* L.

Lemna bannatica Waldst. & Kitaibel *ex* Schleid., Linnaea 13 (1839) 392, *nomen in synon. sub Spirodela polyrhiza* (L.) Schleid.

Lemna cherokensis Schweinitz *ex* Hegelm., Bot. Jahrb. 21 (1895) 297, *nomen.*

Lemna conjugata Willd. *ex* Schleid., Linnaea 13 (1839) 391, *nomen in synon. sub Lemna minor* L.

Lemna cyclostasa Elliott *ex* Schleid., Linnaea 13 (1839) 391, *nomen in synon. sub Lemna minor* L. Incorrect citation of *Lemna minor* var. *cyclostasa* Elliott, Bot. S. Carol. & Georgia 2 (1824) 518. In literature this combination has been repeatedly ascribed to Chevallier ('Fl. Par. 2, 1827, p. 256') but this is incorrect.

Lemna javanica Bauer *ex* Hegelm., Lemnac. (1868) 150, *nomen in synon. sub Spirodela oligorrhiza* ε *javanica* Hegelm. = *Spirodela punctata* (G. F. W. Meyer) Thompson.

Lemna microscopica Schur, Enum. Pl. Transs. (1866) 635, *nomen in synon. sub Telmatophace arrhiza* Schur = *Wolffia arrhiza* (L). Horkel *ex* Wimmer.

Lemna minima Chev. *ex.* Schleid., Linnaea 13 (1839) 391, *nomen in synon. sub Lemna minor* L. Incorrect citation of *L. minor* var. *minima* Chev., Fl. Par. 2 (1827) 256. We have not found any indication that Chevallier based his var. *minima* on *Lemna minima* Thuiller *ex* Beauvois, J. Phys. Chim. Hist. Nat. 82 (1816) 113. The diagnoses are very different.

Lemna minima H.B.K. *ex* Kunth, Enum. Pl. 3 (1841) 5, *nomen in synon. sub Lemna minor* L. Incorrect citation of *L. minuta* H.B.K. (1815) = *Lemna minuscula* Herter.

Lemna minor var. *gunnii* Hegelm., Bot. Jahrb. 21 (1895) 292, *nomen.* Tasmania.

Lemna minuta Rafin., Med. Repos. N. York 5 (1808) 353, *nomen.*

Lemna monorhiza Montand. *ex* Daubs, Monogr. Lemnac. (1965) 22, *nomen in synon. sub Lemna minor* L. Incorrect reference to *Lenticularia monorhiza* Montand., Guide Bot. (1868) 308.

Lemna obcordata Wallich, Cat. (1828) 181, no. 5201, cited in Index Kewensis, not seen by us.

Lemna obcordata Bojer, Hort. Maurit. (1837) 358. Usually placed in the synonymy of *Lemna minor* L., but in need of reinvestigation.

Lemna ovata A. Br. *ex* Krauss, Flora 28 (1845) 344, *nomen*, placed in the synonymy of *Lemna minor* L. on the authority of Hegelmaier.

Lemna palustris Haenke *ex* Mert. & Koch, Roehlings Deutsch. Fl. ed 3, 1 (1823) 295, *nomen in synon. sub Lemna minor* L.

Lemna platyclados Hegelm. *ex* Thompson, Rep. Mo. Bot. Gard. 9 (1897) 36. Incorrect citation of *Lemna valdiviana* var. *platyclados* Hegelm.

Lemna pusilla Hegelm. *ex* Daubs, Monogr. Lemnac. (1865) 14, *nomen in synon. sub Spirodela oligorrhiza* (Kurz) Hegelm. = *Spirodela punctata* (G. F. W. Meyer) Thompson. Incorrect citation of *Spirodela oligorrhiza* γ *pusilla* Hegelm.

Lemna transsilvanica Schur, Enum. Pl. Transs. (1866) 635, *nomen in synon. sub Telmatophace orbicularis* Schur = *Spirodela polyrhiza* (L.) Schleid.

Lemna tricorrhiza Thuiller *ex* Schleid., Linnaea 13 (1839) 391, *nomen in synon. sub Telmatophace gibba* Schleid. = *Lemna gibba* L.

Lemna umbonata A. Br. *ex* Hegelm., Lemnac. (1868) 156, manuscript name, referred to by Hegelmaier as *Spirodela polyrhiza* (L.) Schleid.

Lenticula cruciata Roxb. *ex* Miq., Fl. Ned. Ind. 3 (1855) 222, *nomen in synon. sub Lemna trisulca* L. Incorrect citation of *Lemna cruciata* Roxb.

Lenticula cyclostasa Elliott *ex* Kurz, J. Linn. Soc. Lond. 9 (1866) 266, *nomen in synon. sub Lemra minor* L. Incorrect citation of *Lemna minor* var. *cyclostasa* Elliott.

Lenticula gibba Lamk, Fl. Fr. 2 (1778) 189, *nomen in synon. sub Lenticula vulgaris* var. β = *Lemna gibba* L. This combination was validly published by Moench, Meth. (1794) 319.

Lenticula minima Humb. & Kunth *ex* Miq., Fl. Ned. Ind. 3 (1855) 222, *nomen in synon. sub Lemna minor* L. Incorrect citation of *Lemna minuta* H.B.K. (1815).

Telmatophace cylindracea Welw. *ex* Hegelm., Lemnac. (1868) 123, *nomen in synon. sub Wolffia cylindracea* Hegelm. = *Wolffia globosa* (Roxb.) den Hartog & van der Plas.

Telmatophace generalis E. H. L. Krause in Sturm, Fl. Deutschl. ed 2, 1 (1906) 184, *nomen in synon. sub Lemna gibba* L.

EXCLUDED NAMES

Lemna dimidiata Rafin., Amer. Monthly Mag. 2 (1817) 43 = **Ricciocarpus natans** (L.) Corda, a liverwort.

Lemna minuta Steudel, Nom. ed 1, 2 (1823) 469. Incorrect citation of *Lemma minuta* Desrous. in Lamk, Encycl. 3 (1792) 721. = **Marsilea minuta** L.

Lemna obcordata Vahl, Symb. Bot. 2 (1791) 95; Persoon, Syn. Pl. 2 (1807) 532; Beauvois, J. Phys. Chim. Hist. Nat. 82 (1816) 113 = **Ricciocarpus natans** (L.) Corda, a liverwort.

Lemna quadrifolia Steudel, Nom. ed. 1, 2 (1823) 469. Incorrect citation of *Lemma quadrifolia* Desrous. in Lamk, Encycl. 3 (1792) 720 = **Marsilea quadrifolia** L.