

LENTIBULARIACEAE (P. Taylor, Kew)

A small family of annual or perennial herbs, all of which are variously adapted for the capture and digestion of small animals (insects, *Crustacea*, etc.). Only one genus (*Utricularia*) occurs in Malesia.

The family is cosmopolitan, including arctic regions, but is more or less absent from Polynesia. It includes 4 genera with c. 250 *spp.*

The largest and most widely spread is the cosmopolitan genus *Utricularia* L. with c. 180 *spp.*, almost half of which occur in the New World, the rest being more or less equally distributed between tropical Africa, Asia, and Australia, with a few in the north temperate zone, 22 *spp.* occurring in Malesia.

Pinguicula L., with some 50 *spp.*, has a curious distribution, with a few circum-boreal species and concentrations in the Mediterranean region and in North, but especially in Central and in South America, as far south as Patagonia.

Genlisea ST.HIL., with c. 16 *spp.*, is confined to the tropics of South America and Africa.

Polypompholyx LEHM., with 2 *spp.*, occurs only in Australia.

All genera are associated with damp or wet habitats and most frequently found on sterile mineral soils where they are often associated with other carnivorous plants (as e.g. *Drosera*).

Unfortunately no fossils are known with certainty, apart from some Quaternary pollen.

The affinities of the family have been the subject of considerable discussion and opinions are divided between a relationship with *Scrophulariaceae* and *Primulaceae*. The combination of free basal (or free central) placentation, a spurred personate corolla (the spur is always present but occasionally reduced), two stamens and the carnivorous habit is diagnostic for the family. In favour of affinity with *Scrophulariaceae* are the morphology of the corolla, the structure and number of the stamens, the bilobed stigma, and such cytological evidence as is available. The pollen of *Lentibulariaceae* is similar to that of both of the families in question. The placentation (and no doubt the mode of dehiscence of the probably most derived aquatic European species, i.e. those most usually studied) is certainly the reason for a suggested alliance with *Primulaceae* but the two families have little else in common. The transition from axile to free central (or basal) placentation by the loss of the septum is quite feasible and the mode of dehiscence of at least what are presumably the most primitive *Utricularia* species could support such a hypothesis.

Within the family the combination of two-lobed calyx and trap structure is diagnostic for the genus *Utricularia*. *Polypompholyx* is very close to *Utricularia* but with 4 calyx lobes in two whorls. *Genlisea* and *Pinguicula* both have true leaves and a 5-lobed calyx, the traps of the former genus being extremely complex but quite different from those of *Utricularia*. *Genlisea* has also a unique type of fruit dehiscence — likening the fruit to a globe it splits at the equator and at least partially at both tropics. *Pinguicula* has an apparently much less complex trapping mechanism consisting of two types of superficial glands on the leaves while the dehiscence is constantly valvate. Theories have been advanced as to how the various trapping mechanisms could be derived one from the other but they are on the whole unconvincing.

UTRICULARIA

LINNÉ, Gen. Pl. ed. 5 (1754) 11; Sp. Pl. (1753) 18; A. DC. in DC. Prod. 8 (1844) 3; B. & H. Gen. Pl. 2 (1876) 987; KAMIENSKI in E. & P. Nat. Pfl. Fam. 4, 3b (1895) 119; P. TAYLOR, Kew Bull. 18 (1964) 1; Mem. N.Y. Bot. Gard. 17, 1 (1967) 206; KOMIYA, J. Jap. Bot. 48, 5 (1973) 149. — *Polypompholyx* (*non* LEHM.) BENJ. in Mart. Fl. Bras. 10 (1847) 251; Linnæa 2 (1847) 447; GRISEB. Cat. Pl. Cub. (1866) 162; PELLEGRI. Bull. Soc. Bot. Fr. 60 (1914) 514; *ibid.* 61 (1914) 20; PERRIER, Mém. Inst. Sci. Madag. sér. B. 5 (1955) 199; in Humbert, Fl. Madag., Lentib. (1955) 19. — *Biovularia* KAMIENSKI, Zap. Novoross. Obtsch. Est. 12 (1890) 204; in E. & P. Nat. Pfl. Fam. 4, 3b (1895) 122; Bot. Jahrb. 33 (1902) 113; BARNH. Mem. N.Y. Bot. Gard. 6 (1915) 58; MELCHIOR in Engl. Syll. Pfl. ed. 12, 2 (1964) 467. — Fig. 1–26.

Annual or perennial aquatic terrestrial or epiphytic herbs always of damp places, without true roots or leaves but with stems modified in various ways to function as rhizoids, stolons and foliar organs, all species bearing small complex bladder-like traps for the capture and digestion of small aquatic organisms. *Inflorescence* racemose, peduncled, usually simple, bracteate; sterile bracts (scales) often present on the peduncle and sometimes also on the inflorescence axis; two bracteoles often present, almost always at the base of the pedicel, usually free, rarely \pm connate with the bract. Bracts very varied, basifixed, medifixed or variously produced below the point of attachment. *Calyx* 2-lobed, usually \pm accrescent, the lobes \pm equal or variously dissimilar, usually free, sometimes \pm connate at the base. *Corolla* bilabiate, yellow, various shades of violet or purple, white or rarely blue or red; upper lip entire or 2- or more-lobed; lower lip with an entire or 2–5-lobed limb, a \pm raised, often gibbous palate and a usually subulate or conical spur, in a few species reduced to a short sac. *Stamens* 2 inserted at the base of the upper lip; filaments usually short, linear, often curved and often \pm flattened and dilated above; anthers dorsifixed, \pm ellipsoid, thecae \pm confluent. *Ovary* globose or ovoid, ovules 2-many on a free basal or free central \pm fleshy placenta; style usually short; stigma bilabiate, the lower lip usually much larger. *Capsule* globose or ovoid, dehiscing very variously by longitudinal slits, dorsiventral or rarely lateral valves, pores or circumscissile or rarely indehiscent. *Seeds* 1-many, very variously shaped and sculptured.

Distr. Cosmopolitan but mostly in the tropical zone. About 180 *spp.*, almost half of which occur in the New World, the rest more or less equally distributed between tropical Africa, Asia and Australia with a few in the north temperate zone; in *Malesia* 22 *spp.*

The geographical relationships of the Malesian *spp.* are of some interest. Twelve species are more or less widespread throughout tropical Asia and Australia and four of these occur also in tropical Africa. *U. subulata* is widespread in tropical America and Africa, apparently absent from India, but present in Thailand, Malaya and Borneo. *U. pulchra*, which is allied to the very widespread *U. striatula*, appears to be endemic in New Guinea while *U. salwinensis* of the same affinity is known only from the Gajo mountains of North Sumatra and from SW. China (Yunnan). *U. vitellina* is apparently local-endemic in Malaya while the allied *U. involvens* is known from that country, adjacent Burma, Thailand, and N. Australia. *U. heterosepala*, a slightly anomalous species in the same group (which is predominantly Asian but with representatives in tropical Africa and to a lesser extent in America) appears to be endemic in the Philippines. The circumboreal species *U. minor* occurs at high altitudes in New Guinea and *U. australis*, which is widely distributed in the Old World north temperate zone, occurs, mostly at high altitudes, in a number of places in Malesia; it is known also in the mountains of tropical Africa and at lower altitudes in SE. Australia. Two species known otherwise only from northern Australia occur in SE. New Guinea: *U. chrysantha* and *U. muelleri*. One strange apparent absence from the Malesian region is *U. stellaris* which is known from tropical Africa and Asia as far as Indo-China and reappears in northern Australia. It is included in the key to the species as it seems very probable that it does occur in the area.

Ecol. Marshes, wet grassfields, swamps, swamp-forest, streams and rivers and open damp sandy ground, a few species epiphytic among moss on trees (and rocks), occurring in Malasia from sea-level to 3660 m.

Pollination. The flowers often secrete nectar and in some species are fragrant. Pollination by *Diptera* and *Hymenoptera* has been observed and the flowers are sometimes visited by *Lepidoptera*. However, self pollination is probably usual and cleistogamous forms are frequent and in some species inflorescences normally bear both cleistogamous and chasmogamous flowers.

Dispersal. Dispersal over short distances can easily take place in aquatic species by floating of entire plants or parts thereof, or by dispersal of buds (turions), according to RIDLEY (Disp. 1930).

Seeds are mostly very small and sometimes winged and therefore perhaps sometimes dispersed by wind, although gravity is probably the most normal agent. In some of the aquatic species the seeds do not float, or they do so only for a time (RIDLEY, Disp. 1930, 220). A few (not Mal. spp.) growing in swiftly flowing water have seeds with a mucilaginous testa and in the epiphytic species the seeds are either very small (orchid-like) or winged or (*U. striatula*) beset with glochidiate processes. Fig. 13t.

The occurrence of some species which are epiphytic among moss on tree-trunks in dense primary rain-forest where there is hardly any wind might point to very short-distance dispersal by ants or other insects. Fig. 14.

In open terrain the seed qualities would point to wider exozooic dispersal by migrating waterfowl and waders for aquatic species, and by wind. This might induce dispersal enthusiasts to explain the enormous disjunct gaps in the range of *U. minor* between Burma and New Guinea, and that of *U. stellaris* between Indo-China and Australia by erratic long-distance dispersal.

However, several terrestrial species show similar wide disjunctions, e.g. *U. salwinensis* between Yunnan and North Sumatra, *U. scandens* and *U. limosa* between the Malay Peninsula and New Guinea, and *U. baouleensis* between Luzon and Java. Though the present revision is based upon some 2000 collections, the latter two species may have escaped attention of collectors in intermediate stations. However, the disjunct range of the subalpine *U. salwinensis* is certainly a real gap, as high mountains are at present absent between Yunnan and N. Sumatra. A similar disjunction is found in the ranges of other high mountain plants, such as for example *Swertia bimaiculata* and *Viola biflora* which are certainly not overlooked.

It should be admitted, though, that *Utricularia* must often have escaped attention of collectors, especially in seasonal areas where flowering is of short duration and ephemeral. On the other hand in a thoroughly explored island as Java, *U. baouleensis* is known only from Madura I. in one collection. This leads to the conclusion that it is most unlikely that the gaps mentioned above will be reasonably filled by later exploration, especially these of the high altitude species. This argument is strengthened by the fact that these disjunctions are by no means unique: the gap of *U. salwinensis* is matched by that of *Viola biflora*, *Hedyotis verticillaris*, etc., the gap of *U. minor* by that of *Drosera rotundifolia* and several *Carices*, but also by that found in *Fagoideae*. Even an extraordinary range as that of *U. livida*, which is found in East Africa and Madagascar but also in Mexico, is ± matched by a few other taxa or affinities with similar disjunction, in tropical America, e.g. tribe *Ravenalae* (*Musaceae*) and *Rheedia* (*Guttiferae*).

Then there are some Indo-Australian species showing a huge disjunction: *U. involvens*, Burma, Thailand, Malaya and N. Australia, and a closely related one, *U. odorata*, Thailand, Indo-China and N. Australia.

It gives thought to the assumption that these disjunctions cannot simply be explained by erratic long-distance dispersal. Also the occurrence of three local-endemic species makes such a correlation with dispersal capacity highly dubious and does not plead for easy dispersal. Neither does the fact that the ecology of many *Utricularia* spp. is very wide; they are not particular to soil, many are found in the tropics under both everwet and seasonal climatic conditions, and a fair number have a very large altitudinal range.

On the other hand it must be realized that the very widely distributed *U. australis*, which ranges all over the Old World with isolated sporadic localities on the southern hemisphere, is not known to produce fruit and seed, which forces to assume dispersal of small particles of its vegetative parts by migrating birds. This implies that such parts should be capable to withstand desiccation which will certainly happen during such migratory flight. Experiments could add some evidence. It is e.g. shown by V. A. WAGER (Trans. R. Soc. S. Afr. 16, 1928, 204, pl. 24) that *U. australis* (under the erroneous name *U. stellaris*) forms resting buds towards the end of the season which may carry the plant over until the following spring. These resting buds are not damaged by exposure to drought; buds taken from a herbarium specimen six months old put into an aquarium slowly swelled and developed into healthy plants.

Chromosomes. Relatively few (about 15%) of the species of *Utricularia* have been examined; the chromosomes are apparently small and not easily observed. Basic numbers of $x = 7$ and 9 seem to predominate but $x = 6, 8, 10, 11$ and 15 are recorded. An American species, *U. inflata* WALT., has $2n = 18$ and 36 , the latter being morphologically gigantic whereas the closely allied *U. radiata* SMALL has $2n = 28$. The common Australian species *U. dichotoma* LABILL. has $2n = 28$ while conversely a morphologically small variant of this, *U. uniflora* R.Br., has $2n = 56$. Cf. J. CASPAR in Fedde, Rep. 86 (1975) 211-232.

Morph. The most remarkable feature of the genus are the traps. They are minute vesicles produced with an apical orifice at the ventral side. The narrow opening leading to the water-filled cavity is formed by a ventral lip, and a dorsal valve which enables the prey to enter, but prevents it from escaping, in which it is also hampered by glandular papillae of striking structure. The inner wall of the trap is densely glandular-papillose and exudes proteolytic enzymes.

The functioning of the trap, by the opening of the valve, is caused by irritation of the sensitive hairs on this lid by which small crustacea or other matter is 'sucked' in. See E. MERL (Flora: Allg. Bot. Z. 115,

1922, 59-74) extracted by JACOBSON in Trop. Natuur 17 (1928) 107-113, 4 fig., in Dutch, and especially F. E. LLOYD, The Carnivorous Plants (1942) 233-270; furthermore the excellent survey by Y. HESLOP-HARRISON (Endeavour 35, 1975, 114-122).

Paly. Pollen grains are tricolporate or stephanocolporate with up to 28 colpi. Tetrads occur in two species of *Utricularia*. Size ranges from 17 µm in *U. neottioides* to 51 µm in *U. humboldtii*. Shape varies from oblate to prolate. Sculpture is generally smooth in *Utricularia* or finely reticulate as in *Pinguicula* (ERDTMAN, Pollen morphology and plant taxonomy. Angiosperms. Almqvist & Wiksell, Stockholm, 1952, 233-234).

In *Utricularia* HUYNH (Étude de la morphologie du pollen du genre *Utricularia* L., Pollen et Spores 10, 1968, 11-55) has described a considerable amount of pollen-morphological variability. Tricolporate types with long or very short colpi and stephanocolporate types with equatorially fused endoapertures occur. In some types the apocolpia are dissected by interconnections between colpi.

A remarkable similarity exists between the stephanocolporate grains in *Utricularia* and the pollen of *Polygalaceae*. — J. MULLER.

Notes. The study of *Utricularia* has always been hampered by badly collected and inadequate material. Of the aquatic species the vegetative parts should be suitably supported by a (rigid) sheet of paper and thus be raised out of the water in their natural position and then dried as rapidly as possible. Additional inflorescences and infructescences should be added. Terrestrial species have often not very obvious vegetative parts which are usually beneath or in the substrate. They must be carefully 'unearthed', or dried with the adhering mud.

Specimens in liquid are of course excellent. FAA is not so suitable; the best solution is a mixture of 50-55% alcohol, 40% water and 5-10% glycerine; the latter may be omitted or even added later; it is important that the receptacle is entirely filled with liquid.

It is important to take many flowers but see that also fruit and seed are represented.

As two or more terrestrial species are frequently growing together, with their vegetative parts intimately mixed in the substrate, care is needed in collecting. It is important to note the flower colour; this is in several species very variable.

Hardly any *Utricularia* spp. have been collected in the Lesser Sunda Islands. Though this archipelago is subject to a dry season, collecting at the end of the wet season in rice-fields, shallow swamps and damp grassland may yield interesting results, as several species have been found in the adjacent Madura & Kangean Islands which have the same climatic regime.

KEY TO THE SPECIES

1. Foliar organs conspicuous and numerous at anthesis, divided into narrowly linear to capillary segments, the ultimate segments bearing apical and often lateral solitary or fasciculate setulae.
2. Turions (winter buds) of tightly clustered modified foliar segments present at the apex of some of the stolons.
3. Turions glabrous or almost so. Ultimate foliar segments with minute apical but with or without microscopic lateral setulae 22. *U. minor*
3. Turions densely setulose. Ultimate foliar segments with ± numerous lateral setulae 21. *U. australis*
2. Turions not present.
4. Primary foliar segments 3 or more semi-verticillate on the stolons usually with hyaline or foliose setulose stipule-like segments at the base. Scales on peduncle absent.
5. Peduncle with a whorl of inflated ellipsoid floats some distance above the base. Basal segments of foliar organs hyaline.
6. Floats shortly stipitate with capillary foliar segments at the base. Capsule much longer than the calyx lobes. Seeds thinly lenticular with a single marginal wing 20. *U. muelleri*
6. Floats sessile without foliar segments at the base. Capsule shorter than the calyx. Seeds prismatic, narrowly winged on the angles. Africa, Madagascar, SE. Asia, Australia. Cf. P. TAYLOR, Kew Bull. 18 (1964) 189, f. 77 6-11, 79; ASTON, Aquat. Pl. Austr. (1973) f. 39 a-j *U. stellaris* L. f.
5. Peduncle without floats or with a whorl of narrowly fusiform floats at the base. Basal segments of foliar organs foliose 19. *U. aurea*
4. Primary foliar segments 1 or 2 usually without stipule-like segments at the base. Scales (or at least one) present on the peduncle.
7. Foliar organs less than 10 mm long with few (2-10) ultimate segments with few or no lateral setulae.
8. Ultimate segments distinctly flattened with microscopic or no lateral setulae. Bracts and scales auriculate, the scales few but dispersed through the length of the peduncle. Spur of the corolla very short, saccate. Capsule circumscissile. Seeds prismatic 22. *U. minor*
8. Ultimate segments terete, sometimes with a few lateral setulae. Bracts and scales not auriculate, scales usually only one near the middle of the peduncle. Spur of the corolla narrowly conical. Capsule laterally bivalvate. Seeds lenticular, winged 18. *U. exoleta*
7. Foliar organs more than 20 mm long with very numerous ultimate segments bearing ± numerous lateral setulae.
9. Ultimate segments terete. Traps absent from the lowermost part of the foliar organs. Bracts and scales medifixed, the scales disposed through the length of the peduncle. Corolla mauve or white. Seeds with a broad dentate wing 17. *U. punctata*

9. Ultimate segments distinctly flattened. Traps present in the lowermost part of the foliar organs and with rudimentary traps at the very base. Bracts and scales basifixed, slightly auriculate, the scales few and usually present only in the upper part of the peduncle. Corolla yellow.
21. *U. australis*
1. Foliar organs simple, orbicular to linear, never setulose, often not present or conspicuous at anthesis.
10. Bracts medifixed or produced below the point of attachment.
11. Bracteoles present.
12. Calyx lobes approximately equal in size. Foliar organs linear to narrowly obovate, usually not conspicuous at anthesis 11. *U. caerulea*
12. Calyx lobes very unequal in size, the upper much larger. Foliar organs reniform to obovate, usually present and \pm conspicuous at anthesis.
13. Corolla lower lip 3-lobed, the lateral lobes obliquely emarginate, spur c. 2 mm long. Seeds ovoid, densely echinate 14. *U. salwinensis*
13. Corolla lower lip \pm regularly 5-lobed, spur at least 5 mm long.
14. Spur over 10 mm long, usually longer than and widely diverging from the lower lip of the corolla. Flowers 1 or 2. Peduncle up to 6 cm long, relatively stout 13. *U. pulchra*
14. Spur c. 5 mm long, usually about as long as and \pm parallel with the lower lip of the corolla. Flowers up to 10. Peduncle up to 15 cm long, very slender. Seeds pyriform, glochidiolate. 12. *U. striatula*
11. Bracteoles absent.
15. Lower lip of corolla deeply 2-lobed, corolla pink or white. Pedicel minutely papillose. Seeds globose with distinct coarse isodiametric reticulation 15. *U. limosa*
15. Lower lip of corolla deeply 3-lobed, corolla yellow. Pedicel smooth. Seeds ellipsoid with indistinct coarse very elongate reticulation 16. *U. subulata*
10. Bracts basifixed.
16. Bracteoles absent. Lower calyx lobe much longer than upper in fruit 6. *U. heterosepala*
16. Bracteoles present. Calyx lobes \pm equal or upper longer.
17. Bracteoles not much narrower (at least half as wide) than the bract.
18. Calyx, peduncle and pedicels \pm densely covered with often long septate hairs 10. *U. hirta*
18. Calyx glabrous. Peduncle glabrous or with a few short septate hairs 9. *U. minutissima*
17. Bracteoles much narrower (less than one quarter as wide) than the bract.
19. Lower lip of corolla deeply 4-lobed. Corolla yellow 8. *U. c'rysantha*
19. Lower lip of corolla entire, emarginate or \pm 3-lobed.
20. Corolla yellow.
21. Peduncle twining.
22. Corolla (11-)15-20 mm long, upper lip orbicular, much wider than the calyx lobes. 2. *U. involvens*
22. Corolla 5-10 mm long, upper lip oblong, narrower than the calyx lobes 5. *U. scandens*
21. Peduncle erect.
23. Lower lip of corolla 3-lobed, corolla 15-22 mm long 1. *U. vitellina*
23. Lower lip of corolla entire or emarginate, corolla 6-10 mm. Pedicels strongly recurved in fruit 3. *U. bifida*
20. Corolla mauve or white.
24. Peduncle twining. Pedicels strongly reflexed in fruit. 7. *U. baouleensis*
24. Peduncle erect. Pedicels erect or spreading in fruit. 4. *U. uliginosa*

1. *Utricularia vitellina* RIDL. Fl. Mal. Pen. 2 (1923) 492; SPARE, Mal. Nat. J. 1 (1940) 89. — *U. aurea* (non LOUR.) RIDL. J. Fed. Mal. St. Mus. 6 (1915) 165. — Fig. 1.

Terrestrial. *Rhizoids* capillary, simple. *Stolons* capillary, sparsely branched. *Foliar organs* present at anthesis, sparsely rosulate, narrowly linear, membranous, 1-2 cm long, 0.5-1 mm wide, 1-nerved, apex rounded. *Traps* few on the stolons and foliar organs, globose, 0.5-1 mm long, shortly stalked, mouth basal, upper lip with 2 short subulate reflexed appendages. *Inflorescence* erect, 2.5-5 cm long; peduncle filiform, terete, glabrous; flowers 1-2; scales few in the lower third of the peduncle, the lowermost usually at its very base, similar to the bracts; bracts basifixed, ovate-deltoid, acute, c. 1.5 mm long; bracteoles narrowly linear, acute, slightly shorter than the bract; pedicels spreading, usually curved, 4-8 mm long, dorsiventrally flattened, very narrowly winged. *Calyx lobes* unequal, upper narrowly ovate, c. 4.5 mm long, apex obtuse, lower similar but c. 3 mm long,

apex obscurely bidentate. *Corolla* yellow streaked with brown, 15-22 mm long, upper lip obovate-oblong to \pm orbicular, slightly longer than the upper calyx lobe, apex rounded or emarginate, lower lip much larger, up to 10 mm wide, \pm orbicular, apex distinctly 3-lobed, palate scarcely prominent, spur subulate, about as long as the lower lip but widely diverging from it, usually strongly curved. *Filaments* filiform, \pm straight, c. 1 mm long, anther thecae distinct. *Ovary* ovoid, style short, distinct, stigma lower lip orbicular, upper obsolete. *Capsule* and *seeds* not known.

Distr. *Malasia*: Malay Peninsula (Pahang: G. Tahan and G. Kerbau only).

Ecol. Peaty streambanks in moss, c. 1500-2100 m. Fl. Jan.-July.

2. *Utricularia involvens* RIDL. J. Bot. 33 (1895) 11; PRAIN, J. As. Soc. Beng. 74, ii (1905) 371; RIDL. Fl. Mal. Pen. 2 (1923) 493, f. 121; SPARE, Mal. Nat. J. 1 (1940) 89. — Fig. 3.

Terrestrial. *Rhizoids* few, capillary, basally

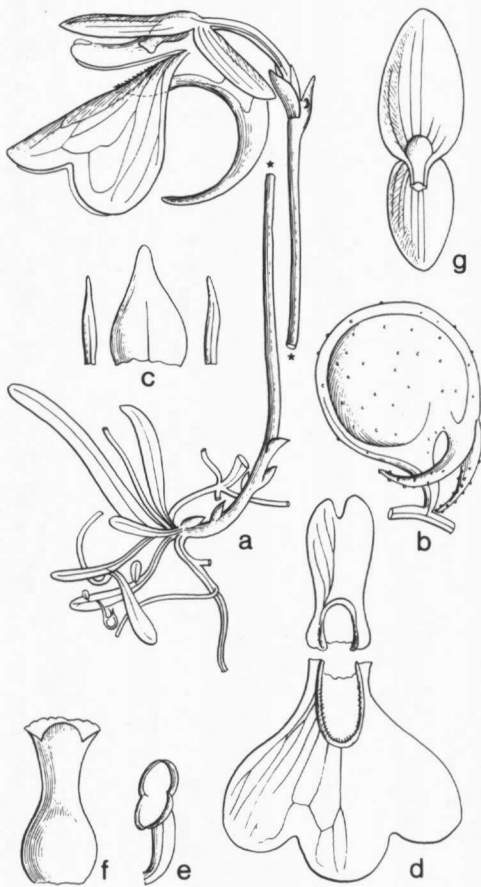


Fig. 1. *Utricularia vitellina* RIDL. a. Flowering plant, $\times 4$, b. trap, $\times 24$, c. bract & bracteoles, $\times 12$, d. corolla, the two lips from inside, $\times 4$, e. stamen, $\times 12$, f. pistil, $\times 12$, g. calyx, $\times 6$ (all after RIDLEY, type, except b SPARE S4/41).

thickened, with numerous papillose branches 0.5–1 mm long. *Stolons* few, capillary, branched. *Foliar organs* usually conspicuous at anthesis, rosulate and on the stolons, obovate to narrowly oblong, membranous, up to 2.5 cm long, 2–4 mm wide, multinerved, apex rounded. *Traps* on the vegetative organs, globose, 0.5–1 mm long, shortly stalked, mouth basal, upper lip with 2 simple subulate appendages, lower lip with 1 short obtuse appendage. *Inflorescence* twining, up to 30 cm long; peduncle filiform, terete, glabrous; flowers 2–6, distant; scales numerous, similar to the bracts; bracts basifixed, ovate, acute, 2–3 mm long; bracteoles subulate, shorter than the bract; pedicels erect or spreading, filiform, 10–15 mm long, narrowly winged. *Calyx lobes* subequal, ovate to

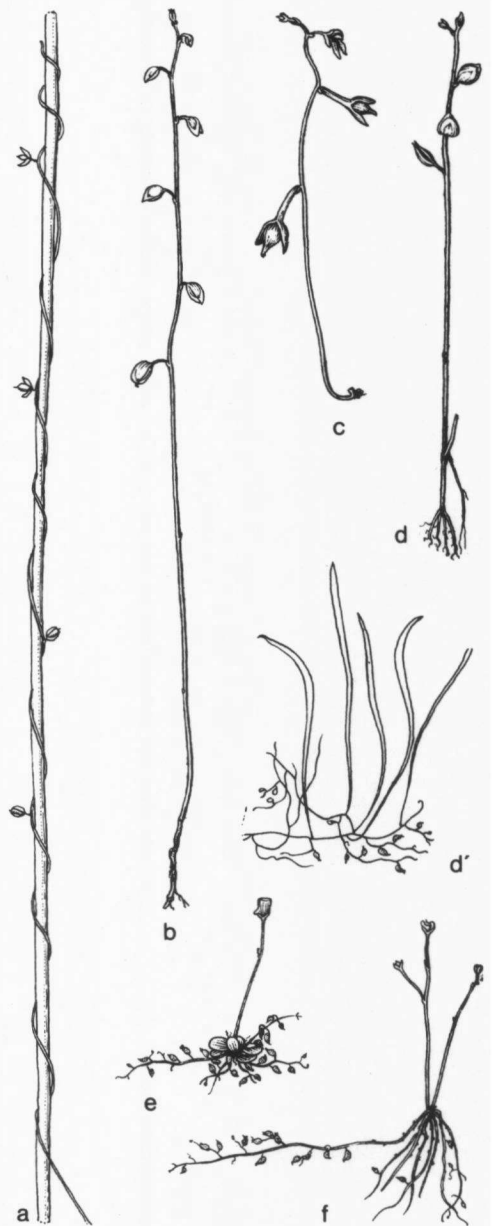


Fig. 2. Habit of some *Utricularia* species. a. *U. baouleensis* A.CHEV. trailing along a sedge, b. *U. bifida* L., c. *U. aurea* LOUR. (inflorescence only), d. *U. uliginosa* VAHL and d'. detail of vegetative parts, e. *U. striatula* J.SM. with cleistogamous flowers, f. *U. exoleta* R.BR. All $\times 2/3$.

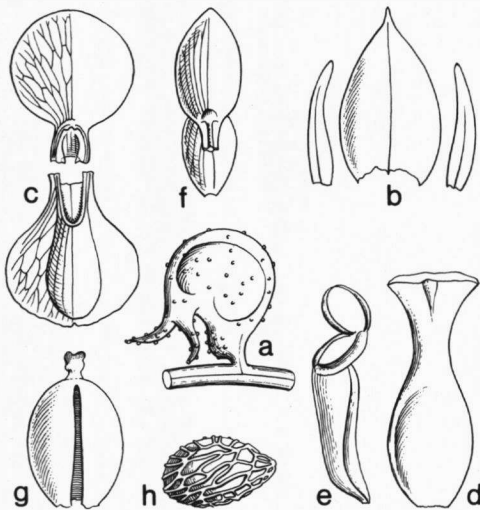


Fig. 3. *Utricularia involvens* RIDL. a. Trap, $\times 24$, b. bract & bracteoles, $\times 12$, c. corolla, the two lips from inside, $\times 2$, d. pistil, $\times 12$, e. stamen, $\times 12$, f. fruiting calyx, $\times 2$, g. dehiscent capsule, $\times 4$, h. seed, $\times 24$ (a, b, h DING HOU 783, the others after RIDLEY, type).

broadly ovate, 4–5 mm long at anthesis, up to 7 mm long in fruit, upper slightly larger, apex obtuse or subacute, lower shortly bidentate. Corolla yellow, 11–20 mm long, upper lip orbicular, longer than the upper calyx lobe, 7–12 mm wide, apex rounded, lower lip \pm orbicular, up to 15 mm wide, apex emarginate, palate very conspicuously raised, gibbous, extending almost to the apex of lower lip, spur subulate, straight or slightly curved, about as long as but widely diverging from the lower lip. Filaments linear, curved, c. 1.5 mm long, anther thecae subdistinct. Ovary ovoid, style relatively long, stigma lower lip orbicular, deflexed, upper lip obsolete. Capsule broadly ovoid, dorsiventrally compressed, uniformly membranous, 4–5 mm long, dehiscent by dorsal and ventral longitudinal slits. Seeds numerous, ovoid, c. 0.4 mm long, testa conspicuously coarsely reticulate, reticulations elongate.

Distr. S. Burma (Tenasserim), Thailand, N. Australia, and Malesia: Malay Peninsula (Kedah Peak, G. Jerai).

Ecol. Damp grassy places and along creeks, 900–1000 m in Malaya but at low altitude in Thailand and Australia. Fl. April–Jan.

3. *Utricularia bifida* LINNÉ, Sp. Pl. (1753) 18; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 182; CLARKE, Fl. Br. Ind. 4 (1884) 332; RIDL, Trans. Linn. Soc. Lond. II, Bot. 3 (1893) 327; Fl. Mal. Pen. 2 (1923) 492; MERR. En. Philip. 3 (1923) 466; PELLEGR. Fl. Gén. I.-C. 4 (1930) 482; STEEN. Arch. Hydrobiol. Suppl. 11 (1932) 331, f. 8 I;

HAND.-MAZZ. Symb. Sin. 7 (1936) 872; BACK. & BAKH. f. Fl. Java 2 (1965) 518; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 529. — *U. recurva* LOUR. Fl. Coch. (1790) 26. — *U. humilis* VAHL, Enum. 1 (1804) 203. — *U. ramosa* VAHL, l.c. 204. — *U. antirrhinoides* WALL. Cat. (1829) n. 1498, nomen. — *U. wallichiana* BENJ. Bot. Zeit. 3 (1845) 213. — *U. brevicaulis* BENJ. Linnaea 20 (1847) 303. — *U. sumatrana* MIQ. Fl. Ind. Bat. 2 (1859) 998, p.p.; Suppl. 1 (1860) 246. — *U. biflora* HAYATA, J. Coll. Sc. Imp. Un. Tokyo 30 (1911) 210; Ic. Pl. Formos. 2 (1913) 125. — Fig. 2b, 4.

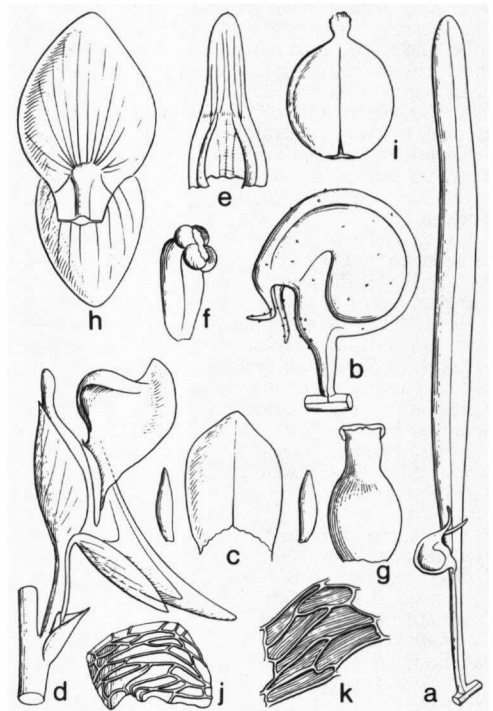


Fig. 4. *Utricularia bifida* L. a. Foliar organ, $\times 6$, b. trap, $\times 24$, c. bract & bracteoles, $\times 15$, d. flower, $\times 6$, e. upper lip of corolla, $\times 6$, f. stamen, $\times 12$, g. pistil, $\times 12$, h. fruiting calyx, $\times 6$, i. capsule, $\times 6$, j. seed, $\times 45$, k. testa, $\times 75$ (all after LARSEN 5121).

Terrestrial. Rhizoids few, capillary, basally thickened, with numerous papillose branches 0.5–1 mm long. Stolons few, capillary, branched. Foliar organs usually \pm conspicuous at anthesis on the stolons, narrowly linear, membranous, 1–2 cm long, up to 1 mm wide, 1-nerved, apex rounded. Traps on the vegetative organs, globose, 0.6–1 mm long, stalked, mouth basal, upper lip with 2 simple subulate appendages, lower lip with a \pm well developed obtuse swelling at the distal end of the stalk. Inflorescence erect, 5–20 cm long; peduncle filiform, terete, glabrous above, minutely glandular

below; flowers 1–10, distant; scales few, similar to the bracts; bracts basifixed, broadly ovate-oblong, obtuse, c. 1 mm long; bracteoles linear-subulate, c. 0.5 mm long; pedicels erect at anthesis strongly recurved in fruit, filiform, distinctly winged, 2–4 mm long. *Calyx lobes* subequal, the upper slightly larger, broadly ovate, base \pm broadly connate and decurrent, apex obtuse, c. 3 mm long at anthesis, up to 6 mm long in fruit. *Corolla* yellow, 6–10 mm long, upper lip narrowly oblong, 1–2 mm wide, apex rounded, slightly longer than upper calyx lobe, lower lip \pm orbicular, up to 4 mm wide, apex rounded, palate conspicuously raised, gibbous, spur subulate, acute, curved, longer than and widely diverging from the lower lip. *Filaments* oblong, straight, c. 1 mm long, c. 0.5 mm wide, anther thecae subdistinct. *Ovary* ovoid, style short but distinct, stigma lower lip quadrate, deflexed, upper lip much shorter, entire or bidenticulate. *Capsule* broadly elliptic, dorsiventrally compressed, uniformly membranous, 2.5–3 mm long, dehiscent by a single ventral longitudinal slit. *Seeds* numerous, \pm ovoid, c. 0.4 mm long, testa rugose, reticulate, reticulations relatively large, elongate.

Distr. India to China and Japan, Indo-China, Malesia to northern Australia; in *Malesia* not recorded from the Lesser Sunda Is. (but present in Kangean Is.) or Moluccas, but common elsewhere.

Ecol. Swamps and marshes, sometimes as a weed in rice-fields, on moist sandy plains, floating in lakes, in *Sphagnum* swamps, on edge of *Melaleuca* swamp and in moist Eucalypt savannahs, mainly at low altitude, but up to at least 2000 m (in Java and New Guinea). *Fl.* Jan.–Dec.

Vern. Malaya: *bunga janggut kelli*, *b. këning layah*, M; New Guinea: *ararëbo*, *pëkatorrò*, Kapauko lang.

4. *Utricularia uliginosa* VAHL, Enum. 1 (1804) 203; SANTAPAU, J. Bomb. Nat. Hist. Soc. 49 (1950) 217; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 532. — *U. cyanea* R. BR. Prod. Nov. Holl. (1810) 431; GUILLAUMIN, Fl. Nouv.-Caléd. (1948) 319. — *U. affinis* WIGHT, Ic. (1850) t. 1580; MIQ. Fl. Ind. Bat. Suppl. 1 (1860) 246; CLARKE, Fl. Br. Ind. 4 (1884) 330; TRIMEN, Handb. Fl. Ceyl. 3 (1895) 269; PELLEGR. Fl. Gén. I.-C. 4 (1930) 479; STEEN. Arch. Hydrobiol. Suppl. 11 (1932) 333, f. 8 III; BACK. & BAKH. f. Fl. Java 2 (1965) 518. — *U. griffithii* WIGHT, Ic. (1850) t. 1576; MIQ. Fl. Ind. Bat. 2 (1859) 999; RIDL. Fl. Mal. Pen. 2 (1923) 492; SPARE, Mal. Nat. J. 1 (1940) 89. — *U. affinis* var. *griffithii* (WIGHT) OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 179; CLARKE, Fl. Br. Ind. 4 (1884) 331; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 119; PRAIN, J. As. Soc. Beng. 74, ii (1905) 370; MERR. En. Born. (1921) 537. — Fig. 2d, 5.

Terrestrial. *Rhizoids* few capillary, basally thickened, with numerous papillose branches c. 1 mm long. *Stolons* few, capillary, branched, up to 6 cm long or more. *Foliar organs* often not conspicuous at anthesis, on the stolons, ovate to linear, membranous, up to 4 cm long, 1.5–6 mm wide, multinerved, apex obtuse to subacute. *Traps* on the stolons and foliar organs, globose, 1–2 mm long, shortly stalked, mouth basal, upper lip with 2 simple subulate appendages. *Inflorescence* erect, up to 30 cm long; peduncle filiform, terete, glab-

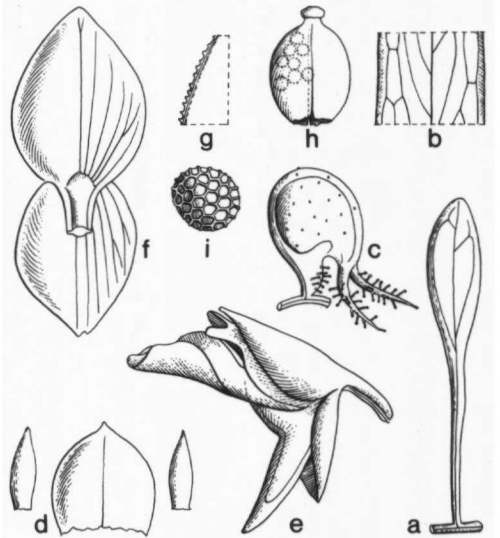


Fig. 5. *Utricularia uliginosa* VAHL. a. Small, young, foliar organ, $\times 6$, b. part of fully developed foliar organ, venation, $\times 4$, c. trap, $\times 12$, d. bract & bracteoles, $\times 12$, e. flower, $\times 6$, f. fruiting calyx, $\times 6$, g. margin of this, $\times 24$, h. capsule, $\times 6$, i. seed, $\times 24$ (all after SINCLAIR 10157).

rous; flowers 2–10, rather distant; scales few, similar to the bracts; bracts basifixed, ovate, acuminate, 2–3 mm long, 3-nerved; bracteoles subulate, about half as long as the bract, 1-nerved; pedicels erect 1.5–2 mm long at anthesis, often spreading and up to 3 mm long in fruit, filiform distinctly winged. *Calyx lobes* subequal, very broadly ovate to almost orbicular, c. 2.5 mm long at anthesis, up to 5 mm long in fruit, surface minutely papillose, margin usually minutely denticulate, upper lobe slightly larger, apex very shortly acuminate, lower with apex shortly bifid. *Corolla* blue, violet, mauve or white, 3–7 mm long, upper lip \pm orbicular scarcely longer than upper calyx lobe, apex rounded, emarginate or \pm bifid, lower lip larger, \pm orbicular, apex rounded, entire or \pm obscurely 3-crenate, palate raised, gibbous, spur conical-subulate, acute, curved or \pm straight, longer than and widely diverging from the lower lip. *Filaments* linear, curved, c. 1.5 mm long, anther thecae distinct. *Ovary* ovoid, style short but distinct, stigma lower lip quadrate, upper lip obsolete. *Capsule* broadly ellipsoid, dorsiventrally compressed, 2–4 mm long uniformly membranous, dehiscent by dorsal and ventral longitudinal slits. *Seeds* numerous, \pm globose or very broadly ellipsoid, c. 0.3–0.4 mm long, testa thin, conspicuously reticulate, reticulations \pm regularly hexagonal isodiametric or very slightly elongate, hilum not prominent.

Distr. India to Japan and Australia, also in New Caledonia; in *Malesia*: Sumatra (also Banka & Riouw Is.), Malaya, Java, Borneo, and New Guinea.

Ecol. Swamps, streamsides and wet sandy places, abandoned mining-land, in *Melaleuca* savannahs, in silt grass-wastes, both under everwet and seasonal climatic conditions, from sea-level to 2100 m (in New Guinea). *Fl.* Jan.-Dec.

5. *Utricularia scandens* BENJ. *Linnaea* 20 (1847) 309; P. TAYLOR, *Dansk Bot. Ark.* 23 (1968) 531. — *U. volubilis* WIGHT *ex* BENJ. *Linnaea* 20 (1847) 309, non R. BR. 1810, *pro syn.* — *U. wallichii* WIGHT, *Hook. J. Bot. Kew Misc.* 1 (1849) 372. — *U. wallichiana* WIGHT, *IC.* 4 (1850) t. 1572, non BENJ. 1845; OLIVER, *J. Linn. Soc. Lond. Bot.* 3 (1859) 182; CLARKE, *Fl. Br. Ind.* 4 (1884) 332; PRAIN, *J. As. Soc. Beng.* 74, ii (1905) 371; RIDL, *Fl. Mal. Pen.* 2 (1923) 493; GAMBLE, *Fl. Madras* 2 (1924) 982; PELLEGR. *Fl. Gén. I.-C.* 4 (1930) 484; SPARE,

Mal. Nat. J. 1 (1940) 89. — *U. gibbsiae* STAFF, *Fl. Trop. Afr.* 4 (1906) 574. — *Polypompholyx madecassa* PERRIER, *Mém. Inst. Sci. Madag. sér. B.* 5 (1955) 199; in Humbert, *Fl. Madag.*, *Lentib.* (1955) 19. — *U. scandens ssp. scandens* P. TAYLOR in Hutch. & Dalz. *Fl. W. Trop. Afr.* ed. 2, 2 (1963) 378; *Kew Bull.* 18 (1964) 46. — Fig. 6.

Terrestrial. *Rhizoids* numerous, capillary, with papillose branches *c.* 0.5 mm long. *Stolons* few capillary branched. *Foliar organs* on the stolons, linear, membranous, up to 1 cm long, *c.* 1 mm wide, 1-nerved, apex rounded or subacute. *Traps* on the vegetative organs, globose, 0.6–1 mm long, shortly stalked, mouth basal, upper lip with 2 simple subulate recurved appendages, lower lip with 1 shorter truncate or shortly bifid usually apically glandular appendage. *Inflorescence* twining, 3–35 cm long; peduncle filiform, terete, glabrous; flowers 1–8, distant, with 1 or 2 sterile bracts on the internodes; scales few, similar to the bracts; bracts broadly ovate-deltoid, acute or acuminate, 1–1.5 mm long, nerveless; bracteoles linear-lanceolate, about as long as the bract, nerveless; pedicels erect, filiform, narrowly winged, about as long as the flowering calyx. *Calyx lobes* subequal, ovate or broadly ovate, 2.5–3 mm long at anthesis, up to 5 mm long in fruit, upper slightly larger, apex shortly acuminate, lower with apex shortly bi- or tridentate. *Corolla* yellow, 5–10 mm long, upper lip oblong, usually shorter and narrower than upper calyx lobe, apex rounded, entire or emarginate or \pm bifid, lower lip larger, \pm orbicular, apex rounded, entire or 2–3-crenate, palate \pm raised, smooth or 2–4-gibbous, spur subulate, acute, curved, longer than and widely diverging from the lower lip. *Filaments* linear, \pm straight, anther thecae \pm confluent. *Ovary* ovoid, style short, indistinct, stigma lower lip semi-orbicular, upper lip similar, smaller. *Capsule* oblong-ovoid, dorsiventrally compressed, membranous, 2–2.5 mm long, dehiscent by a single ventral longitudinal marginally thickened slit. *Seeds* numerous, broadly ellipsoid or ovoid, *c.* 0.2 mm long, testa thin, smooth, reticulate, reticulations elongate, hilum lateral, prominent.

Distr. Tropical Africa, South Africa, Madagascar, India, Indo-China, through Malesia to N. Australia; in *Malesia*: a single record from Malay Peninsula (G. Ledang) and more widespread in New Guinea and the adjacent Aru Is.

Ecol. Damp places twining up grasses, in Malaya at 1200 m, ascending in New Guinea from the lowland to 2700 m. *Fl.* April–Aug.

6. *Utricularia heterosepala* BENJ. *Linnaea* 20 (1847) 310; MIQ. *Fl. Ind. Bat.* 2 (1859) 1000; VIDAL, *Rev. Pl. Vasc. Filip.* (1886) 200; MERR. *En. Philip.* 3 (1923) 466. — Fig. 7.

Terrestrial. *Rhizoids* few, capillary, basally thickened, with numerous papillose branches *c.* 0.5 mm long. *Stolons* numerous capillary, much branched and mat-forming, up to 15 cm long or more. *Foliar organs* very numerous and conspicuous at anthesis, on the stolons, narrowly ovate or elliptic, membranous, 1–2 cm long, 2–3 mm wide, apex rounded, multinerved. *Traps* numerous on the vegetative organs, globose, 1–2 mm long, shortly stalked, mouth basal, upper lip with 2 long simple subulate appendages, lower lip sometimes

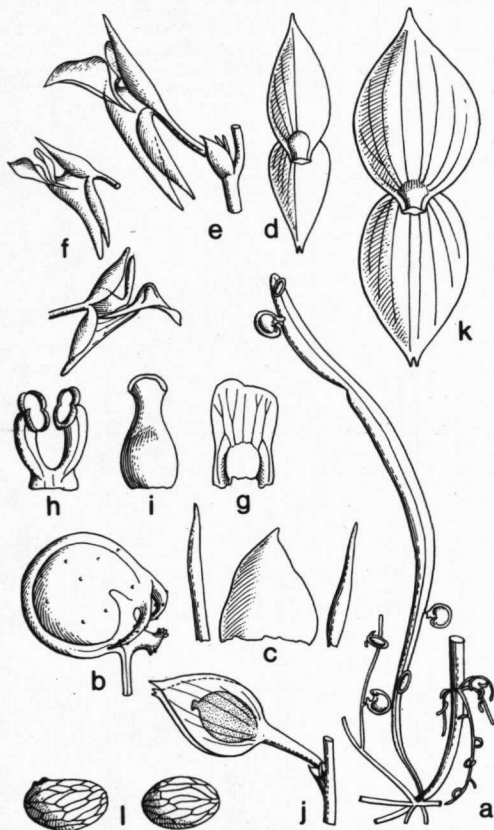


Fig. 6. *Utricularia scandens* BENJ. a. Base of peduncle with rhizoids, foliar organ and traps, \times 4, b. trap, \times 30, c. bract & bracteoles, \times 15, d. calyx, \times 6, e. a large flower, \times 4, f. two small flowers, \times 4, g. upper lip, \times 6, h. stamens, \times 15, i. pistil, \times 15, j. fruit concealed by calyx, \times 4, k. fruiting calyx, \times 6, l. seeds, \times 45 (all after LARSEN 6195, except a and c MILNE-REDHEAD & TAYLOR 8008B).

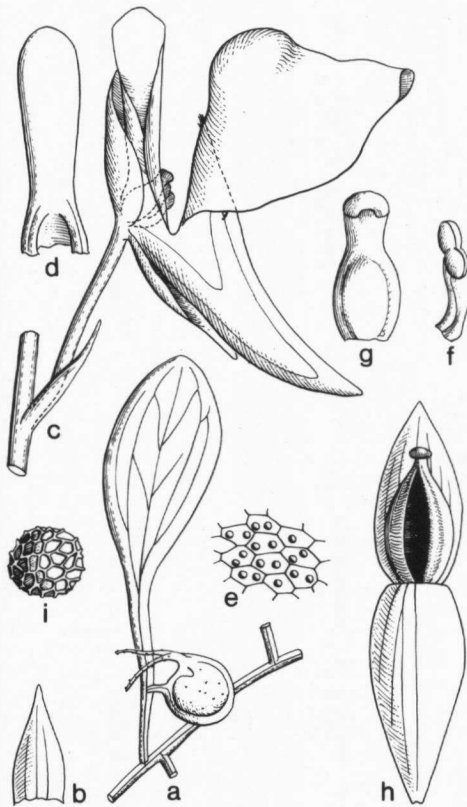


Fig. 7. *Utricularia heterosepala* BENJ. a. Foliar organ with trap, b. bract, c. flower, d. upper lip, all $\times 6$, e. glands inside spur, $\times 45$, f. stamen, $\times 12$, g. pistil, $\times 12$, h. calyx with dehiscent fruit, a thickened area bordering the cleft, $\times 6$, i. seed, $\times 24$ (a-b, h-i ELMER 13127, c-g MERRILL 2085).

with a small \pm obscure lamelliform projection at the distal end of the stalk. *Inflorescence* erect, 4-15 cm long; peduncle filiform, terete, glabrous; flowers 3-12, distant; scales few, similar to the bracts; bracts basifixed, ovate-deltoid, acute, 2-3 mm long, 3-nerved; bracteoles absent; pedicels erect, filiform, very narrowly winged. *Calyx lobes* subequal at anthesis, very unequal in fruit, narrowly ovate, both c. 4 mm long at anthesis, apex of upper acute, of lower obscurely bidentate, lower conspicuously accrescent and up to 6 mm long and 2.5 mm wide in fruit. *Corolla* pink or white, 8-11 mm long, upper lip narrowly oblong or oblong-ovobate, about $1\frac{1}{2}$ times as long as upper lobe, apex rounded or truncate, lower lip larger, \pm orbicular, apex rounded, entire or emarginate, palate conspicuously raised, gibbous, spur subulate, acute, curved, longer than and widely diverging from the lower lip. *Filaments* linear, straight, c. 1 mm long, anther thecae \pm confluent. *Ovary* ovoid, style short, stigma lower lip quadrate,

deflexed, upper lip much smaller, rounded. *Capsule* very narrowly ovoid, membranous, c. 3 mm long, dehiscent by a ventral longitudinal marginally thickened slit. *Seeds* few, globose, c. 0.5 mm long, testa thin, reticulate, reticulations distinct, isodiametric or slightly elongate.

Distr. Malasia: Philippines (Palawan, Luzon, and Sibuyan).

Ecol. In wet places on stones in the forest and along streams and creeks at medium and low altitudes (MERRILL). *Fl.* Febr.-May.

Note. Specimens of this very distinct species (ELMER 13127, Palawan) were distributed bearing the manuscript name *U. elmeri* STAFF. I can find no evidence of this name ever being published.

7. *Utricularia baouleensis* A. CHEV. Bull. Soc. Bot. Fr., Mém. 8 (1912, ante Sept. 21); P. TAYLOR in Hutch. & Dalz. Fl. W. Trop. Afr. ed. 2, 2 (1963) 378; Kew Bull. 18 (1964) 69; BACK. & BAKH. f. Fl. Java 2 (1965) 518. — *U. scandens* (non BENJ.) OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 181; CLARKE, Fl. Br. Ind. 4 (1884) 332. — *U. tenerrima* MERR. Philip. J. Sc. 7 (1912, Sept. 30) Bot. 247; Fl. Manila (1912) 433; En. Philip. 3 (1913) 467;

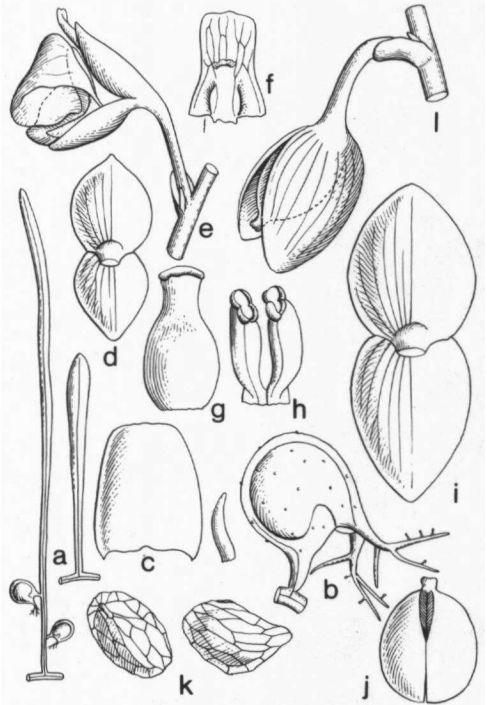


Fig. 8. *Utricularia baouleensis* A. CHEV. a. Foliar organs, $\times 4$, b. trap, $\times 15$, c. bract & one (of two) bracteoles, $\times 15$, d. calyx, $\times 6$, e. flower, $\times 6$, f. upper lip of corolla, $\times 6$, g. stamens, $\times 15$, h. pistil, $\times 15$, i. fruiting calyx, $\times 6$, j. capsule, $\times 6$, k. two seeds, $\times 45$ (all after FAULKNER 269A).

BACK. Onkr. Suiker. (1931) 635; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 194, p. 3. — Fig. 2a, 8.

Terrestrial. *Rhizoids* few, capillary, with numerous papillose branches c. 0.5 mm long. *Stolons* few, capillary branched, up to 5 cm long. *Foliar organs* usually not conspicuous at anthesis, on the stolons, linear, membranous, up to 3 cm long, 0.4–1 mm wide, apex acute or rounded, 1-nerved. *Traps* few on the stolons and foliar organs, globose, 0.8–1.2 mm long, shortly stalked, mouth basal, upper lip with 2 filiform-subulate sparsely branched appendages. *Inflorescence* twining, up to 20 cm long; peduncle capillary, terete, glabrous; flowers 2–5, very distant; scales few, similar to the bracts; bracts ovate to ovate-oblong, c. 1.2 mm long, nerveless, apex obtuse to shortly acuminate; bracteoles linear-lanceolate, acute, \pm straight, about half as long as the bract, nerveless; pedicels erect at anthesis, sharply reflexed in fruit, about as long as the calyx, filiform, dorsiventrally flattened and narrowly winged. *Calyx lobes* subequal, ovate, obtuse to subacute, c. 2 mm long at anthesis, 3.5–4 mm long in fruit. *Corolla* pale blue or mauve, 3–4 mm long, upper lip oblong, apex truncate, slightly longer than the upper calyx lobe, lower lip larger, \pm orbicular, apex obscurely 3-crenate, palate scarcely raised, spur narrowly conical, obtuse, longer than and \pm diverging from the lower lip. *Filaments* linear, \pm straight, anthers c. 0.3 mm long, thecae subdistinct. *Ovary* ovoid, style short, distinct, stigma lower lip orbicular, upper much shorter, truncate. *Capsule* broadly ovoid, dorsiventrally compressed, membranous, dehiscing by a longitudinal ventral marginally thickened slit. *Seeds* numerous, ovoid or ellipsoid, c. 0.3 mm long, testa loose, corky, distinctly reticulate, reticulations elongate.

Distr. Scattered in tropical Africa from Mali to Mozambique, in Madagascar, India, China (Hainan), Thailand, and Malesia to Queensland; in *Malesia*: E. Java (Madura: Lampek), Philippines (Luzon).

Ecol. Damp places twining up grasses, in Madura abundant in rice-fields. Fl. March, Sept.

Note. This extremely widespread and distinct but very inconspicuous species is probably much commoner than the few specimens seen (less than 20) would suggest. Despite the wide geographical range the Queensland examples (and all from intermediate localities) are identical in every respect with those from West Africa.

5. *Utricularia chrysantha* R. BR. Prod. Nov. Holl. (1810) 432; BTH. Fl. Austr. 4 (1869) 527; F. M. BAILEY, Queensl. Fl. 4 (1901) 1127; EWART & DAVIES, Fl. North. Terr. (1917) 249; SPECHT, Arnheim Land Exped. 3 (1958) 301. — Fig. 9.

Terrestrial. *Rhizoids* numerous, capillary, with numerous short papillose branches. *Stolons* few, capillary, sparsely branched. *Foliar organs* not usually conspicuous at anthesis, on the stolons, narrowly linear, up to 3 cm long and 0.7 mm wide, 1-nerved. *Traps* few on the stolons and foliar organs, obliquely ovoid, 0.4–0.7 mm long, sessile, mouth lateral, upper lip with a prominent dorsiventrally flattened, apically rounded appendage fringed with long unicellular setae, lower lip with a shorter appendage fringed with shorter setae.

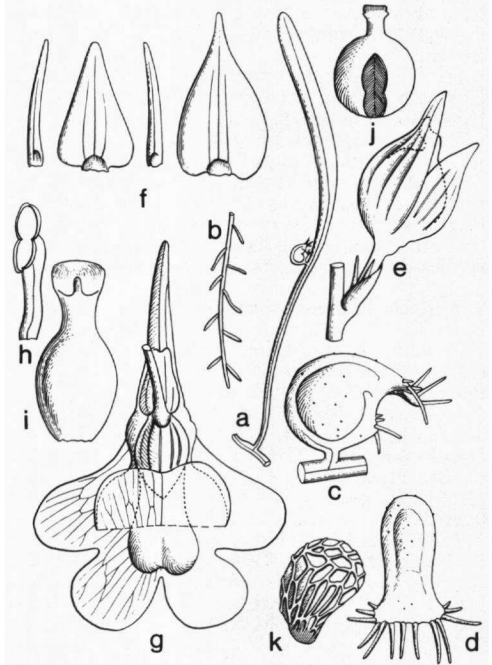


Fig. 9. *Utricularia chrysantha* R. BR. a. Foliar organ, $\times 6$, b. part of rhizoid, $\times 6$, c. trap, lateral view, $\times 24$, d. ditto, dorsal view, $\times 24$, e. fruit in calyx, $\times 6$, f. bract, bracteoles & (on right) scale, $\times 12$, g. flower with upper lip half bent back, $\times 4$, h. stamen, $\times 12$, i. pistil, $\times 12$, j. capsule, ventral view, $\times 6$, k. seed, $\times 75$ (a-d, f-j ADAMS 1737, e GEORGE 12231, k PULLEN 7136).

Inflorescence erect, up to 55 cm long (–63 fide PULLEN); peduncle filiform, terete, glabrous throughout or minutely papillose at the base; flowers 1–15, distant; scales numerous, especially below, similar to the bracts; bracts basifixed, ovate-deltoid, 1–1.5 mm long, base shortly auriculate, apex acute or acuminate, 1–3-nerved; bracteoles linear-subulate, acute, 0.6–1 mm long; pedicels erect, c. 1.5 mm long, terete. *Calyx lobes* unequal, upper broadly ovate, cucullate, c. 2.5 mm long, apex rounded, scarcely accrescent, nerves c. 9, plicate, lower narrowly ovate, about as long, apex emarginate, 5-nerved. *Corolla* bright yellow with an orange palate and externally tinged with reddish brown, c. 10 mm long, upper lip \pm orbicular, apex retuse, longer than upper calyx lobe, lower lip much larger, \pm orbicular in outline, apex \pm deeply 4-lobed, palate prominent, bigibbous, spur subulate, curved, acute, about as long as the lower lip and diverging from it at an angle of c. 90° . *Filaments* linear, c. 1.5 mm long, anthers c. 1 mm long, c. 0.3 mm wide, thecae distinct. *Ovary* ovoid, style short but distinct, stigma lower lip orbicular, upper minute, deltoid. *Capsule* globose, c. 2 mm long, firm and relatively thick, dehiscing by a ventral narrowly linear lanceolate pore. *Seeds* numer-

ous, obovoid, c. 0.25 mm long, hilum terminal, distinct, testa thin, reticulate, reticulations slightly elongate.

Distr. Australia (northern W. Australia, Northern Territory and Queensland) and *Malesia*: New Guinea (Papua).

Ecol. Sandy open heathland and in *Melaleuca-Acacia* savanna, at low altitude. Fl. June-Aug.

Note. This well known Australian species has been discovered (as has *U. muelleri*) in a number of localities in Papua relatively recently. It is possible that other smaller and less conspicuous Australian species may yet be found in the same region.

9. *Utricularia minutissima* VAHL, Enum. 1 (1804) 204; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 190; RIDL. Trans. Linn. Soc. Lond. II, Bot. 3 (1892) 327; J. Bot. 33 (1895) 11; PRAIN, J. As. Soc. Beng. 74, ii (1905) 371; RIDL. Fl. Mal. Pen. 2 (1923) 492; HEND. J. Mal. Br. R. As. Soc. 17 (1939) 60; SPARE, Mal. Nat. J. 1 (1940) 89; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 531. — *U. pygmaea* R. BR. Prod. (1810) 432; non BTH. Fl. Austr. 4 (1869) 526, *quae est U. exoleta*. — *U. capillacea* (non WILLD.) WALL. Cat. (1832) n. 6399; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 184; THW. En. Pl. Zeyl. (1860) 171; TRIMEN, Handb. Fl. Ceyl. 3 (1895) 270. — *U. siamensis* OSTENF. in Fedde, Rep. 2 (1906) 68; PELLEGR. Fl. Gén. I.-C. 4 (1930) 480. — *U. nipponica* MAKINO, Bot. Mag. Tokyo 20 (1906) 95; OHWI, Fl. Japan (1965) 814. — *U. nigricaulis* RIDL. J. Linn. Soc. Lond. Bot. 38 (1908) 317; J. Fed. Mal. St. Mus. 6 (1915) 164; Fl. Mal. Pen. 2 (1923) 493; SYMINGTON, J. Mal. Br. R. As. Soc. 14 (1936) 357. — *U. calliphysa* STAPP in Gibbs, J. Linn. Soc. Lond. Bot. 42 (1914) 115; MERR. En. Born. (1921) 537; SPECHT, Arnhem Land Exped. 3 (1958) 300. — *U. brevibrabris* LACE, Kew Bull. (1915) 404; PELLEGR. Fl. Gén. I.-C. 4 (1930) 481, *incl. var. parviflora*. — *U. lilliput* PELLEGR. Bull. Mus. Nat. Hist. Paris 26 (1920) 181; Fl. Gén. I.-C. 4 (1930) 482; SUBRAMANYAM & BALAKRISHNAN, Bull. Bot. Surv. India 2 (1960) 347. — *U. evrardii* PELLEGR. Fl. Gén. I.-C. 4 (1930) 476. — *U. barnesii* LLOYD, The Carnivorous Plants (1942) 232, *nomen*. — Fig. 10.

Terrestrial. *Rhizoids* few, capillary, simple. *Stolons* capillary, sparsely branched. *Foliar organs* sparsely rosulate and on the stolons, narrowly linear to narrowly obovate-spathulate, up to 2 cm by 0.5–1 mm, apex obtuse, 1-nerved. *Traps* numerous on the vegetative organs, broadly ovoid, c. 0.2 mm long, stalked, mouth lateral, upper lip with a solitary multicellular subulate appendage, lower lip with radiating rows of basally connate obliquely gland-tipped processes. *Inflorescence* erect, 3–12 cm long, glabrous or with a few short septate hairs on the peduncle; peduncle terete, filiform; flowers 1–10, distant; scales numerous, similar to the bracts; bracts basifixed, narrowly ovate, acute, 0.8–1 mm long; bracteoles similar or less acute; additional bracts subtending dormant (inflorescence branch) buds usually present on inflorescence axis a short distance above each or most of those subtending flowers; pedicels erect, capillary terete, c. 1 mm long. *Calyx lobes* subequal, broadly ovate, 1–2 mm long, apex of upper obtuse, of lower emarginate, nerves obscure, not raised. *Corolla* mauve or white, 2.5–7 mm long,

upper lip narrowly oblong, much longer than upper calyx lobe, apex emarginate or rounded, lower lip larger, ± orbicular, obscurely to distinctly 3-lobed, palatæ raised, spur subulate, obtuse, straight, usually much longer than and parallel with the lower lip. *Filaments* linear curved, anther thecae ± confluent. *Ovary* ovoid, style short, stigma lower lip orbicular, upper lip much smaller, deltoid.

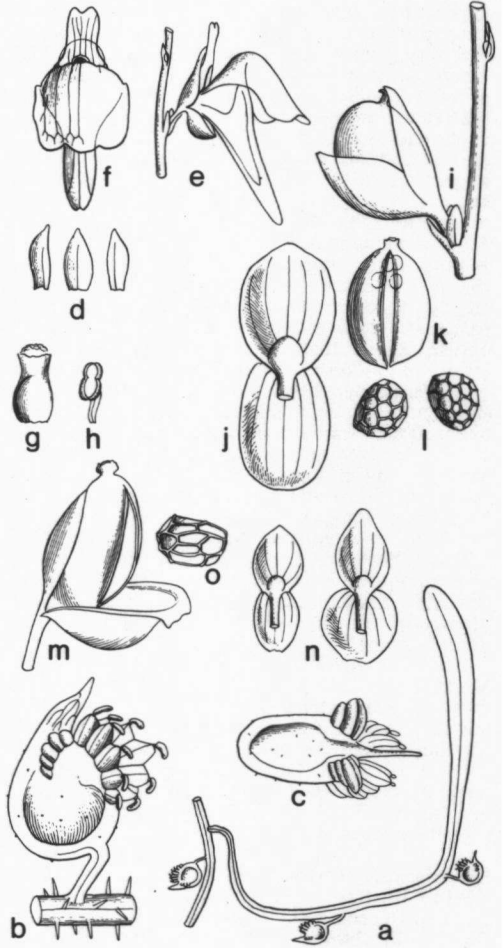


Fig. 10. *Utricularia minutissima* VAHL. a. Stolon with traps and foliar organ, $\times 12$, b. trap, $\times 75$, c. *ditto*, dorsal view, $\times 75$, d. bract & bracteoles, $\times 12$, e. flower, lateral view, $\times 6$, f. *ditto*, frontal view, $\times 6$, g. pistil, $\times 12$, h. stamen, $\times 12$, i. capsule, asymmetric in lateral view, $\times 12$, j. fruiting calyx, $\times 12$, k. dehiscent capsule, $\times 12$, l. seeds, $\times 45$, m. dehiscent capsule, $\times 12$, n. flowering (left) and fruiting calyces, $\times 6$, o. seed, $\times 45$ (a–c MELIER 26395, d–l. RAYNAL 17295, m–o MELIER 26395).

Capsule obliquely oblong-ovoid, 1.5–2 mm long, membranous in texture, translucent, dehiscing by a longitudinal ventral slit which is marginally scarcely thickened. *Seeds* few globose, 0.17–0.2 mm long, testa smooth, reticulate, reticulations relatively large, \pm isodiametric.

Distr. India to China and Japan, Indo-China, Malasia, and Australia (Northern Territory and Queensland); in *Malasia*: Sumatra, Malaya, Borneo, Philippines, and New Guinea.

Ecol. Damp open sandy or rocky places and peaty swamps, also found on wet limestone, mostly at low altitude but ascending to 2100 m on G. Tahan (Malaya). *Fl.* March–Dec.

Note. This species is very variable in overall and in flower size, and the degree to which the lower corolla lip is lobed. The peduncle varies from quite glabrous to sparsely hairy but the hairs when present do not extend to the calyx as in *U. hirta*. The 'rigid patent black bristly hairs' mentioned by PRAIN and often present are in fact not hairs but fungal growths.

10. *Utricularia hirta* KLEIN ex LINK, Jahrb. 1, 3 (1820) 55; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 183; CLARKE, Fl. Br. Ind. 4 (1884) 332;

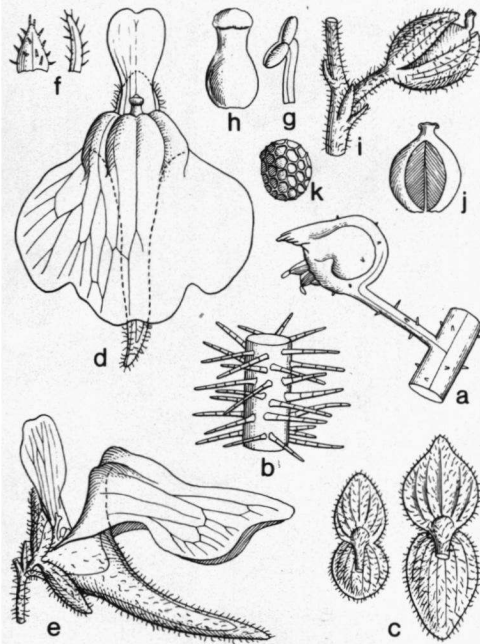


Fig. 11. *Utricularia hirta* KLEIN ex LINK. a. Trap, $\times 75$, b. part of hairy peduncle, $\times 24$, c. flowering calyx (left) and fruiting calyx, d. flower, e. ditto, lateral view, all $\times 6$, f. bract & bracteole, g. stamen, h. pistil, all $\times 12$, i. calyx with fruit, $\times 6$, j. capsule, thickened area shaded, $\times 6$, k. seed, $\times 45$ (all after SMITINAND & WARNECKE s.n., except e G. TAYLOR s.n.).

PELLEGR. Fl. Gén. I.–C. 4 (1930) 479, incl. var. *elongata*; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 531. — *U. papillacea* (non WILLD.) VAHL, Enum. 1 (1804) 204. — *U. setacea* (non MICHX.) WALL. Cat. (1832) n. 6398. — Fig. 11.

Terrestrial. *Rhizoids* few, capillary, simple. *Stolons* capillary, sparsely branched. *Foliar organs* sparsely rosulate and on the stolons, narrowly obovate-spathulate, up to 2 cm by 0.5–1 mm, apex obtuse, 1-nerved. *Traps* numerous on the vegetative organs, broadly ovoid, c. 0.2 mm long, stalked, mouth lateral, upper lip with a solitary multicellular subulate appendage, lower lip with radiating rows of basally connate obliquely gland-tipped processes. *Inflorescence* erect, 8–30 cm long, \pm densely covered throughout (including the calyx and at least the spur of the corolla) with short to long septate hairs; peduncle filiform, terete; flowers 1–5, distant; scales numerous, similar to the bracts; bracts basifixed, narrowly ovate, acute, 1–1.2 mm long; bracteoles slightly narrower and longer; additional bracts subtending dormant (inflorescence branch) buds usually present on inflorescence axis a short or very short distance above each or most of those subtending flowers; pedicels erect, capillary, terete, 1–2 mm long. *Calyx lobes* subequal, broadly ovate, 2–3.5 mm long, upper slightly smaller, apex obtuse, nerves raised, lower relatively broader, apex emarginate or obscurely tridentate. *Corolla* mauve or white, 8–10 mm long, upper lip narrowly oblong, much longer than upper calyx lobe, apex \pm emarginate, lower lip larger, \pm orbicular, distinctly 3-lobed, palate raised, spur subulate, acute apically curved, usually longer than and \pm parallel with the lower lip. *Filaments* linear, curved, anther thecae distinct. *Ovary* ovoid, style short but distinct, stigma lower lip orbicular, upper lip much smaller, deltoid. *Capsule* oblong-ovoid to globose, 1.5–2.5 mm long, firm in texture, opaque, dehiscing by a longitudinal ventral marginally thickened slit. *Seeds* few, \pm globose, c. 0.25 mm long, testa smooth, reticulate, reticulations relatively large, slightly elongate.

Distr. India, Indo-China, Thailand and Malasia: Borneo (Bako National Park).

Ecol. Damp open sandy or muddy places at low altitude. *Fl.* Febr., July.

Note. Very similar to *U. minutissima* (with which it sometimes occurs) but distinguished by its larger size, larger flowers and hairy calyx.

11. *Utricularia caerulea* LINNÉ, Sp. Pl. (1753) 18; BURM. f. Fl. Ind. (1768) 11; WIGHT, Ic. (1850) t. 1583; GAMBLE, Fl. Madras 2 (1924) 983; SANTAPAU, J. Bomb. Nat. Hist. Soc. 49 (1950) 217; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 530. — *U. nivea* VAHL, Enum. 1 (1804) 203; WIGHT, Ic. (1850) t. 1582; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 186; MERR. Fl. Manila (1912) 433; Philip. J. Sc. 7 (1912) Bot. 247; En. Philip. 3 (1923) 466; BACK. Onkr. Suiker. (1931) 636; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 194, p. 3; BACK. & BAKH. f. Fl. Java 2 (1965) 518. — *U. baueri* R. BR. Prod. Nov. Holl. (1810) 431; BTH. Fl. Austr. 4 (1869) 531; SPECHT, Arnheim Land Exped. 3 (1958) 300. — *U. complanata* WALL. Cat. (1829) n. 1497, nomen. — *U. racemosa* WALL. ex WALP. in Meyen, Observ. Bot. Nov. Acta 19

(1843) 401; A. DC. in DC. Prod. 8 (1844) 21; WIGHT, Ic. (1850) t. 1584(1); OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 186; CLARKE, Fl. Br. Ind. 4 (1884) 333; FORBES & HEMSLE. J. Linn. Soc. Lond. Bot. 26 (1890) 224; RIDL, Trans. Linn. Soc. Lond. II, Bot. 3 (1893) 327; J. Str. Br. R. As. Soc. n. 33 (1900) 119; *ibid.* n. 59 (1911) 144; STAFF in Gibbs, Arfak (1917) 180; MERR. Lingn. Sc. J. 5 (1927) 167; MELCHIOR, Bot. Jahrb. 62 (1929) 383; PELLEGR. Fl. Gén. I.-C. 4 (1930) 485; HAND.-MAZZ. Symb. Sin. 7 (1936) 873; MERR. J. Arn. Arb. 18 (1937) 73; SPARE, Mal. Nat. J. 1 (1940) 90. — *U. filicaulis* WALL. (Cat. 1829, n. 1501) ex A. DC. in DC. Prod. 8 (1844) 21; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 186; MIQ. Fl. Ind. Bat. 2 (1859) 999; PELLEGR. Fl. Gén. I.-C. 4 (1930) 486, *incl. var. papillosa*. — *U. bifida* (non L.) MACRAE ex A. DC. in DC. Prod. 8 (1844) 21, *pro syn.* — *U. squamosa* BENJ. Bot. Zeit. 3 (1845) 212. — *U. rosea* EDGEW. Proc. Linn. Soc. Lond. 1 (1847) 352. — *U. purpurea* (non WALT.) WILLD. ex BENJ. Linnæa 20 (1847) 309, *pro syn.* — *U. paucifolia* BENJ. Ic. 309. — *U. obtusiloba* BENJ. l.c. 312. — *U. albiflora* (non R. Br.) GRIFF. Notul. 4 (1854) 168. — *U. racemosa* var. *filicaulis* CLARKE, Fl. Br. Ind. 4 (1884) 333; BOERL. Handl. 2, 2 (1899) genus 559; PRAIN, J. As. Soc. Beng. 74, ii (1905) 373; MERR. En. BORN. (1921) 538. — *U. campestris* MIQ. ex CLARKE, Fl. Br. Ind. 4 (1884) 333, *pro syn.* — *U. warburgii* GOEBEL, Ann. Jard. Bot. Btzg 9 (1891) 22. — *U. ophirensis* RIDL. J. Bot. 33 (1895) 10; PRAIN, J. As. Soc. Beng. 74, ii (1905) 373; RIDL. Fl. Mal. Pen. 2 (1923) 495, f. 122; PELLEGR. Fl. Gén. I.-C. 4 (1930) 487. — *U. cavalerii* STAFF, Kew Bull. (1910) 195. — *U. sootepensis* CRAIB, Kew Bull. (1911) 430; PELLEGR. Fl. Gén. I.-C. 4 (1930) 487. — *U. kerrii* CRAIB, Kew Bull. (1911) 429; PELLEGR. Fl. Gén. I.-C. 4 (1930) 485. — *U. charnleyensis* FITZGERALD, J. R. Soc. W. Austr. 3 (1918) 207. — *U. albina* RIDL. Fl. Mal. Pen. 2 (1923) 493; HEND. Gard. Bull. S. S. 4 (1928) 295. — *U. roseo-purpurea* STAFF ex GAMBLE, Fl. Madras 2 (1924) 983. — Fig. 12.

Terrestrial. *Rhizoids* few to very numerous, capillary, simple. *Stolons* capillary, sparsely branched. *Foliar organs* not always conspicuous at anthesis, rosulate and on the stolons, narrowly obovate-spathulate, up to 7 mm long and 1.5 mm wide, apex rounded, 1-nerved. *Traps* rather few on the vegetative organs, \pm dimorphic, ovoid, shortly stalked, mouth terminal, oblique, the larger traps up to 1.5 mm long including a long carinate beak on the upper lip, the smaller traps about half as long with a relatively shorter beak, mouth and beak of both types densely stipitate-glandular. *Inflorescence* erect, 5–30 cm long; peduncle filiform to relatively stout, 0.3–1.5 mm thick, terete, glabrous; flowers 1–20 or more very variably disposed, distant to quite densely congested and subcapitate; scales numerous, similar to the bracts; bracts medifixed, variably attached above or below the middle, narrowly rhombic, acuminate at both extremities, 2–2.5 mm long; bracteoles similar but often shorter and narrower; pedicels erect at anthesis, spreading or reflexed in fruit, filiform, terete, 0.5–1 mm long. *Calyx lobes* unequal, usually minutely papillose, upper ovate-oblong, cucullate, 2–3 mm long, apex rounded, lower shorter, transversely elliptic with conspicuously

inrolled margins. *Corolla* pink, mauve, purple or blue, often white and sometimes yellow, 4–10 mm long, externally minutely papillose, upper lip narrowly ovate-oblong, longer than upper calyx lobe, apex rounded or truncate, lower lip larger, \pm orbicular, apex retuse, palate raised, \pm conspicuously transversely crested, spur narrowly conical or cylindrical from a broader conical base, straight or curved, usually longer than and \pm parallel with the lower lip. *Filaments* filiform, straight, c. 1 mm long, anther thecae distinct, minutely papillose. *Ovary* ovoid, style variably in length, usually distinct, stigma lower lip orbicular, upper

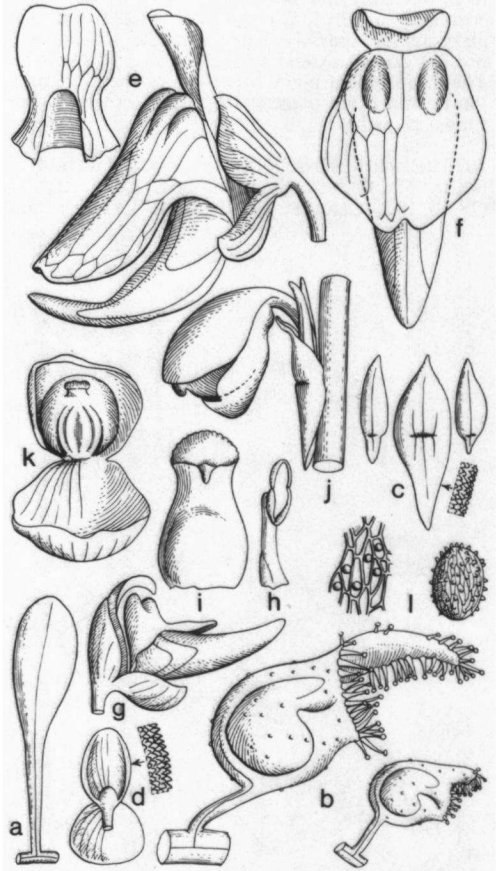


Fig. 12. *Utricularia caerulea* L. a. Foliar organ, $\times 6$, b. large and small trap, $\times 24$, c. bract & bracteoles, all peltately attached, $\times 6$, detail of surface papillae, $\times 24$, d. calyx in flower, $\times 6$, detail of surface papillae, $\times 24$, e. flower, lateral view, and upper lip from front, f. flower, front view, g. small flower, all $\times 6$, h. stamen, $\times 12$, i. pistil, $\times 12$, j. calyx with fruit, $\times 6$, k. fruit exposed, $\times 6$, l. seed, $\times 45$, with detail of testa enlarged, $\times 75$ (all after J. RAYNAL 17069, large form, except a-b, d, g LARSEN 5160, small form).

lip minute, deltoid. *Capsule* globose, c. 2 mm long, firm, opaque, dehiscing by a ventral longitudinal slit. *Seeds* numerous, obliquely oblong-ellipsoid, c. 0.3 mm long, testa thin, smooth to distinctly papillose, obscurely reticulate, reticulations elongate.

Distr. India to China and Japan and Australia; in *Malesia*: not recorded from the Lesser Sunda Is. (but present in Kangean Is.) or Celebes, but otherwise widespread and common.

Ecol. Damp or wet open situations on sand (also on kerangas and in heath-forest) or mud both under everwet and seasonal climatic conditions, from sea-level to 2700 m. *Fl.* Jan.-Dec.

Note. This is an excessively variable plant in which the extreme forms, often of quite distinct appearance, are linked by intermediates.

12. *Utricularia striatula* J.SM. in Rees, *Cyclop.* 37 (1819) n. 17; FORBES & HEMSLEY, *J. Linn. Soc. Lond. Bot.* 26 (1890) 224; GOEBEL, *Ann. Jard. Bot. Btzg* 9 (1890) 68; RIDL, *Fl. Mal. Pen.* 2 (1923) 495; GAMBLE, *Fl. Madras* 2 (1924) 983; PELLEGRINI, *Fl. Gén. I.-C.* 4 (1930) 474; HAND-MAZZ., *Symb. Sin.* 7 (1936) 872; SPARE, *Mal. Nat. J.* 1 (1940) 88; BAKH, *f. in Back. Bekn. Fl. Java (em. ed.)* 8 (1949) fam. 194, p. 2; SANTAPAU, *J. Bomb. Nat. Hist. Soc.* 49 (1950) 220; P. TAYLOR in HUTCH. & DALZ., *Fl. W. Trop. Afr.* ed. 2, 2 (1963) 378; *Kew Bull.* 18 (1964) 91; BACK. & BAKH, *f. Fl. Java* 2 (1965) 517; P. TAYLOR, *Dansk Bot. Ark.* 23 (1968) 532. — *U. pusilla* (non VAHL) GRAH. *Cat. Pl. Bombay* (1839) 165. — *U. orbiculata* WALL. (*Cat.* 1829, n. 1500) ex A. DC. in DC. *Prod.* 8 (1844) 18; OLIVER, *J. Linn. Soc. Lond. Bot.* 3 (1859) 187; CLARKE, *Fl. Br. Ind.* 4 (1884) 334; STAPP, *Trans. Linn. Soc. Lond. II*, Bot. 4 (1894) 211; TRIMEN, *Handb. Fl. Ceyl.* 3 (1895) 271; RIDL, *J. Str. Br. R. As. Soc.* n. 59 (1911) 144; MERR. *En. Born.* (1921) 538; *En. Philip.* 3 (1923) 467; STEEN, *Arch. Hydrobiol. Suppl.* 11 (1932) 333, f. 8 IV; H. J. LAM, *Blumea* 5 (1945) 582. — *U. rosulata* BENJ. *Linnaea* 20 (1847) 310; MRO. *Fl. Ind. Bat.* 2 (1859) 1000; MERR. *En. Philip.* 3 (1923) 189. — *U. glochidiata* WIGHT, *lc.* (1850) t. 1581. — *U. harlandii* OLIVER ex BTH. *Fl. Hongk.* (1861) 257; FORBES & HEMSLEY, *J. Linn. Soc. Lond. Bot.* 26 (1890) 223. — *U. anthropophora* RIDL, *J. Fed. Mal. St. Mus.* 6 (1915) 165. — *U. striatula* var. *minor* RIDL, *Trans. Linn. Soc. Lond. II*, Bot. 9 (1916) 122; MELCHIOR, *Bot. Jahrb.* 62 (1929) 384. — Fig. 2e, 13-14.

Epiphytic or terrestrial. *Rhizoids* few, capillary, simple. *Stolons* capillary, branched. *Foliar organs* numerous and conspicuous at anthesis, rosulate and on the stolons, obovate, orbicular or reniform with a \pm distinct pseudopetiole, membranous, 3-10 mm long, up to 6 mm wide, with numerous dichotomously branched nerves. *Traps* numerous on the stolons, obliquely globose or ovoid, 0.6-0.8 mm long, long stalked, mouth lateral, upper lip projecting with 2 divergent stipitate-glandular appendages. *Inflorescence* erect, 1-15 cm long; peduncle filiform, glabrous, usually less than 0.3 mm thick; flowers 1-10, distant; scales few, similar to the bracts; bracts medifixed, lanceolate, apex obtuse or acute, base truncate to acute; bracteoles similar; pedicels spreading at anthesis, \pm reflexed in fruit, capillary, usually less than 0.2 mm thick. *Calyx lobes* very unequal, papillose,

upper orbicular-obcordate, 1.5-2.5 mm long at anthesis, apex emarginate, lower very much smaller, ovate-oblong, apex truncate or retuse. *Corolla* white, pink or mauve with a yellow spot on the palate, 3-10 mm long, upper lip minute, semi-orbicular, apex bidentate, very much shorter than the upper calyx lobe, lower lip orbicular or transversely elliptic, 3-10 mm wide, apex \pm distinctly 3-5-lobed, palate slightly raised, spur subulate,

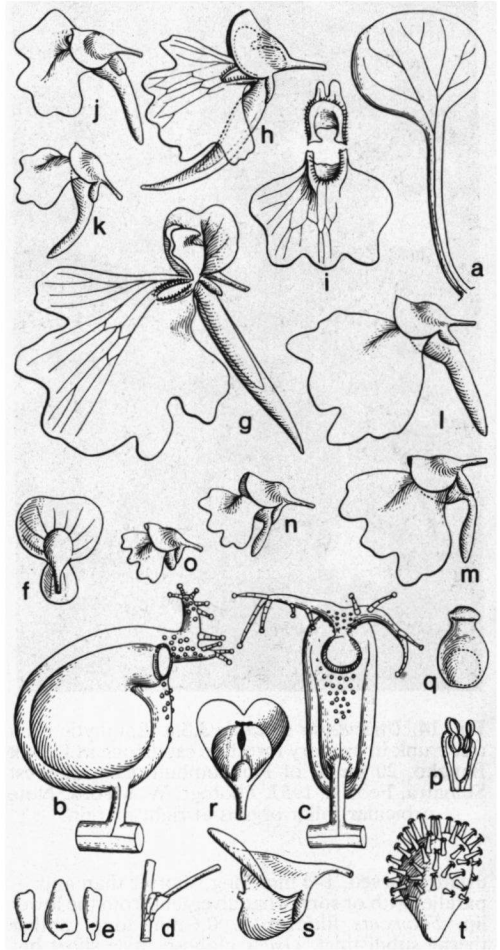


Fig. 13. *Utricularia striatula* J.SM. a. Foliar organ, $\times 6$, b-c. trap, lateral & ventral views, $\times 24$, d. insertion of pedicel, with bract & bracteoles *in situ*, $\times 6$, e. the latter enlarged, $\times 12$, f. calyx in flower, $\times 6$, g. flower calyx lobe bent back to show upper corolla lip, $\times 5$, h. *ditto*, in lateral view, $\times 5$, i. upper & lower lip flattened, $\times 6$, j-k. two flowers, $\times 5$, l-o. four *ditto*, $\times 5$, p. stamens, $\times 12$, q. pistil, $\times 12$, r. dehiscent fruit, $\times 6$, s. fruit in lateral view, $\times 6$, t. seed, $\times 45$ (a-c, g-h, r-t ALLEN *s.n.*, Borneo, f, l-q J. RAYNAL 16843, d-e, i-k CRUTTWELL 201).



Fig. 14. *Utricularia striatula* J.SM. Epiphytic on a tree trunk in primary forest on sandstone at Lubuk Bangko, 20 km E of Pajakumbuh, Central West Sumatra, Febr. 2, 1957. Photogr. W. MEIJER. Note orbicular foliar organs at right margin.

usually curved, 1–4 mm long, shorter than and \pm parallel with or somewhat divergent from the lower lip. *Filaments* filiform, c. 0.6 mm long, anther thecae subdistinct. *Ovary* globose, style short but distinct, stigma lower lip semi-orbicular, upper obsolete. *Capsule* \pm globose, obliquely dorsiventrally compressed, membranous, obscurely ventrally keeled, dehiscing by a ventral longitudinal slit. *Seeds* few, pyriform or obovoid, c. 0.25 mm long, hilum terminal, prominent, testa smooth, bearing, especially distally, numerous unicellular apically glochidiate processes.

Distr. Tropical Africa (but apparently absent from Madagascar), widespread from India to China, Indo-China and throughout *Malesia*.

Ecol. Rocks or trees or less commonly damp soil among moss in somewhat shady permanently

moist conditions, on mossy tree trunks, on stones in rivers, near waterfalls, on wet talus, from sea-level up to 3300 m. *Fl.* Jan.–Dec.

Vern. Banka: *kakrak*, *rumpit kitjekar*, M; New Guinea: *romaripi*, Orne lang., Wantipi.

13. *Utricularia pulchra* P. TAYLOR, *sp. nov.* — Fig. 15.

Affinis *U. striatulae* J.SM. *sed floribus duplo majoribus, paucioribus in inflorescentia crassiore congestis differt.* — Type: New Guinea, Irian Jaya, Tembagapura (southern slopes of Mt Carstensz), alt. 2400 m, 30 April 1973, RAYNAL 17440 (K, P). — *U. striatula* (non J.SM.) RIDL. Trans. Linn. Soc.

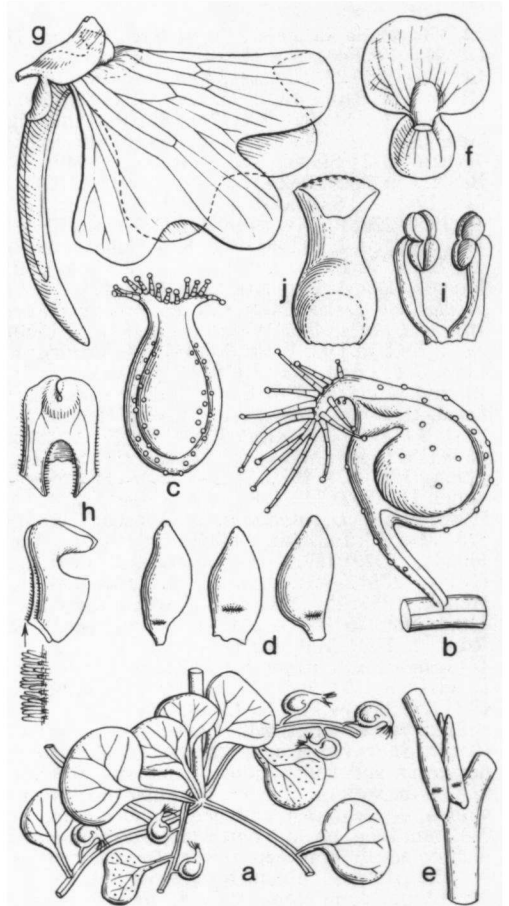


Fig. 15. *Utricularia pulchra* P. TAYLOR. a. Habit of vegetative parts, $\times 4$, b–c. trap, lateral & dorsal views, $\times 24$, d. bract & bracteoles, $\times 8$, e. their insertion, $\times 6$, f. calyx, $\times 4$, g. (large) flower, $\times 3$, h. upper lip, ventral & lateral views, $\times 6$, detail of hairs, $\times 24$, i. stamens, $\times 12$, j. pistil with circular adnation to calyx at base, $\times 12$ (all after J. RAYNAL 17440, type).

Lond. II, Bot. 9 (1916) 122; MELCHIOR, Bot. Jahrb. 62 (1929) 384.

Terrestrial. *Rhizoids* few, capillary, simple. *Stolons* few, capillary, up to 5 cm long. *Foliar organs* present at anthesis, rosulate and on the stolons, reniform, fleshy, \pm pseudopetiolate, 2–4 mm long. *Traps* numerous on the stolons, globose, 0.6–1 mm long, stalked, mouth lateral, upper lip projecting, with 2 short divergent stipitate-glandular appendages. *Inflorescence* erect, 4–6 cm long; peduncle filiform, glabrous, 0.5–0.7 mm thick; flowers 1–3, congested; scales 1 or 0, similar to the bracts; bracts medifixed, ovate, 1.5–2 mm long, apex obtuse, base truncate or bidentate; bracteoles similar; pedicels erect, filiform, dorsiventrally flattened, 4–5 mm long, c. 0.5 mm wide. *Calyx lobes* very unequal, papillose, upper orbicular or broadly reniform, apex rounded or retuse, 3–4 mm long, 3.5–5 mm wide, lower much smaller, orbicular or broadly ovate, 2–2.5 mm long. *Corolla* mauve or violet with a yellow spot on the palate, 17–20 mm long, upper lip about as long as upper calyx lobe, oblong, cucullate, apex emarginate, lower lip flabellate, 5-lobed, up to 20 mm wide, palate slightly raised, spur subulate, \pm straight, 10–12 mm long, as long as or longer than the lower lip and diverging from it at a very obtuse angle. *Filaments* linear, c. 1.2 mm long, anther thecae distinct. *Ovary* obliquely ovoid, c. 1.5 mm long, style very short, stigma lower lip semi-orbicular, upper lip obsolete. *Capsule* and *seeds* not known.

Distr. *Malesia*: New Guinea (West New Guinea: Mt Carstensz; T.N.G., Sepik Distr.: Sirius Plateau).

Ecol. Wet cliffs and damp leached sand or among moss, 2400–3000 m. Fl. March–April, Oct.

Note. *U. pulchra* is very close to *U. striatula* but differs constantly in its fewer, much larger flowers and its shorter stouter habit.

14. *Utricularia salwinensis* HAND.-MAZZ. Symb. Sin. 7 (1936) 873. — Fig. 16.

Terrestrial. *Rhizoids* few, capillary, simple. *Stolons* capillary, sparsely branched, up to 5 cm long. *Foliar organs* present at anthesis, sparsely rosulate and on the stolons, flabellate, cuneate or obovate-spathulate to orbicular, with a distinct pseudopetiole, 1.5–3.5 mm wide, up to 2.5 cm long. *Traps* rather few on the stolons, ovoid, long stalked, c. 0.8 mm long, mouth lateral, upper lip with a relatively large flabellate appendage c. 1 mm long and 2 mm wide including c. 8 marginal subulate multicellular gland-tipped processes. *Inflorescence* erect, up to 8 cm long; peduncle filiform, terete, glabrous; flowers 1–3, \pm distant; scales 0 or 1 in the upper part of the peduncle, similar to the bracts; bracts medifixed, ovate, membranous, sparsely glandular, 1.2–1.5 mm long, apex acute, base truncate, apiculate; bracteoles similar but base obliquely truncate; pedicels erect at anthesis, strongly recurved in fruit, 2–4 mm long. *Calyx lobes* very unequal, papillose, upper \pm orbicular, c. 1.5 mm long at anthesis, up to 3 mm long in fruit, apex emarginate, lower much smaller, ovate-oblong, c. 1 mm long, apex truncate or retuse. *Corolla* white (in Mal.) with a yellow (fide DE WILDE) or brown (fide VAN STEENIS) spot on the palate or pink (in Yunnan, fide HANDEL-MAZZETTI), 4–6 mm long, upper lip transversely

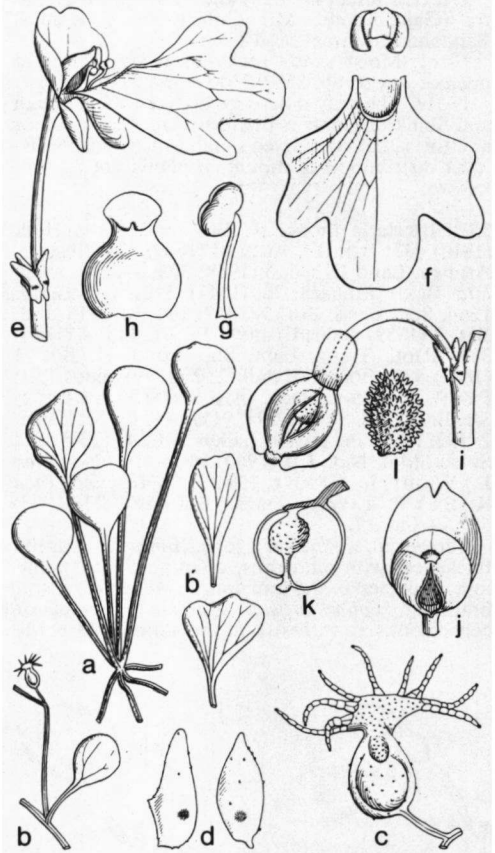


Fig. 16. *Utricularia salwinensis* HAND.-MAZZ. a. Rosette of foliar organs, b. stolon with foliar organ, branch and trap, b'. lamina of two foliar organs, all $\times 3$, c. trap, $\times 12$, d. bract (right) & bracteole, $\times 12$, e. flower, $\times 6$, f. corolla, upper & lower lip laid out, $\times 6$, g. stamen, $\times 24$, h. pistil, $\times 24$, i. dehiscent fruit in calyx, j. ditto, lower calyx lip removed, k. capsule in LS, seeds compressed, all $\times 6$, l. seed, $\times 24$ (a VAN STEENIS 8598, the others after DE WILDE 15258).

oblong, cucullate, apex emarginate, much shorter than upper calyx lobe, lower lip flabellate, 4–5 mm wide, 3-lobed, midlobe quadrate or semi-orbicular, side lobes smaller, obliquely and obscurely unequally 2-lobed, palate scarcely raised, shortly fimbriate, spur narrowly cylindrical, apex obtuse, much shorter than the lower lip. *Filaments* filiform, c. 1 mm long, anther thecae distinct. *Ovary* globose, c. 0.6 mm long, style very short, stigma lower lip orbicular, upper lip minute, deltoid. *Capsule* globose, obliquely dorsiventrally compressed, c. 2 mm long, dehiscent by a longitudinal ventral slit. *Seeds* few, ovoid, c. 0.5 mm long, shortly densely echinate.

Distr. China (Yunnan) and *Malesia*: N. Sumatra (Gajo Lands: Mts Goh Lembuh, Kemiri, Bandahara, Mamas, and Losir).

Ecol. Moist sandy rocky or mossy places in open or low scrub, 2500–3300 m. *Fl.* Febr.–May.

Note. The only difference between the Yunnan and Sumatra plants is the recorded corolla colour and this is not considered significant. Similarly disjunct distribution of mountain plants are not unknown.

15. *Utricularia limosa* R. BR. Prod. Nov. Holl. (1810) 432; BTH. Fl. Austr. 4 (1869) 531; SPECHT, Arnhem Land Exped. 3 (1958) 302. — *U. verticillata* BENJ. Linnæa 20 (1847) 312; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 184; MIQ. Fl. Ind. Bat. 2 (1859) 1000; CLARKE, Fl. Br. Ind. 4 (1884) 333; RIDL. Trans. Linn. Soc. Lond. II, Bot. 3 (1893) 327; BOERL. Handl. 2, 2 (1899) genus 559; PRAIN, J. As. Soc. Beng. 74, ii (1905) 372; RIDL. J. Str. Br. R. As. Soc. n. 59 (1911) 144; Fl. Mal. Pen. 2 (1923) 493; PELLEGR. Fl. Gén. I.-C. 4 (1930) 484; SPARE, Mal. Nat. J. 1 (1940) 90. — *U. bifida* (non L.) WIGHT, Ic. (1850) t. 1584(2). — *U. biloba* (non R. BR.) P. TAYLOR, Dansk Bot. Ark. 23 (1968) 529. — Fig. 17.

Terrestrial. *Rhizoids* few, filiform, basally thickened, with numerous, often geminate, papillose branches c. 0.5 mm long. *Stolons* capillary, branched. *Foliar organs* often not present or conspicuous at anthesis, on the stolons, narrowly

linear, 1.5–2.5 cm long, c. 0.3 mm wide, 1-nerved, apex acute. *Traps* few on the stolons and foliar organs, obliquely ovoid, 0.5–1 mm long, stalked, stalk 2–3 times as long as trap, mouth lateral, upper lip with 2 long densely hairy setiform appendages. *Inflorescence* erect, up to 25 cm long; peduncle filiform, glabrous or basally glandular, 0.5–0.8 mm thick; flowers 2–10, rather distant; scales few, similar to the bracts; bracts medifixed, narrowly elliptic, 1.5–2 mm long, apex acute, base acute or obliquely truncate; bracteoles absent; pedicels filiform, slightly dorsiventrally flattened, minutely papillose, distinctively curved, erect at base and apex, spreading in the middle part, up to 6 mm long in fruit. *Calyx lobes* unequal, upper transversely elliptic, apex rounded, up to 1.5 mm long in fruit, lower obovate-oblong, apex rounded or obscurely crenulate, up to 2 mm long in fruit. *Corolla* violet, pink or white, 4.5–6 mm long, upper lip broadly ovate, about twice as long as upper calyx lobe, apex rounded; lower lip larger, quadrate, bilobed to half its length, lobes ovate-oblong, curved upwards, palate raised, spur narrowly cylindrical from a conical base, apex obtuse, somewhat longer than lower lip. *Filaments* linear, strongly curved, flattened and apically dilated, c. 0.6 mm long, anthers c. 0.3 mm long, thecae confluent. *Ovary* globose, style short, stigma lower lip orbicular, upper lip obsolete. *Capsule* globose, c. 2 mm long, membranous, dehiscent by a longitudinal ventral marginally thickened slit, the thickened area before dehiscence apically acute, broader and emarginate at the base. *Seeds* numerous, globose or slightly angular, c. 0.25 mm long, testa thin, coarsely reticulate, reticulation \pm isodiametric.

Distr. Indo-China, Thailand, and Australia; in *Malesia*: Malay Peninsula and New Guinea.

Ecol. Seasonally flooded grassland at low altitude. *Fl.* Febr.–May, Sept.

NOTE. *U. limosa* belongs to a small, very distinct group of species, the others in the group being apparently confined to Australia.

16. *Utricularia subulata* LINNÉ, Sp. Pl. (1753) 18; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 532. — For full synonymy, which is large and exclusively American and African, see P. TAYLOR, Kew Bull. 18 (1964) 81–83 and Mem. N.Y. Bot. Gard. 17 (1967) 223. — Fig. 18.

Terrestrial. *Rhizoids* few, capillary, basally thickened and rigid, with numerous papillose branches c. 0.5 mm long. *Stolons* capillary, much branched. *Foliar organs* often not conspicuous at anthesis, narrowly linear, 1–2 cm long, c. 0.5 mm wide, apex acute, 1-nerved. *Traps* very numerous on the vegetative organs, ovoid, stalked, 0.2–0.5 mm long, mouth lateral, upper lip projecting with 2 spreading curved subulate sparsely branched appendages. *Inflorescence* erect, up to 25 cm long; flowers 1–25, moderately distant; peduncle capillary, glabrous above, usually minutely papillose below; scales few, similar to the bracts but narrower and acuminate at base and apex, often papillose; bracts medifixed, petalate, broadly elliptic to orbicular, membranous, 0.75–1 mm long, obtuse or subacute at base and apex; bracteoles absent; pedicels ascending, capillary, terete, 2–10 mm long. *Calyx lobes* subequal, broadly ovate to orbicular,

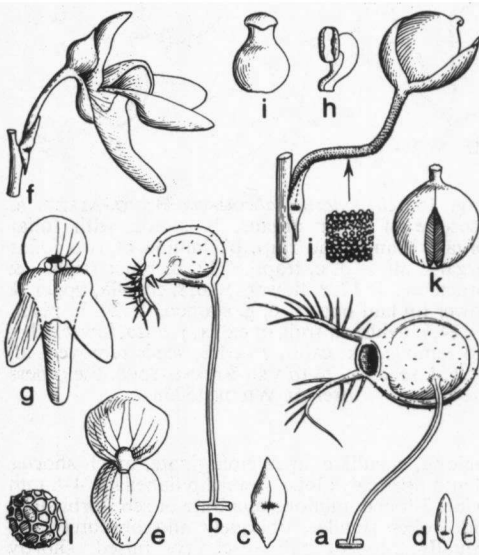


Fig. 17. *Utricularia limosa* R. BR. a–b. Traps, large & small, $\times 12$, c. bract, d. scales, mid and lower (small one), e. fruiting calyx, all $\times 6$, f–g. flower, in two views, $\times 6$, h. stamen, $\times 12$, i. pistil, $\times 12$, j. capsule, $\times 6$, and enlarged surface of pedicel, $\times 24$, k. capsule, ventral view, thickened area shaded, $\times 6$, l. seed, $\times 45$ (a–e, k MUST 1004, the others after J. RAYNAL 17296).

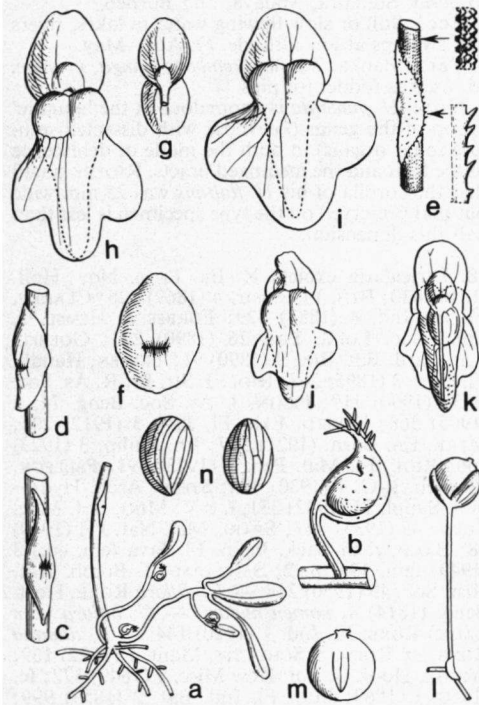


Fig. 18. *Utricularia subulata* L. a. Base of peduncle and vegetative parts, $\times 6$, b. trap, $\times 45$, c. smooth peduncle with lower scale, $\times 12$, d. *ditto*, with upper scale, both $\times 12$, e. peduncle near base with papillae and teeth on margin of scale, $\times 15$, with details, $\times 75$, f. bract, flattened, $\times 12$, g. calyx in flower, h-i. corolla, *j. ditto*, small size, k. *ditto*, adaxial aspect, l. fruiting pedicel, m. capsule, ventral view, all $\times 6$, n. two seeds, $\times 45$ (a, j, k LARSEN & WARNCKE 13, b-d, f JACOBS 5494, e, i KERR 14338, g, h FRANCK *s.n.*, l, m MILNE-REDHEAD & TAYLOR 7779B, n MELVILLE & HOOKER 253).

c. 1 mm long at anthesis, slightly accrescent, apex rounded or truncate. *Corolla* yellow, 6-10 mm long, upper lip broadly ovate to orbicular, 2-3 times as long as upper calyx lobe, apex rounded, lower lip larger, \pm flabellate, deeply 3-lobed, midlobe larger than side lobes, apex of lobes rounded to truncate, palate much raised, bigibbous, spur subulate from a short conical base, parallel with and about as long as lower lip, apex usually obtuse, sometimes acute or 2-4-denticulate. *Filaments* filiform, curved, anther thecae confluent. *Ovary* globose, style very short, stigma lower lip orbicular, upper lip obsolete. *Capsule* globose, 1-1.5 mm long, membranous, dehiscent by a small ventral ovate pore. *Seeds* numerous, ovate, 0.2-0.25 mm long, testa thin, obscurely longitudinally striate.

Distr. Eastern North America, throughout Central and South America to Argentina, through-

out tropical Africa and in S. Africa and Madagascar, also in Portugal (possibly introduced); in Thailand and in *Malesia*: Malaya (Selangor) and Borneo (Bako National Park, Kalabit Highlands, and once in Central Borneo).

Ecol. Damp open sandy or boggy ground at low altitude. *Fl.* Sept.

Note. It is curious that this species, which is widespread and abundant in the New World, Africa and Madagascar, should never have been found in India. There can be no doubt that the Malesian plant is the same as the African and American ones.

17. *Utricularia punctata* WALL. (Cat. 1829, n. 2121) ex A. DC. in DC. Prod. 8 (1844) 5; WIGHT, Ic. (1850) t. 1570; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 175; MIQ. Suppl. 1 (1860) 246; KURZ, Nat. Tijds. N. I. 27 (1864) 213; RIDL. Trans. Linn. Soc. Lond. II, Bot. 3 (1893) 327; BOERL. Handl. 2, 2 (1899) genus 559; PRAIN, J. As. Soc. Beng. 74, ii (1905) 369; MERR. En. Born. (1921) 538; RIDL. Fl. Mal. Pen. 2 (1923) 491; SPARE, Mal. Nat. J. 1 (1940) 88; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 531, *excl. syn. U. rogersiana*. — *U. fluitans* RIDL. J. Str. Br. R. As. Soc. n. 61 (1912) 32; Fl. Mal. Pen. 2 (1923) 491; Disp. (1930) 180, *sphalm. 'fluviatilis'*. — *U. aurea* (non LOUR.) P. TAYLOR, Dansk Bot. Ark. 23 (1968) 529, *quoad syn. U. fluitans*. — Fig. 19.

Aquatic. Rhizoids apparently absent. *Stolons* filiform, terete, sparsely branched, up to 20 cm long, 0.5-1 mm thick, glabrous. *Foliar organs* numerous on the stolons, 2-6 cm long, the primary segment divided in 2 or 3 just above the base, then repeatedly divided into very numerous segments, the secondary pinnae \pm reflexed, the lowermost somewhat remote from the base which may or may not be provided with sparse stipule-like segments resembling the ultimate segments, the latter capillary, terete, sparsely minutely setulose; the primary segments of the foliar organ basal to the inflorescence often longer, inflated, \pm fusiform and bearing fewer shorter ultimate segments. *Traps* not numerous, lateral on the penultimate and ultimate segments, broadly obliquely ovoid, 1-2 mm long, shortly stalked, mouth lateral with short marginal setae, upper lip with 2 long, branched setiform appendages. *Inflorescence* erect, 8-30 cm long; peduncle filiform, terete; flowers 6-12, \pm distant; scales few, similar to the bracts; bracts medifixed, peltate, inserted shortly above the base of the pedicel, ovate, apex acute, base rounded, membranous, c. 2 mm long, attached below the middle; bracteoles absent; pedicels capillary, terete, erect or ascending, c. 6 mm long at anthesis, up to 15 mm long in fruit. *Calyx lobes* subequal, the lower slightly smaller, orbicular, membranous, c. 1.5 mm long, scarcely accrescent. *Corolla* lilac, violet, pink or rarely white, with a yellow spot on the palate, 6-10(-15) mm long, externally glabrous, upper lip transversely elliptic or orbicular, cucullate, apex rounded, lower lip larger, transversely oblong-elliptic, up to 12 mm wide, base auriculate, apex rounded, lateral margins incurved, palate raised, gibbous, spur conical, slightly curved, apex obtuse, about as long as and \pm parallel with the lower lip. *Filaments* falcate, considerably expanded above, c. 1.5 mm long, anther thecae confluent. *Ovary* ovoid, style about as long as ovary,

stigma lower lip orbicular, upper lip much smaller, deltoid. *Capsule* ellipsoid, membranous, c. 3 mm long, laterally bivalvate. *Seeds* few, lenticular, 1.5–2 mm wide, margin winged, deeply irregularly dentate.

Distr. Burma, Indo-China, Thailand; in *Malesia*: Sumatra, Malaya, and Borneo.

Ecol. Still or slow flowing water in lakes, rivers and swamps at low altitude. *Fl.* Aug.–May.

Vern. Banka: *kantur*, *kembang ganga*, *kramor*, M, used as fodder for pigs.

Note. *U. punctata* is anomalous in the 'aquatic' group of the genus (*i.e.* those with dissected setulose foliar organs) in both the mode of dehiscence of the fruit and the medifixed bracts. RIDLEY stated that the corolla of his *U. fluitans* was 25 mm wide but that preserved on the type specimen is less than half this dimension.

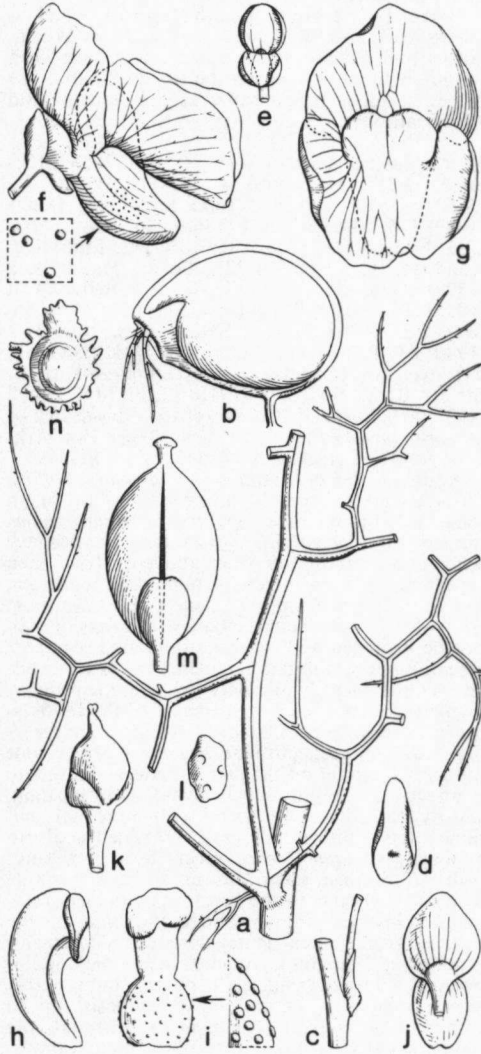


Fig. 19. *Utricularia punctata* WALL. ex A.DC. a. Stolon with part of a branched foliar organ, at the base with stipule-like basal segments, $\times 5$, b. trap, $\times 24$, c. bract *in situ*, $\times 4$, d. bract, $\times 7\frac{1}{2}$, e. flowering calyx, $\times 4$, f. flower, lateral view, $\times 4$, detail of glands inside spur, $\times 75$, g. corolla, front view, $\times 4$, h. stamen, $\times 15$, i. pistil, $\times 15$, detail of glands on ovary $\times 75$, j. fruiting calyx, $\times 6$, k. fruit, $\times 4$, l. placenta, $\times 4$, m. dehiscent fruit, abaxial ventral view, $\times 6$, n. seed, $\times 7\frac{1}{2}$ (all after LARSEN 82, except b CASTLE 88, j, m FLENLEY 134).

18. *Utricularia exoleta* R. BR. Prod. Nov. Holl. (1810) 430; BTH. Fl. Austr. 4 (1869) 526; CLARKE, Fl. Br. Ind. 4 (1884) 329; FORBES & HEMSL. J. Linn. Soc. Lond. Bot. 26 (1890) 223; GOEBEL, Ann. Jard. Bot. Btzg 9 (1890) 91; TRIMEN, Handb. Fl. Ceyl. 3 (1895) 268; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 119; PRAIN, J. As. Soc. Beng. 74, ii (1905) 368; KOORD. Exk. Fl. Java 3 (1912) 204; MERR. En. Born. (1921) 537; En. Philip. 3 (1923) 466; RIDL. Fl. Mal. Pen. 2 (1923) 491; PELLEGR. Fl. Gén. I-C. 4 (1930) 473; STEEN. Arch. Hydrobiol. Suppl. 11 (1932) 331, f. 8 V; MIKI, Bot. Mag. Tokyo 49 (1935) 847; SPARE, Mal. Nat. J. 1 (1940) 88; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 194, p. 2; SANTAPAU, J. Bomb. Nat. Hist. Soc. 49 (1950) 218. — *U. diflora* ROXB. Hort. Beng. (1814) 4, *nomen nudum*. — *U. biflora* (non LAMK) ROXB. Fl. Ind. 1 (1820) 144. — *U. diantha* ROXB. ex ROEM. & SCHULTES, Mant. 1 (1822) 169; WIGHT, Hook. J. Bot. Kew Misc. 1 (1849) 372; Ic. (1850) t. 1569; MIQ. Fl. Ind. Bat. 2 (1859) 999; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 176. — *U. roxburghii* SPRENG. Syst. 1 (1825) 52. — *U. pauciflora* BL. Bijdr. (1826) 739; MIQ. Fl. Ind. Bat. 2 (1859) 999. — *U. ambigua* A. DC. in DC. Prod. 8 (1844) 9. — *U. pterosperma* EDGEW. Proc. Linn. Soc. Lond. 1 (1847) 352. — *U. conferta* HASSK. Nat. Tijds. N. I. 10 (1855) 90 (Retzia 1 (1855) 90); MIQ. Fl. Ind. Bat. 2 (1859) 998. — *U. sumatrana* MIQ. Fl. Ind. Bat. 2 (1859) 998, p. p.; Suppl. 1 (1860) 246. — *U. saharunporensis* ROYLE ex OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 176, *pro syn.* — *U. elegans* WALL. (Cat. 1829, n. 1502) ex OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 176, *pro syn.* — *U. gracilis* LEPR. ex OLIVER, J. Linn. Soc. Lond. Bot. 9 (1865) 147, *pro syn.* — *U. amphibia* WELW. ex KAMIENSKI, Bot. Jahrb. 33 (1902) 112, *pro syn.* — *U. exoleta* var. *lusitanica* KAMIENSKI, Bot. Jahrb. 33 (1902) 112. — *U. riccioides* A. CHEV. Bull. Soc. Bot. Fr. Mém. 8 (1912) 187. — *U. nagurai* MAKINO, Bot. Mag. Tokyo 27 (1913) 59. — *U. gibba* L. ssp. *exoleta* (R. BR.) P. TAYLOR, Mitt. Bot. Staatssamml. München 4 (1961) 101; in Hutch. & Dalz. Fl. W. Trop. Afr. ed. 2, 2 (1963) 381; Kew Bull. 18 (1964) 204; Dansk Bot. Ark. 23 (1968) 530; BACK. & BAKH. f. Fl. Java 2 (1965) 51. — Fig. 2f, 20.

Aquatic. *Rhizoids* few, filiform with short botryform branches. *Stolons* filiform, terete, up to 20 cm long or more, up to 1 mm thick, much branched and often mat-forming. *Foliar organs* numerous on the stolons, up to 15 mm long, sparsely dichotomously divided, ultimate segments few, capillary, terete, glabrous or very sparsely setulose. *Traps* numerous, lateral on the foliar segments, obliquely ovoid, stalked, 1–1.5 mm long, mouth lateral,

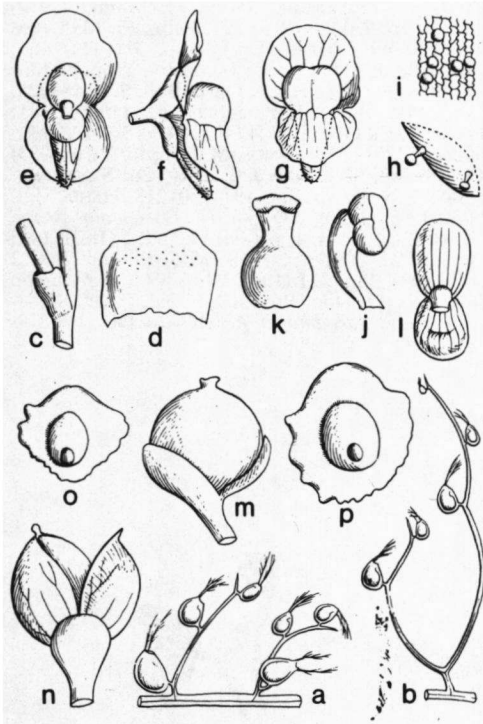


Fig. 20. *Utricularia exoleta* R.Br. a-b. Foliar organs on stolon, $\times 4$, c. bract *in situ*, $\times 6$, d. *ditto*, flattened, $\times 15$, e-g. flower, in adaxial, lateral and frontal views respectively, $\times 4$, h. glands on spur outside, $\times 75$, i. *ditto* inside, $\times 75$, j. stamen, $\times 15$, k. pistil, $\times 15$, l. fruiting calyx, $\times 6$, m. fruit, $\times 6$, n. *ditto*, dehiscent, $\times 6$, o-p. seeds, $\times 15$ (a, e-i JONES 310, b-d, j-l JONES 386, m-n, p ADAMES 201, o JORDAN 2096).

sometimes with short marginal setae, upper lip with 2 long, much branched setiform appendages. *Inflorescence* erect, 2-15 cm long, solitary or fasciculate; peduncle filiform, terete, glabrous; scales usually 1 near the middle of the peduncle, similar to the bracts; bracts basifixed, transversely oblong or semi-orbicular, c. 1 mm long, apex truncate or obscurely crenulate; bracteoles absent; pedicels filiform, terete, suberect, 2-12 mm long. *Calyx lobes* subequal, \pm orbicular, apex rounded. *Corolla* yellow, 4-8 mm long, upper lip orbicular or broadly ovate, about twice as long as upper calyx lobe, 3-4 mm wide, apex rounded or truncate, lower lip similar, palate raised, gibbous, spur narrowly cylindrical from a conical base, straight, apex obtuse, slightly longer than and \pm parallel with the lower lip. *Filaments* linear, curved, anther thecae \pm confluent. *Ovary* globose, style short but distinct, stigma lower lip semi-orbicular, upper lip much shorter or obsolete. *Capsule* globose, 2-3 mm long, firm in texture, laterally bivalvate. *Seeds* few, lenticular, 1-1.6 mm

wide, with a broad irregular corky wing, testa smooth or slightly verrucose, hilum prominent.

Distr. Tropical Africa, Portugal, India to China and Japan and N. Australia; in *Malesia* common and widespread but not recorded from the Lesser Sunda Is.

Ecol. Shallow still water in lakes, swamps and marshes, also in *Pandanus* swamp forest, largely at low altitude, occasionally ascending to 1600, and even to 2100 m. *Fl.* Febr.-March, July-Dec.

Vern. W. Java: *lukut tjai*, S; W. Borneo: *veenparril*, Pontianak; New Guinea: *keenapidu*, Enga lang.

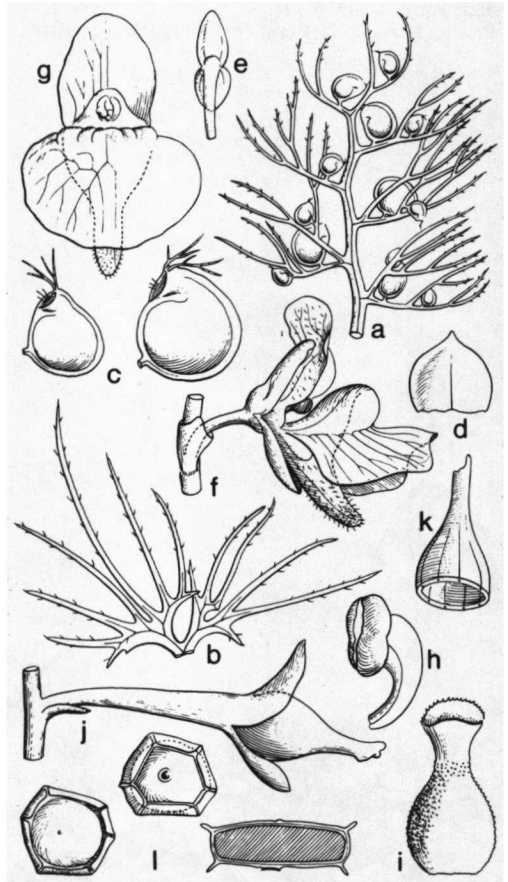


Fig. 21. *Utricularia aurea* LOUR. a. Foliar organ with traps, $\times 4$, b. foliose stipule-like segments at base of foliar organs, $\times 6$, c. small and large trap, $\times 6$, d. bract, flattened, $\times 6$, e. flowering calyx, $\times 4$, f. flower in lateral view, $\times 4$, g. *ditto*, frontal view, $\times 4$, h. stamen, $\times 12$, i. pistil, $\times 12$, j. young fruit, with swollen pedicel, $\times 4$, k. circumscissile upper half of dehiscent capsule, $\times 4$, l. seed, left to right in abaxial, adaxial view, $\times 12$, and in section, $\times 24$ (a, d-e, g, j-k LARSEN & WARNCKE 1663, b-c, f, h-i DARBYSHIRE 605, l HAVILAND 2177A).

19. *Utricularia aurea* LOUR. Fl. Coch. (1780) 26; MERR. Trans. Am. Phil. Soc. 24 (1935) 356; HAND-MAZZ. Symb. Sin. 7 (1936) 874; STEEN. Trop. Natuur Jub. no. (1936) 123, f. 20; BACK. & BAKH. f. Fl. Java 2 (1965) 517; P. TAYLOR, Dansk Bot. Ark. 23 (1968) 529, *excl. syn. U. fluitans*. — *U. vulgaris* LINNÉ, Sp. Pl. (1753) 18, *partim quoad ref. Fl. Zeyl.* — *U. flexuosa* VAHL, Enum. 1 (1804) 198; BL. Bijdr. (1826) 739; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 175, *excl. syn. U. ramosa*; BTH. Fl. Austr. 4 (1869) 525, *excl. syn. U. australis*; CLARKE, Fl. Br. Ind. 4 (1884) 329; FORBES & HEMSL. J. Linn. Soc. Lond. Bot. 26 (1890) 223; RIDL. Trans. Linn. Soc. Lond. II, Bot. 3 (1893) 327; TRIMEN, Handb. Fl. Ceyl. 3 (1895) 267; BOERL. Handl. 2, 2 (1899) 560; RIDL. J. Str. Br. R. As. Soc. n. 33 (1900) 119; PRAIN, J. As. Soc. Beng. 74, ii (1905) 368; RIDL. J. Str. Br. R. As. Soc. n. 59 (1911) 144; KOORD. Exk. Fl. Java 3 (1912) 204; MERR. Fl. Manila (1912) 432; BOLD. Zakfl. (1916) 126; RIDL. Fl. Mal. Pen. 2 (1923) 491; MERR. En. Philip. 3 (1923) 466; Lingn. Sc. J. 5 (1927) 167; JACOBSON, Trop. Natuur 17 (1928) 112, fig.; HEND. Gard. Bull. S. S. 4 (1928) 295; MELCHIOR, Bot. Jahrb. 62 (1929) 385; PELLEGR. Fl. Gén. I.-C. 4 (1930) 471; BACK. Onkr. Suiker. (1931) 633; SANDS, Mal. Agric. J. 21 (1933) 175; SPARE, Mal. Nat. J. 1 (1940) 88; SANTAPAU, J. Bomb. Nat. Hist. Soc. 49 (1950) 218; HEND. Mal. Nat. J. 6 (1950) 336. — *U. fasciculata* ROXB. (Hort. Beng. 1814, 4, *nomen*) Fl. Ind. 1 (1820) 143; WALL. Cat. (1829) n. 1568; MIQ. Fl. Ind. Bat. 2 (1859) 997; Suppl. 1 (1860) 246. — *U. confervifolia* JACKS. ex D. Don, Prod. Fl. Nepal. (1825) 84. — *U. flexuosa* var. *blumei* A. DC. in DC. Prod. 8

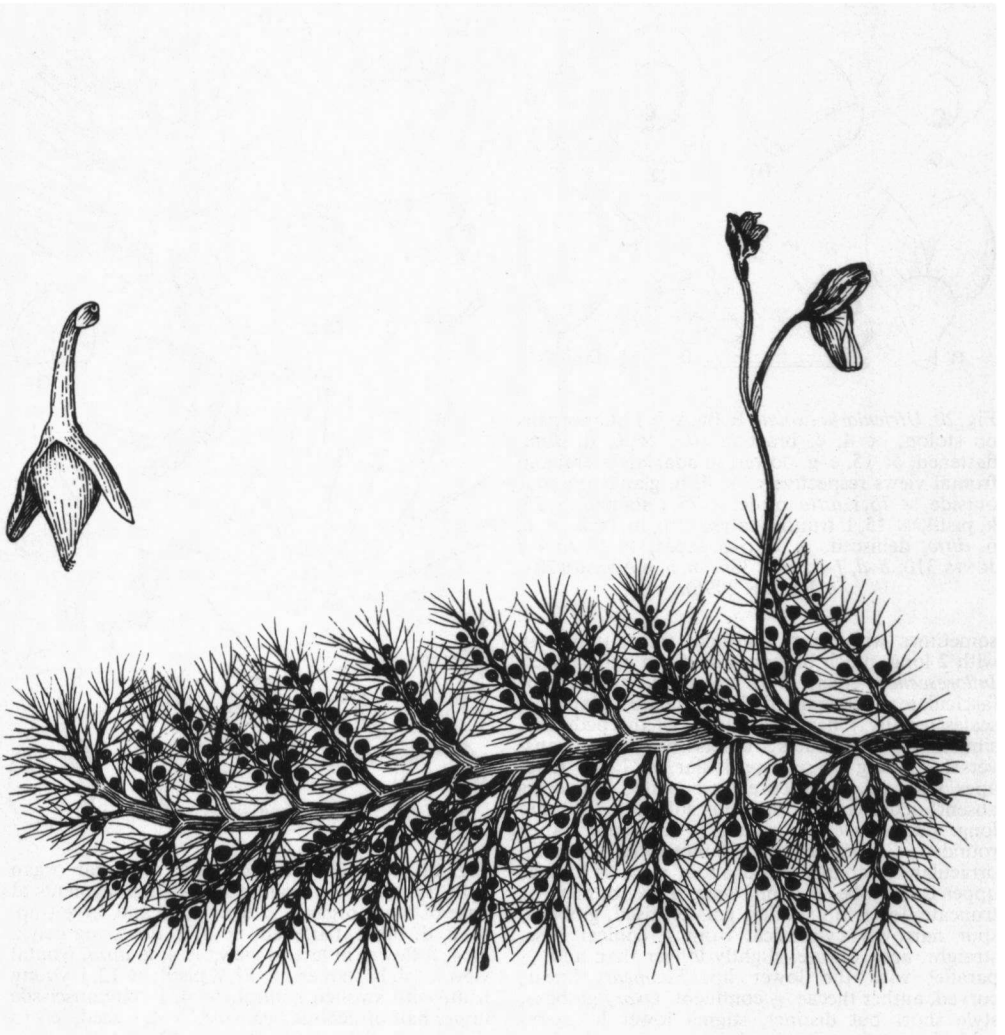


Fig. 22. *Utricularia aurea* LOUR. Habit, about nat. size, a fruit in natural poise separately (DOCTERS VAN LEEUWEN 2281).

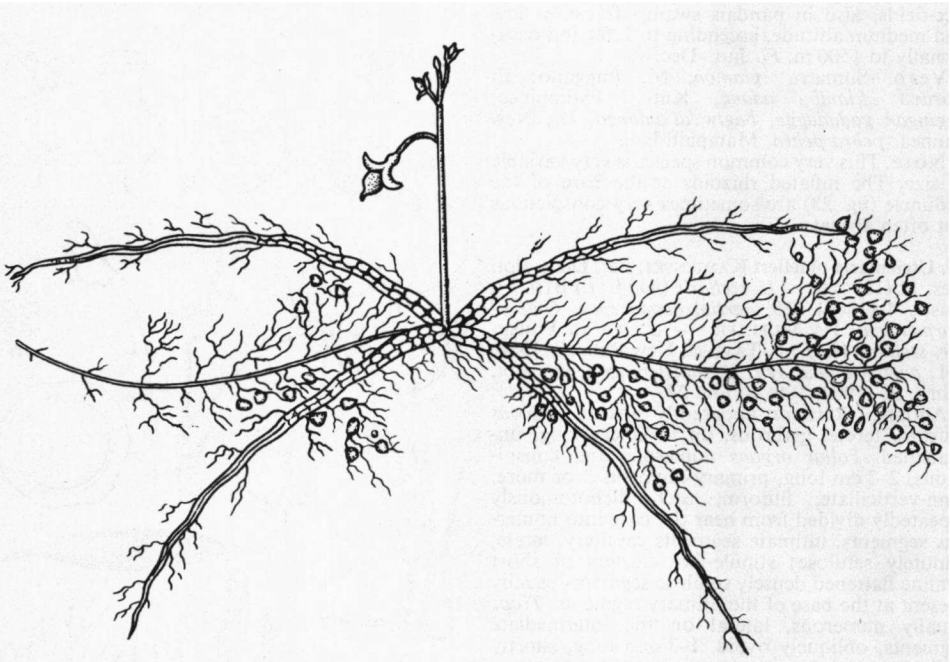


Fig. 23. *Utricularia aurea* LOUR. Form with conspicuous inflated rhizoids from the base of the peduncle, slightly enlarged. In clay ditch in seasonal savanna, Indramayu, W. Java, March 1936 (VAN STEENIS *s.n.*).

(1844) 24. — *U. inaequalis* BENJ. Linnaea 20 (1847) 304. — *U. calumpitensis* LLANOS, Fragm. (1851) 11; MERR. Sp. Blanc. (1918) 351. — *U. extensa* HANCE in Walp. Ann. 3 (1852) 3. — *U. reclinata* HASSK. Versl. Med. Kon. Ak. Wet. A'dam 4 (1855) 161; Retzia 1 (1855) 92; *ibid.* 10 (1856) 92; BOERL. Handl. 2, 2 (1899) genus 559. — *U. blumei* (A. DC.) MIQ. Fl. Ind. Bat. 2 (1859) 997. — *U. vulgaris* var. *pilosa* MAKINO, Bot. Mag. Tokyo 9 (1895) 111. — *U. pilosa* (MAKINO) MAKINO, Bot. Mag. Tokyo 11 (1897) 70. — Fig. 2c, 21–23.

Aquatic. *Rhizoids* usually present, verticillate at or near the base of the peduncle, fusiform, inflated, 2–6 cm long, 1–3 mm thick (fig. 23), with filiform branches bearing botryform clusters of ellipsoid segments 0.1–0.2 mm long. *Stolons* filiform to relatively thick, up to 50 cm long, terete, branched, glabrous or \pm densely covered with short simple hairs. *Foliar organs* numerous and conspicuous 2–6 cm long, primary segments 3–4, semi-verticillate, filiform or sometimes thick and inflated, each pinnately repeatedly divided from near the base into numerous segments, ultimate segments capillary, terete, setulose; stipule-like clusters of short capillary setulose segments usually present at the base of the primary segments. *Traps* usually numerous, lateral on the foliar segments and sometimes also in the angle between segments, obliquely ovoid, shortly stalked, 1–4 mm long, mouth lateral, upper lip usually with 2 short sparsely branched setiform appendages or without appendages. *Inflorescence* erect, 5–25 cm long; peduncle filiform, terete, glabrous; flowers 5–10, initially congested

becoming \pm distant; scales always absent; bracts basifixed, \pm orbicular, 1.5–2 mm long, apex rounded or subacute; bracteoles absent; pedicels filiform, dorsiventrally flattened, elliptic in cross section, 4–20 mm long, erect at anthesis, usually sharply reflexed and thickened, especially apically, in fruit. *Calyx lobes* subequal, the upper slightly longer, ovate, 3–4 mm long at anthesis, rather fleshy, apex obtuse, margins strongly incurved, very accrescent, up to 9 mm long and spreading or reflexed in fruit. *Corolla* yellow, externally glabrous or sparsely hairy, 10–15 mm long, upper lip broadly ovate, about twice as long as the upper calyx lobe, apex rounded, lower lip larger, transversely elliptic, apex rounded, entire or retuse palate raised, gibbous, spur cylindrical from a conical base, often constricted at the middle, apex obtuse, slightly shorter than and \pm parallel with the lower lip. *Filaments* linear, expanded above, c. 2 mm long, anther thecae confluent. *Ovary* globose, glandular, style relatively long, stigma lower lip orbicular, margin hyaline, ciliate, upper lip much shorter, margin glabrous. *Capsule* globose up to 5 mm long, relatively thick and fleshy, circumscissile, style usually greatly enlarged and elongated, often equalling or exceeding the capsule. *Seeds* numerous, lenticular-prismatic, 5-angled, 1.5–2 mm wide, very narrowly winged on all the angles, testa thin, obscurely reticulate, reticulations slightly elongate.

Distr. India to China and Japan to Australia, throughout *Malesia*, common and widespread.

Ecol. Deep or shallow still water in lakes and

rice-fields, also in pandan swamp forest at low and medium altitude, ascending to 1200 and occasionally to 1500 m. Fl. Jan.-Dec.

Vern. Sumatra: *giamon*, M, Enggano; E. Borneo: *klanibu udang*, Kutei; Philippines: *bagingan gadudugge, bagiw di udongo*, If.; New Guinea: *pehra pehra*, Matapaili lang.

Note. This very common species is very variable in size. The inflated rhizoids at the base of the peduncle (fig. 23) are sometimes very conspicuous but often absent.

20. *Utricularia muelleri* KAMIENSKI, Ber. Deut. Bot. Ges. 12 (1894) 5. — *U. stellaris* (non L. f.) BTH. Fl. Austr. 4 (1869) 525, *partim quoad spec.* Gulf of Carpentaria, F.v.MUELLER. — *U. inflexa* FORSK. var. *stellaris* (L. f.) P. TAYLOR, Kew Bull. 18 (1964) 191, *partim quoad syn. U. muelleri* excl. ref. Bot. Jahrb. 33 (1902) 108. — Fig. 24.

Aquatic. Rhizoids apparently absent. Stolons filiform, terete, glabrous, up to 60 cm long, unbranched. Foliar organs numerous and conspicuous, 2-3 cm long, primary segments 3 or more, semi-verticillate, filiform, each dichotomously repeatedly divided from near the base into numerous segments, ultimate segments capillary, terete, minutely setulose; stipule-like clusters of short hyaline flattened densely setulose segments usually present at the base of the primary segments. Traps usually numerous, lateral on the intermediate segments, obliquely ovoid, 1-3 mm long, shortly stalked, mouth lateral, apparently without appendages. Inflorescence erect, 4-15 cm long, peduncle filiform, terete with a whorl of 4-6 spongy floats approximately midway, floats ellipsoid, 10-20 mm long, shortly stipitate, with capillary foliar segments at the apex and laterally and more numerous at the base; flowers 2-14, rather congested; scales absent; bracts transversely elliptic when flattened, cucullate, amplexicaule, hyaline, nerveless, 2.5-3 mm long, apex \pm deeply denticulate-laciniate; bracteoles absent. Calyx lobes unequal, connate, scarcely accrescent, upper broadly ovate, c. 2 mm long, cucullate, apex rounded, lower about as long but broader \pm orbicular, apex emarginate. Corolla yellow with pink nerves on the palate and spur, 6-9 mm long, glabrous, upper lip oblong, cucullate, much longer than upper calyx lobe, lower lip shorter, transversely oblong, apex emarginate, palate raised, gibbous, spur broadly conical, slightly curved, apex rounded, about as long as lower lip. Filaments falcate, c. 2 mm long, somewhat expanded above, anther thecae subdistinct. Ovary globose, style distinct, stigma lower lip quadrate, reflexed, upper lip very short, emarginate. Capsule globose, 3-4 mm long, circumscissile. Seeds few, thinly lenticular, 1.5-2 mm \varnothing including a distinct narrow hyaline wing, testa thin with small conspicuous reticulation.

Distr. N. Australia (Northern Territory and Queensland) and Malesia: New Guinea (Papua).

Ecol. Shallow water in lowland *Melaleuca* swamp forest. Fl. Aug.

Note. *U. muelleri* is superficially very similar to the more widespread *U. stellaris* L. f. which occurs from tropical Africa to Indo-China and reappears in northern Australia, but is apparently absent from Malesia. For differences see the key to the species.

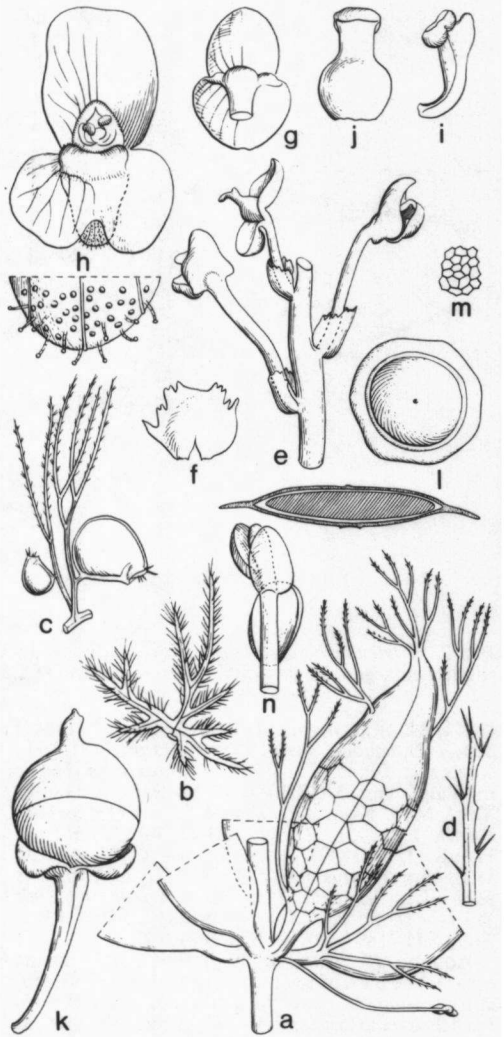


Fig. 24. *Utricularia muelleri* KAMIENSKI. a. Whorl of five floats showing stipites and segments at or near their bases (+ 'air shoot'), $\times 5$, b. hyaline stipule-like segments from base of primary segments, $\times 12$, c. secondary to ultimate segments of foliar organs with traps, $\times 5$, d. apex of foliar segments on floats, $\times 24$, e. part of deflorated inflorescence, $\times 4$, f. bract, flattened, $\times 6$, g. flowering calyx, $\times 6$, h. corolla, front view, $\times 4$, and below it spur apex, with internal sessile and external stipitate glands, $\times 24$, i. stamen, $\times 12$, j. pistil, $\times 12$, k. capsule, with circumscissile line for later dehiscence, $\times 5$, l. seed, $\times 12$, and below it in section filled with embryo, $\times 24$, m. testa, $\times 24$, n. apex of air shoot (a-c, n BYRNES 2381, d-j LATZ 3697, k PARKER 117, l-m PULLEN 7058).

21. *Utricularia australis* R. BR. Prod. Nov. Holl. (1810) 430; A. DC. in DC. Prod. 8 (1844) 6; P. TAYLOR in Tutin *et al.* Flora Europaea 3 (1972) 297. — *U. neglecta* LEHM. Pugillus Plantarum 1 (1828) 38. — *U. saccifomis* BENJ. Linnaea 20 (1897) 302. — *U. flexuosa* (non VAHL) BTH. Fl. Austr. 4 (1869) 525; CLARKE, Fl. Br. Ind. 4 (1884) 329, *partim et quoad syn.* *U. australis* R. BR. — *U. incerta* KAMIENSKI, Bot. Jahrb. 33 (1902) 111. — *U. japonica* MAKINO, Bot. Mag. Tokyo 28 (1914) 28. — *U. stellaris* (non L. f.) WAGER, Trans. R. Soc. S. Afr. 16 (1928) 204. — *U. vulgaris* (non L.) P. TAYLOR, Kew Bull. 18 (1964) 171. — Fig. 25.

Aquatic. *Rhizoids* 2-4 near base of peduncle, capillary, 1-2 cm long with a few short botryform segments. *Stolons* filiform, up to 50 cm long, terete, branched, glabrous. *Foliar organs* numerous, 1.5-4 cm long, primary segments 2, filiform or sometimes \pm inflated, each repeatedly pinnately

divided from very near the base into numerous segments, ultimate segments capillary, distinctly flattened, marginally setulose. Globose or ovoid *turions* (winter buds) 0.5-1.5 cm long of reduced densely setulose foliar segments often present at apex of stolons or stolon branches. *Traps* usually numerous, lateral on the segments and usually also at the base of the primary segments, obliquely ovoid, 1-2 mm long, shortly stalked, mouth lateral, with simple marginal setae, upper lip with two long branched setiform appendages. *Inflorescence* erect, up to 40 cm long; peduncle at first straight becoming flexuous post anthesis, relatively stout, 1-2 mm thick terete, glabrous; flowers 4-10, initially congested becoming \pm distant; scales 2-3 always present in the upper half of the peduncle, similar to the bracts; bracts basifixed, \pm orbicular, 3-5 mm long, base auriculate, apex rounded or obscurely tridentate; bracteoles, absent; pedicels filiform, 1.5-2.5 cm long, erect at anthesis, later \pm spreading. *Calyx lobes* subequal, ovate-oblong, c. 3 mm long, apex of upper rounded, of lower emarginate. *Corolla* yellow, c. 15 mm long, externally glabrous, upper lip ovate to orbicular, 2-3 times as long as upper calyx lobe, lower lip much larger, transversely elliptic, up to 16 mm wide, apex rounded or retuse, palate raised, gibbous, spur cylindrical or broadly conical, obtuse, slightly curved, shorter than the lower lip. *Filaments* linear, curved, anther thecae confluent. *Ovary* globose, style distinct, about as long as ovary, stigma lower lip semi-orbicular, margin denticulate, upper lip very short. *Capsule* and *seeds* not known.

Distr. W. Europe to China and Japan, tropical and S. Africa, India (south to Ceylon) to SE. Australia; in *Malesia*: Sumatra, Java, Philippines, and New Guinea.

Ecol. Pools in swamps, in *Malesia* at high altitudes, 1300-2500 m, often not flowering. *Fl.* April-July, Nov.

Note. This widespread temperate Eurasian species apparently never sets seed and its somewhat sporadic occurrence, mostly at high altitude, in the African and Asian tropics is probably due to transmission of small particles of its vegetative parts by migrating birds. It has been much confused with *U. aurea* but is easily distinguished by its 1 or 2 (not 3 or more) primary foliar segments without basal stipule-like segments and when in flower by the presence of scales on the peduncle.

22. *Utricularia minor* LINNÉ, Sp. Pl. (1753) 18; A. DC. in DC. Prod. 8 (1844) 7; OLIVER, J. Linn. Soc. Lond. Bot. 3 (1859) 176; P. TAYLOR in Tutin *et al.* Fl. Europaea 3 (1972) 296. — *U. rogersiana* LACE, Kew Bull. (1915) 405. — *U. minor* var. *multispinosa* MIKI, Bot. Mag. Tokyo 48 (1934) 337. — *U. multispinosa* (MIKI) MIKI, Water Phaner. Jap. (1937) 109; OHWI, Fl. Japan (1965) 815. — *U. punctata* (non WALL. ex DC.) P. TAYLOR, Dansk Bot. Ark. 23 (1968) 531, *partim, quoad syn.* — Fig. 26.

Aquatic. *Rhizoids* not clearly differentiated. *Stolons* filiform, terete, up to 20 cm long, 0.1-0.3 mm thick, sparsely branched, glabrous, \pm dimorphic, some green, suspended or floating, others without chlorophyll and buried in the substrate. *Foliar organs* numerous, polymorphic, \pm circular in outline, 0.2-1.5 cm long, \pm palmately divided into rather few segments, the ultimate

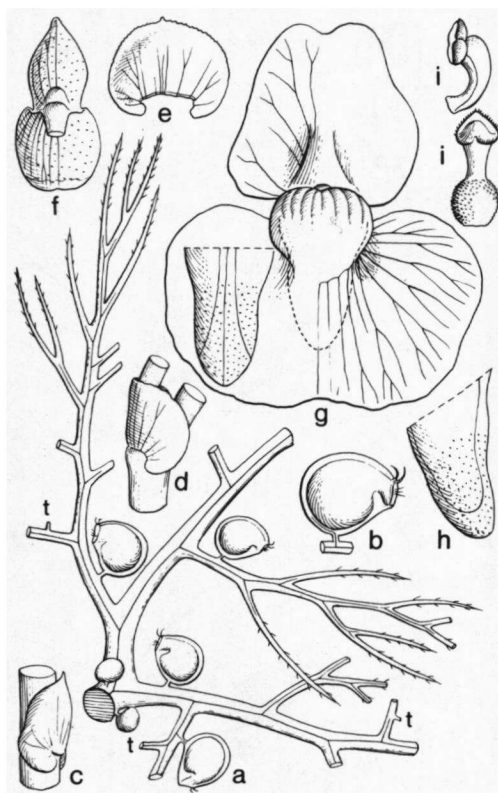


Fig. 25. *Utricularia australis* R. BR. a. Foliar organ, at the base with two rudimentary traps, some traps not drawn indicated by 't', $\times 5$, b. trap, $\times 12$, c. scale, $\times 4$, d. insertion of flower (left stalk), with bract *in situ*, $\times 4$, e. bract, flattened, $\times 4$, f. flowering calyx, lowest margin hyaline, $\times 4$, g. flower, front view, spur separately drawn, $\times 4$, h. spur, lateral view (the punctate glands are internal), $\times 4$, i. stamen, $\times 6$, j. pistil, $\times 6$ (all after ASTON 1799).

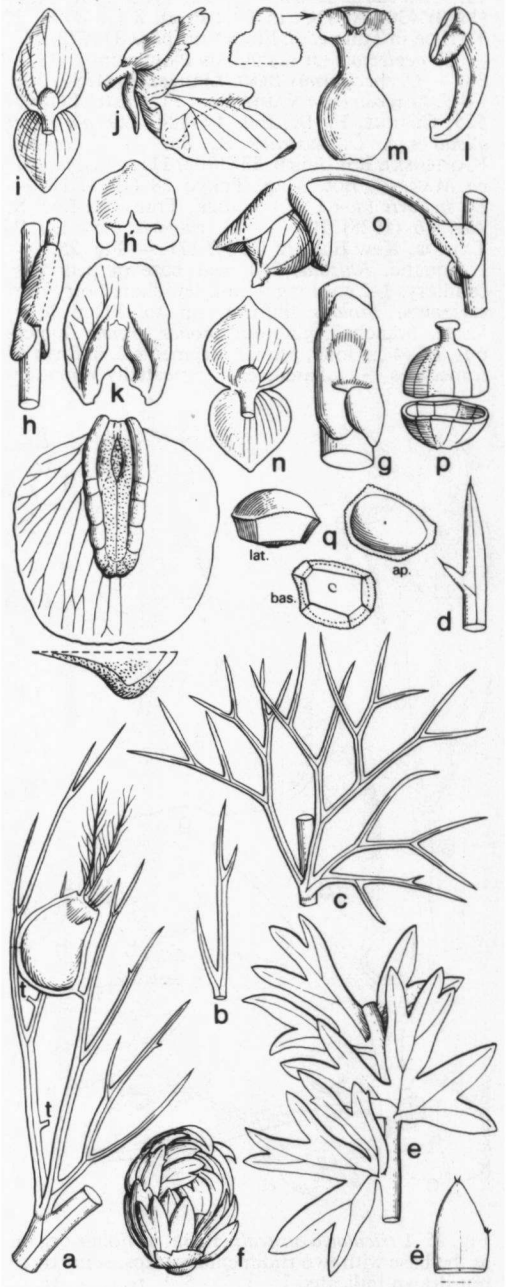
segments flattened, capillary to narrowly linear, 0.1–0.5 mm wide, the margin sometimes sparsely denticulate but not or only microscopically setulose, the apex acute with or without a microscopic seta. Globose turions (winter buds) 1.5–4 mm \varnothing of reduced glabrous foliar segments often present at apex of stolons or stolon branches. Traps rather few on the narrower foliar segments, usually absent on the broader ones and most numerous on reduced segments on the subterranean stolons, obliquely ovoid, shortly stalked, 0.8–2.5 mm long, mouth lateral with marginal simple hairs, upper lip with two long much branched setiform appendages. Inflorescence erect, 5–20 cm long; peduncle filiform, terete, straight; flowers 2–8 somewhat distant, scales 2–4, \pm equally spaced on the peduncle, similar to the bracts; bracts basifixed, broadly ovate-deltoid 1.5–2 mm long, 1-nerved, apex obtuse, base conspicuously auriculate; bracteoles absent; pedicels erect at anthesis, spreading and apically reflexing in fruit, filiform, terete, 4–7 mm long. Calyx lobes subequal, the upper somewhat larger, broadly ovate, c. 2 mm long, apex obtuse, cucullate. Corolla pale yellow, 8–10 mm long, upper lip ovate, apex obtuse, lower lip larger, obovate, apex retuse, palate raised, elongate, distally narrowed, spur saccate, c. 1.5 mm long, internally densely glandular. Filaments linear, curved, dilated above, anther thecae confluent. Ovary globose, style distinct, stigma lower lip orbicular, reflexed, upper lip narrowly deltoid, both fimbriate. Capsule globose, c. 3 mm long, circumscissile. Seeds lenticular-prismatic, c. 0.6 mm \varnothing , very narrowly winged on the angles.

Distr. Circumboreal, extending southwards into the Himalaya, Burma, and Malesia: New Guinea (Mt Hagen area).

Ecol. Shallow water in high mountain swamps, 2500–3660 m.

Note. The three Malesian specimens seen are without inflorescences but there can be little doubt that they are the same as the circumboreal plant. The small, almost glabrous, turions distinguish it from all other species in the genus. Like *U. australis* it is probably distributed by migratory birds.

Fig. 26. *Utricularia minor* L. a. Narrow foliar segments, from stolon, with one trap, $\times 6$, b. ditto, apex of segment, $\times 12$, c. narrow foliar segments, $\times 5$, d. apex, $\times 12$, e. broad foliar segments, with stolon, $\times 6$, e'. apex of broad segment, $\times 12$, f. turion, $\times 6$, g. scale *in situ*, $\times 12$, h–h'. bract *in situ*, and flattened, $\times 6$, i. flowering calyx, $\times 6$, j. flower, lateral view, $\times 4$, k. ditto, upper and lower lip flattened, and below it lateral view of spur, $\times 5$, l. stamen, $\times 12$, m. pistil, $\times 12$, with flattened lower lip of stigma, $\times 12$, n. fruiting calyx, $\times 6$, o. fruit on pedicel, $\times 6$, p. capsule, dehisced, $\times 6$, q. seed, from lateral (lat), apical (ap) and basal (bas) views, $\times 12$ (a–b, e–f ANU 667, c–d, g, n–q P. TAYLOR s.n., h–m R. B. DRUMMOND s.n.).



Doubtful

Lemnopsis mnioides ZIPPEN, Flora 12 (1829) i, 285, *nomen*; Alg. Konst- & Letterbode 1 (1829) 297, *nomen*, is according to HALLIER f. Med. Rijksherb. 1 (1910) 40, cf. Fl. Males. I, 4 (1949) 68 = *Utricularia orbiculata* WALL. = *U. striatula* SM.